

# **AGENDA**

## **Pre-ROC MEETING FOR NFPA 1851**

### **TECHNICAL COMMITTEE ON STRUCTURAL AND PROXIMITY FIRE FIGHTING PROTECTIVE CLOTHING AND EQUIPMENT**

**JANUARY 11-12, 2012**

**EMBASSY SUITES JAMAICAN COURT, ORLANDO, FL**

**WEDNESDAY, JANUARY 11, 2012**

(continuing through close of business on January 12, 2012)

- 1. 9:00** Call to order - Chairman Steve King
- 2.** Introduction of members and guests
- 3.** Committee procedures and staff liaison report – Dave Trebisacci
- 4.** Approval of minutes of the July 26-28, 2011 meeting, Providence, RI
- 5.** Chairman's remarks – S. King
- 6.** Durability studies findings – Dr. Elizabeth Easter, Univ. of Kentucky
- 7.** NFPA 1851
  - ISP task group – Rich Grainger
  - Cleaning task group – Tim Durby
  - Discussion - other proposals
  - Preparation of TC comments
- 8.** Old Business
- 9.** New Business
  - Next TC meeting – April 3-5, 2012, San Antonio, TX, ROC for NFPA 1851
- 10.** Adjourn at close of business on January 12, 2012

**MEETING OF THE  
TECHNICAL COMMITTEE ON  
STRUCTURAL AND PROXIMITY FIRE FIGHTING PROTECTIVE CLOTHING  
AND EQUIPMENT**

**JULY 26-28, 2011**

**PROVIDENCE HILTON  
PROVIDENCE, RI**

**AGENDA**

**ROP MEETING FOR NFPA 1851**

**TUESDAY, JULY 26, 2011** (continuing through close of business on July 28)

1. **9:00** Call to order - Chairman Steve King
2. Introduction of Members and Guests – S. King
3. Committee Procedures and Staff Liaison Report – Dave Trebisacci
4. Approval of Minutes of the April 5-7, 2011 meeting, New Orleans, LA
5. Chairman's Remarks – S. King
6. Discussion – Proposed TIA to NFPA 1851 (attached)
7. Actions on Public and Committee Proposals to NFPA 1851
8. Old Business
9. New Business
  - Next TC meeting – March 2012
10. Adjourn at close of business on July 28, 2011

1851- Log #1 FAE-SPF  
(3.3.36 Flame Resistance and A.3.3.36 (New) )

**Final Action:**

**Submitter:** Glossary of Terms Technical Advisory Committee,

**Recommendation:** Revise text to read as follows:

3.3.36\* Flame resistance (protective apparel). The property of a material whereby combustion is prevented, terminated, or inhibited following application of a flaming or non-flaming source of ignition, with or without subsequent removal of the ignition source. ~~Flame resistance can be an inherent property of a material, or it can be imparted by specific treatment.~~ (See also 3.3.50, Inherent Flame Resistance.)

A.3.3.36 Flame resistance can be an inherent property of the textile material, or it can be imparted by specific treatment.

**Substantiation:** It is important to have consistent definitions of terms within NFPA. The term flame resistance is widely used in the documents associated with protective apparel. NFPA definitions should be in a single sentence. Most NFPA definitions of “flame resistance” and uses of the term are in the documents associated with firefighters/first responders. In general, for other uses the term has been replaced and previous references to flame resistance are now being replaced by references to materials that meet the requirements of NFPA 701. It is likely that the documents associated with first responders would like to retain this concept and therefore the definition is being modified with a qualifier and with an annex note for the second sentence. Also, a recommendation is being made that NFPA 1500 be the primary document responsible. The definition is included in NFPA 1851, 1951, 1971, 1975, 1977, 2112 and 2113.

1851- Log #CP1 FAE-SPF  
(Entire Document)

**Final Action:**

**Submitter:** Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment,

**Recommendation:** Review entire document to: 1) Update any extracted material by preparing separate proposals to do so, and 2) review and update references to other organizations documents, by preparing proposal(s) as required.

**Substantiation:** To conform to the NFPA Regulations Governing Committee Projects.

1851- Log #2 FAE-SPF  
(6.2.2.5(3)(c))

**Final Action:**

**Submitter:** James M. Baker, TotalCare

**Recommendation:** Revise text to read as follows:

Exposed or deformed ~~steel~~-toe, ~~steel~~-midsole, or shank.

New / Exposed or deformed protective toe, protective midsole, or shank.

**Substantiation:** The document assumes that boots will always use steel to protect the toe and midsole. The standard should allow for other technologies that may replace steel.

1851- Log #3 FAE-SPF  
(6.2.3.1)

**Final Action:**

**Submitter:** James M. Baker, TotalCare

**Recommendation:** Add - Separation or peeling of aluminized fabric.

**Substantiation:** Peeling and separation of the fabric has been observed during inspection of aluminized fabric. Issue appears in both new and used fabric.

---

1851- Log #4 FAE-SPF  
(6.2.3.3)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare

**Recommendation:** Add - Separation or peeling of aluminized fabric.

**Substantiation:** Peeling and separation of the fabric has been observed during inspection of aluminized fabric. Issue appears in both new and used fabric.

---

1851- Log #5 FAE-SPF  
(6.3.4)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare

**Recommendation:** The findings of the advanced inspection shall be documented on an inspection form.

Add: This form may be paper, electronic or any type of permanent record.

**Substantiation:** The statement causes the user to assume they must use a paper form.

---

1851- Log #6 FAE-SPF  
(6.3.5.2)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare

**Recommendation:** ADD - Label integrity and legibility

**Substantiation:** Label integrity and legibility is required for record keeping.

---

1851- Log #7 FAE-SPF  
(6.3.5.3)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare

**Recommendation:** ADD - Label integrity and legibility

**Substantiation:** Label integrity and legibility is required for record keeping.

---

1851- Log #8 FAE-SPF  
(6.3.5.4)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare

**Recommendation:** ADD - Label integrity and legibility

**Substantiation:** Label integrity and legibility is required for record keeping.

---

1851- Log #9 FAE-SPF  
(6.3.5.5)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare

**Recommendation:** ADD - Label integrity and legibility

**Substantiation:** Label integrity and legibility is required for record keeping

---

1851- Log #10 FAE-SPF  
(6.3.5.7)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare  
**Recommendation:** ADD - Label integrity and legibility  
**Substantiation:** Label integrity and legibility is required for record keeping

---

1851- Log #11 FAE-SPF  
(6.3.6.1)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare  
**Recommendation:** Add - Separation or peeling of aluminized fabric.  
**Substantiation:** Peeling and separation of the fabric has been observed during inspection of aluminized fabric. Issue appears in both new and used fabric.

---

1851- Log #12 FAE-SPF  
(6.3.6.2)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare  
**Recommendation:** Add - Separation or peeling of aluminized fabric.  
**Substantiation:** Peeling and separation of the fabric has been observed during inspection of aluminized fabric. Issue appears in both new and used fabric.

---

1851- Log #13 FAE-SPF  
(6.3.6.3)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare  
**Recommendation:** Add - Separation or peeling of aluminized fabric.  
**Substantiation:** Peeling and separation of the fabric has been observed during inspection of aluminized fabric. Issue appears in both new and used fabric.

---

1851- Log #14 FAE-SPF  
(6.3.6.5)

**Final Action:**

---

**Submitter:** James M. Baker, TotalCare  
**Recommendation:** Add - Separation or peeling of aluminized fabric.  
**Substantiation:** Peeling and separation of the fabric has been observed during inspection of aluminized fabric. Issue appears in both new and used fabric.

---

1851- Log #15 FAE-SPF  
(7.3.7(10))

Final Action:

---

Submitter: James M. Baker, TotalCare

Recommendation: New text to read as follows:

7.3.7(10)

ADD – Cleaning and soaking agents shall not leave any residue or cause any degrading of the ensemble of ensemble elements

Substantiation: Preliminary testing of some products show a residue after cleaning. This issue is of particular concern with the moisture barrier. It appears that this residue can cause premature seam tape failures.

---

1851- Log #16 FAE-SPF  
(6.3.3)

Final Action:

---

Submitter: Karen E. Lehtonen, LION

Recommendation: Revised text to read as follows:

Advanced inspections of all protective ensemble elements even if not issued and used, shall be conducted at a minimum of every 12 months, or whenever routine inspections indicate that a problem could exist.

Substantiation: There is confusion in the field regarding this paragraph and if advanced inspections are required annually even if the ensemble or ensemble element is not issued or used. The added language is intended to clarify the committee intent assuming the advanced inspection is required annually regardless of the element being issued or used. See also 7.3.3 for reference.

---

1851- Log #17 FAE-SPF  
(5.1.6.1 (New) )

Final Action:

---

Submitter: Karen E. Lehtonen, LION

Recommendation: New text to read as follows:

5.1.6.1\* As a minimum the organization shall ensure the proper overlap between ensemble elements being used, including but not limited to coat to hood and helmet, coat to pant, coat to glove, and pants to footwear. Any other specialty equipment being used shall also be considered to ensure the equipment does not interfere with the proper function and interface of the protective ensemble or ensemble elements.

Substantiation: Additional attention should be given to the interface areas between elements during the selection process. Specific reference to the interface areas should be called out in this standard to ensure the proper attention is given.

---

1851- Log #18 FAE-SPF  
(10.1.2 and 10.1.3)

Final Action:

---

Submitter: Karen E. Lehtonen, LION

Recommendation: Revised text to read as follows:

10.1.2\* Structural fire fighting ensembles and ensemble elements shall be retired in accordance with 10.2.1, ~~no more than 10 years from the date the ensembles or ensemble elements were manufactured.~~ Structural fire fighting ensembles and ensemble elements that have followed the cleaning, inspection and repair requirements of this standard at least annually shall be retired 10 years from the date the ensemble or ensemble element was issued to be worn. Structural fire fighting ensembles and ensemble elements that have not followed the cleaning, inspection and repair requirements of this standard at least annually shall be retired no more than 10 years from the date the ensembles or ensemble elements date of manufacture.

10.1.3\* Proximity fire fighting ensembles and ensemble elements shall be retired in accordance with 10.2.1, ~~no more than 10 years from the date the ensembles or ensemble elements were manufactured.~~ Proximity fire fighting ensembles and ensemble elements that have followed the cleaning, inspection and repair requirements of this standard at least annually shall be retired 10 years from the date the ensemble or ensemble element was issued to be worn. Proximity fire fighting ensembles and ensemble elements that have not followed the cleaning, inspection and repair requirements of this standard at least annually shall be retired no more than 10 years from the date the ensembles or ensemble elements date of manufacture.

Substantiation: Ensembles and Ensemble elements that at least annually have been properly cared for, inspected and maintained in accordance with the requirements of this standard should be allowed to be retired more than 10 years after placement in service. By following a program for inspection, care and maintenance as outlined in this standard there is a protocol that has been established for proper review of the ensemble or ensemble element to ensure its continued fitness for use. In the absence of a care and maintenance program then the element should be required to be retired 10 years from the date of manufacture.

---

1851- Log #19 FAE-SPF  
(11.3.10)

Final Action:

---

Submitter: Rick Mansfield, Apex Fire Services

Recommendation: Revise text to read as follows:

All repair categories that are verified in accordance with this standard shall undergo verification ~~on an annual basis.~~ whenever a revised NFPA 1851 standard is issued, the physical facility of the verified ISP is moved to a new location, and/or the named ISP changes its business name.

Substantiation: Current annual certification is an economic burden on ISPs and end users. Requiring ISPs to re-certify driven upon logical events would make providing services to end users more affordable as well as make it more cost effective for larger end users to become an ISP.

---

1851- Log #20 FAE-SPF  
(4.2.5)

**Final Action:**

---

**Submitter:** Vicki Smith, LION Apparel

**Recommendation:** Revise text to read as follows:

Where the organization performs its own advanced inspection, advanced cleaning or basic repair, the organization shall be trained by the ensemble or ensemble element manufacturer, a Verified ISP or ~~an~~ ISP. Where the organization uses an ISP to perform advanced inspection, or advanced cleaning or basic repair, the ISP shall be trained by the ensemble or ensemble element manufacturer.

**Substantiation:** The standard creates two categories of Independent Service Provider (ISP) — Verified ISP and ISP. A Verified ISP has annual testing of repairs, facility inspection and their Quality Manual audited to verify continued compliance of all services provided. An ISP has not been evaluated for compliance to the standard; therefore should be trained by the manufacturer to perform these services and to train organizations to perform them. Manufacturer training should not be required by Verified ISPs.

---

1851- Log #21 FAE-SPF  
(6.3.1)

**Final Action:**

---

**Submitter:** Vicki Smith, LION Apparel

**Recommendation:** Revise text to read as follows:

Advanced inspection and any necessary testing shall be performed by a verified ISP, ISP, or the organization's trained personnel.

**Substantiation:** The standard must clearly delineate the differences between ISP and verified ISP, and the fact that the ISPs which are under no scrutiny must have manufacturers' training to perform advanced inspection and to train organizations on advanced inspection. Verified ISPs on the other hand have chosen to invest in developing NFPA 1851 compliant processes and have chosen to have these processes scrutinized and deemed acceptable by a third party certification organization.

---

1851- Log #22 FAE-SPF  
(7.3.1)

**Final Action:**

---

**Submitter:** Vicki Smith, LION Apparel

**Recommendation:** Revise text to read as follows:

Advanced cleaning and any necessary testing shall be performed by a verified ISP, ISP, or the organization's trained personnel.

**Substantiation:** The standard must clearly delineate the differences between ISP and verified ISP, and the fact that the ISPs which are under no scrutiny must have manufacturers' training to perform advanced cleaning and to train organizations on advanced cleaning. Verified ISPs on the other hand have chosen to invest in developing NFPA 1851 compliant processes and have chosen to have these processes scrutinized and deemed acceptable by a third party certification organization.

---

1851- Log #23 FAE-SPF  
(8.1.1)

Final Action:

---

Submitter: Vicki Smith, LION Apparel

Recommendation: Revise text to read as follows:

All repairs shall be performed by the original manufacturer, a Verified ISP, and ISP, or a member of the organization who has received training by a manufacturer, a Verified ISP, or by an ISP in the repair of ensemble or ensemble elements.

Substantiation: The standard must clearly delineate the differences between ISP and verified ISP, and the fact that ISPs which are under no scrutiny must have manufacturers' training to perform basic repairs and to train organizations on basic repairs. Verified ISPs on the other hand have chosen to invest in developing NFPA 1851 compliant processes and have chosen to have these processes scrutinized and deemed acceptable by a third party certification organization.

---

1851- Log #24 FAE-SPF  
(11.1.1.1)

Final Action:

---

Submitter: Vicki Smith, LION Apparel

Recommendation: Revise text to read as follows:

Verification of the organization or ISP shall be limited to advanced inspection, advanced cleaning and repairs of garment elements only. Verification of the organization or ISP shall not apply to helmet elements, glove elements, footwear elements, hood element, or optional CBRN ensemble.

Substantiation: The standard contains redundant training requirements for Verified ISPs. Presently Verified ISPs have non-brand specific repair testing to ensure they meeting performance criteria established by the standard, but must seek training from each brand manufacture to clean and inspect the garments that they have demonstrated competence to repair. Although verification testing is specific to garment repairs, the scope of verification covers all operational processes and the quality system since they are required to be documented in a Quality Manual. Once annually, the third party certification organization performs a random inspection of the facility and audits the Quality Manual to verify continued compliance for all services provided. This means that advanced inspection and advanced cleaning, in addition to repairs, are scrutinized for NFPA 1851 compliance and deemed acceptable by a third party certification organization. Advanced inspection and advanced cleaning training by each individual brand manufacturer should not be required for Verified ISPs.

---

1851- Log #25 FAE-SPF  
(A.7.3.6)

Final Action:

---

Submitter: Vicki Smith, LION Apparel

Recommendation: Revise text to read as follows:

Machine cleaning is the most effective method for cleaning ensemble elements such as coats, trousers, coverall, and hoods. It is the most effective means of loosening and removing dirt, soot, and other debris. Presently there are two basic types of automatic washing machines ~~are~~ commonly available for use by end-users: top-loading agitator style machines and front-loading washer/extractors. New technologies are emerging every day in the cleaning industry that will affect options available to both the enduser as well as the ISP for all ensemble elements. At this time, it is generally accepted that front-loading machines are more appropriate for protective ensemble and ensemble elements, where allowed by the element manufacturer....

Substantiation: There are several new technologies that are close to being brought to market that may not use washing machines and could theoretically clean all ensemble elements. Although the standard does mention "emerging technologies" it implies these technologies are applicable to machine washing of fabric elements. If new cleaning technology that is proven effective and safe for all elements is introduced, the standard should contain language that would make it eligible for compliance.

---

1851- Log #26 FAE-SPF  
(A.6.3.5.1(9))

Final Action:

---

Submitter: Tim J. Gardner, 3M Occupational Health and Environmental Safety Division

Recommendation: Add new text at the end of the last paragraph in the section:

With proper care, visibility markings on turnout gear can provide long service, often as long as the service life of the ensemble itself. Attention during inspection should be paid to sections which show evidence of damage, abrasion, or stains/discoloration. With proper maintenance, the performance of visibility markings on the ensemble can be maintained at a high level.

Substantiation: This statement is consistent with findings of the recent in-use garment study performed by the University of Kentucky.

---

1851- Log #27 FAE-SPF  
(12.2.5.1)

Final Action:

---

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: Revise text to read as follows:

12.2.5.1 The liner shall be visually inspected for leakage on the thermal barrier side after ~~3~~ 1 minutes.

Substantiation: Some experimentation has shown that a one minute dwell time can show leaks that would result in exposure of the wearer under actual use conditions. A one minute test time makes it easier to provide a more efficient evaluation of the garment. In addition, a similar proposal has been put forward in the inspection of liners for technical rescue garments.

---

1851- Log #28 FAE-SPF  
(12.2.4.2)

Final Action:

---

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: Add new item (x) after (3) in 12.2.4.2:

(x) Use light clamps or other means to help stabilize and position the tested area on the bucket.

Substantiation: This item is suggested as a means for improving the practicality and precision of the test.

---

1851- Log #29 FAE-SPF  
(12.2.5.3)

Final Action:

---

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: Add new 12.2.5.3, renumber and re-title current 12.2.5.3 as "12.2.6 Returning Garment to Service.":

12.2.5.3 It shall be permitted to use blotting to aid in the detection of wetting on the face cloth side of the thermal barrier. If blotting is used, a soft tissue shall be used and lightly presses against the thermal barrier for 5 seconds. If wetness appears on the tissue, the thermal barrier shall be considered to have been wetted and the liner shall be removed from service and repaired or replaced.

Substantiation: In some cases, wetting of the thermal barrier can be difficult to detect. The current 12.2.5.3 is not related to the results of the testing.

---

1851- Log #30 FAE-SPF  
(6.4.5.2)

Final Action:

---

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: Revise text to read as follows:

*Changes to inspection procedures:*

6.4.5.2 The moisture barrier liner shall be tested using the hydrostatic test to evaluate the water penetration barrier evaluated for liquid leakage, as specified in ~~Section 12.3~~ Section 12.2 and shall show no leakage.

6.4.5.2.1 If leakage of the liner is found, then those portions of the liner showing leakage shall be further evaluated using the hydrostatic test of the moisture barrier as specified in Section 12.3 to determine the specific areas of leakage.

6.4.5.2.2 The results of the hydrostatic testing shall be used to make a determination if the liner can be repaired or must be replaced.

*Changes to water penetration barrier evaluation.*

12.3.1 Application. This evaluation method shall apply to moisture barrier materials and moisture barrier seams in structural or proximity fire fighting protective garment elements that are in service and are found to be leaking as a result of the leakage evaluation applied during the advanced inspection.

*Replace current paragraph 12.3.2.1, 12.3.2.1.1, and 12.3.2.1.2 with:*

12.3.2.1 The same areas of the garment liner that have been found to leak when tested during advanced inspection using the leakage evaluation in 12.2 shall be evaluated.

12.3.2.1.1 The tested areas shall coincide with the center of the test areas evaluated in accordance with 12.2.

Substantiation: A preliminary study has shown that the hydrostatic test identifies leaks in the moisture barrier that are unlikely to result in liquid exposure of the wearer. End users are finding higher than expected failure rates in hydrostatic testing of moisture barriers. These failures apply to material as well as seams and are leading to higher maintenance costs and lower perceptions of barrier quality. A significant number of the failures cannot be identified visually. Moreover, there is often no apparent damage or exposure/use history that can be cited to explain the specific location of the identified failures. Garments that show hydrostatic failures often seem to be still completely serviceable by the respective end users, with no associated complaints of liquid leakage into the garments. In limited testing, garments that show hydrostatic failures have not been shown to have corresponding failures within the Whole Garment Integrity Test (Shower Test) or in other tests that attempt to simulate fireground liquid exposures.

The proposed changes rely on the leakage evaluation (puddle test) to identify potential failure areas of the liner and moisture barrier. Where leakage is found, it is recommended that the water penetration barrier evaluation be applied to determine the specific areas of leakage in the moisture barrier.

1851- Log #31 FAE-SPF  
(6.4.5.2, 12.3.4, and 12.3.5)

Final Action:

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: Revise text to read as follows:

6.4.5.2 The moisture barrier shall be tested using the hydrostatic test to evaluate ~~the~~ its resistance to water penetration barrier, as specified in Section 12.3 and shall show no Type 2 leakage.

12.3.4.1 (3) Visually inspect the visible side of the moisture barrier after 15 seconds to determine if water penetration has occurred and rate any water penetration according to the instructions provided in 12.3.4.2.

12.3.4.2 Rate the observed water penetration for leak location, time of leak, and type of leak according to Table 12.3.4.2.

\*\*\*\*\*Insert Table 12.3.4.2 Here\*\*\*\*\*

12.3.4.3 Any test location that shows a Type 2 rating for any of the rating categories (leak location, time of leak, and type of leak) shall be classified as Type 2 leakage.

12.3.5.1 If any water passes through any Type 2 leakage is found for the moisture barrier or moisture barrier seam, the liner shall be removed from service and repaired or replaced.

Substantiation: The system for applying a pass/fail determination for hydrostatic testing of garment moisture barrier and moisture barrier seams during the complete liner inspection does not account for the potential contribution of the leak to the overall integrity of the garment and its ability to prevent liquid contact with the wearer. Small, non-visible pinhole leaks randomly located on the liner do not result in exposure of the wearer when evaluated under simulated liquid exposure conditions. In contrast, leaks which are visible, which readily occur, and which occur allowing relatively large volumes of liquid do result in potential exposure of the wearer to liquids. The proposed system of rating the damage at the leak location, the onset of leakage, and the type of leak provides discrimination for the significant and potential safety associated with leaks identified by a rigorous hydrostatic test method.

1851- Log #32 FAE-SPF  
(5.1.2 and A.5.1.2(6))

Final Action:

Submitter: Jeffrey O. Stull, International Personnel Protection, Inc.

Recommendation: Change 5.1.2(6) to read "Specific physical area of operation" Renummer current (6) as (7).

Add new paragraph to A.5.1.2.(6): One of the hazards faced by firefighters is being struck by vehicular traffic. The high visibility materials required on firefighter PPE effectively enhance visual conspicuity during the variety of fireground operations. The continuous use of high visibility garments is one component of a strategy to mitigate risks from struck-by hazards, which are known to cause serious firefighter injuries and fatalities on an annual basis. Additional high visibility requirements for firefighters on or near roadways are regulated by the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD, 2009 version). It is the responsibility of the authority having jurisdiction (AHJ) to specify appropriate high visibility apparel from the available garment options, if any, and based on a risk assessment, to establish policies for use in accordance with prevailing regulations (the MUTCD) and in compliance with applicable standards (e.g., NFPA 1971, ANSI/SEA 107, ANSI/SEA 207, et.).

Ordinary firefighter protective ensembles many not permit firefighter to float and are likely to impact the safety of firefighters if they fall into water. The use of personal flotation devices may need to be considered for operations near water ways. Personal flotation devices must comply with applicable U.S. Coast Guard Regulations.

Firefighters operating at elevation may need some form of fall protection, which may or may not be incorporated into their protective clothing. Consideration must be given to devices that comply with NFPA 1983.

Substantiation: The need for additional safety equipment may vary with the physical location of the firefighter. In particular, specific person-position hazards such as operating near vehicle traffic, waterways, or at elevation warrant consideration of additional PPE such as supplemental high visibility apparel, personal flotation devices, or fall protection.

This is not original material; its reference/source is as follows:

1971-190 Log #60.

---

**Table 12.3.4.2 – System of Rating Moisture Barrier Leaks During Hydrostatic Testing**

---

	<b>Leak Location</b>	<b>Time of leak</b>	<b>Type of leak</b>
Type 1	No apparent visible damage	During full applied pressure	1 to 3 water droplets form; thin water stream from pinhole
Type 2	Visible damage at location of leak	Before full applied pressure	More than 4 water droplets form; test basin fills with water

---

1851- Log #33 FAE-SPF  
(6.3.5, A.12.2.1, and A.12.2.3.1)

Final Action:

Submitter: Stacy Trenkamp, University of Kentucky Textile Testing Laboratory

Recommendation: Add new text to read as follows:

6.3.5\* The advanced inspection shall include, as a minimum, the inspections specified in 6.3.5.1 through 6.3.5.7 and for garment elements only the testing specified in Section 12.1 ~~and Section 12.2:~~

~~Section 12.2~~

~~A.12.2.1 It is important to realize that this field evaluation procedure can produce results that are inconsistent with more comprehensive or sophisticated testing and might detect only the worse-case failure areas. To perform more sophisticated testing of the moisture barrier, the garment manufacturer should be contacted for advice.~~

~~A.12.2.3.1 If there are questions about using an alcohol-tap water mixture for evaluating the protective garment, the garment manufacturer should be contacted directly for advice~~

Add new Annex text:

A.6.3.5 Loss of integrity can be determined by a field test evaluation of the moisture barrier using the Leakage Evaluation Test. It is important to realize that this field evaluation procedure can produce results that are inconsistent with more comprehensive or sophisticated testing and might detect only the worse-case failure areas. The procedure in this section is based on Section 12.2 of NFPA 1851 2008 Edition. It is recommended that this section be moved to the annex because the Leakage Evaluation Test is an easy and inexpensive indicator of leakage for field evaluations; however, the study from the Firefighter Durability Study Phase I shows that the Water Penetration Barrier Evaluation shows more accurate results.

For this testing, at a minimum, the front and back body panels of each protective garment should be evaluated using three different moisture barrier material areas. Liner evaluation areas should be from high-abrasion areas of the garment, including, but not limited to:

- (1) Broadest Part of the shoulders
- (2) Back waist area of the coat
- (3) Knees
- (4) Crotch Area
- (5) Seat Area

In addition to the areas listed where potential damage to the garment outer shell or thermal barrier has been detected, the evaluation should be conducted on the corresponding area of the moisture barrier. Where potential damage to the garment moisture barrier has been detected, the evaluation should also be conducted on that area. The liner composite should be positioned in the evaluation apparatus so that the moisture barrier is oriented upward and is contacted with the liquid exposure in the evaluation apparatus. An alcohol-tap water solution should be made by combining 1 part rubbing alcohol, 70 percent isopropanol alcohol with 6 parts tap water. If there are questions about using an alcohol-tap water mixture for evaluating the protective garment, the garment manufacturer should be contacted directly for advice. A 5 gal bucket or similar container should be used to support the liner during evaluation. The evaluation should be performed at room temperature. The evaluation should be conducted using the following procedure:

- (1) If possible, separate the liner from the outer shell.
- (2) Orient the liner such that the moisture barrier is on the outside.
- (3) Position the dry liner over the bucket with the thermal barrier facing down and the moisture barrier side facing up.
- (4) Cup the liner area that is being evaluated, so that it is lower than the surrounding liner.
- (5) Pour 1 cup of the alcohol-tap water mixture onto the moisture barrier in the cupped area of the liner.

The liner should be visually inspected for leakage on the thermal barrier side after 3 minutes. If any liquid passes through the moisture barrier and wets the thermal barrier, the liner should be removed from service and repaired or replaced. After the evaluation procedure has been performed, the liner shall be cleaned and allowed to completely dry to remove all traces of the alcohol-tap water mixture.

Substantiation: It is proposed and recommended to remove the Leakage Evaluation Test from the body of the Standard and revise/enter the test into the annex. The Durability Study (Phase I) conducted at the University of Kentucky did not show a strong correlation between the Water Penetration Barrier Evaluation and the Leakage Evaluation tests, indicating that the accuracy of the Leakage Evaluation Test is not reliable enough for placement in the body of the text. The study documented that 32% of the moisture barriers tested failed the Leakage Evaluation Test, where as 66% of the same moisture barriers tested failed the Water Penetration Barrier Evaluation. A high concentration of failures in the Water Penetration Barrier Evaluation occurred at moisture barrier seams; therefore, it is being

recommended that the Leakage Evaluation Test be moved to the annex of NFPA 1851. This would provide a simple and inexpensive test to be conducted on moisture barrier fabrics as a field evaluation/inspection.

This is not original material; its reference/source is as follows:

Firefighter Durability Study Phase I, Deena Cotterill's Thesis, is available upon request.

---

1851- Log #34 FAE-SPF  
(6.4.3 and A.6.4.3)

**Final Action:**

---

**Submitter:** Stacy Trenkamp, University of Kentucky Textile Testing Laboratory

**Recommendation:** Revise text to read as follows:

6.4.3 A complete liner inspection of all garment elements shall be conducted at a minimum after ~~3~~2 years in service and annually thereafter or whenever advanced inspections indicate that a problem might exist. The liner system shall be opened to expose all layers for inspection and testing.

A.6.4.3 It should be noted that this standard's requirement that a complete liner inspection be performed after the first ~~3~~2 years of service and every year thereafter should not negate the necessity of conducting a complete liner inspection sooner than the required time frame if circumstances or appearances dictate. For example, inside layers that show marked discoloration or physical deterioration should trigger a complete liner inspection.

**Substantiation:** We recommended changing the liner inspection from after three years of service to two years of service based on findings of the Water Penetration Barrier Evaluation conducted in the Firefighter Durability Study Phase I. In this study, it was found that 53% of garments in the 2-3 year age category leaked during the Water Penetration Barrier Evaluation. Since over half of the moisture barriers had water penetration after the evaluation, it is recommended that a liner inspection be completed after two years in service for the safety of the firefighter and for preventative measures against burn injury.

This is not original material; its reference/source is as follows:

Deena Cotterills Thesis, The Firefighter Durability Phase I is available upon request.

---

1851- Log #35 FAE-SPF  
(A.7.1.1)

Final Action:

---

Submitter: Stacy Trenkamp, University of Kentucky Textile Testing Laboratory

Recommendation: Revise text to read as follows:

A.7.1.1 The importance of maintaining the cleanliness of ensembles and ensemble elements should not be underestimated. Studies have shown that soiled or contaminated ensembles and ensemble elements are a hazard to fire fighters because soils and contaminants can be flammable, toxic, or carcinogenic. Additionally, soiled or contaminated ensembles and ensemble elements can have reduced protective performance. Clean ensembles and ensemble elements offer the emergency responder better protection and can add to the life of the ensemble and ensemble elements. Ensembles and ensemble elements should be cleaned whenever they have become soiled.

In everyday use, personal protective equipment becomes dirty by absorbing sweat from the wearer and soils, soot, and so forth from the outside environment. Cleaning of ensembles and ensemble elements removes those substances. Ensembles and ensemble elements can also become contaminated with other substances, principally hazardous materials, particulates, and body fluids. The removal of these substances is most often referred to as *decontamination*. In structural and proximity fire fighting, both general cleaning and decontamination of ensembles and ensemble elements might be necessary.

*Health risks of soiled or contaminated ensembles and ensemble elements.* Soiled or contaminated ensembles and ensemble elements can expose fire fighters to toxins and carcinogens that enter the body through ingestion, inhalation, or absorption. Repeated small exposures to some contaminants can add up over time and cause health problems. Although great emphasis is placed on safety to avoid injury or inhalation hazards to personnel working on the fire ground, many of the toxins that lead to health risks are being carried away from the fire scene on personal protective equipment used by the fire fighter.

Toxins that a fire fighter will come into contact with can be trapped in the fibers of soiled ensembles and ensemble elements or absorbed into the materials themselves. Contact with the soiled ensembles and ensemble elements increase the risk of the toxic contaminants being introduced into the body.

Ensembles and ensemble elements contaminated with body fluids presents a potential risk of a communicable disease being transmitted to the person coming into contact with the contaminated ensembles or ensemble elements.

*Reduced performance hazards of contaminated ensembles and ensemble elements.* When ensembles or ensemble elements become laden with particles and chemicals, other problems are faced in addition to being exposed to toxins, such as the following:

(1) Soiled ensembles and ensemble elements typically reflects less radiant heat. After materials are saturated with hydrocarbons, they will tend to absorb rather than reflect the radiant heat from the surrounding fire.

(2) Ensembles and ensemble elements heavily contaminated with hydrocarbons are more likely to conduct electricity, increasing the danger when entering a building or vehicle where wiring can still be live.

(3) Ensembles and ensemble elements impregnated with oil, grease, and hydrocarbon deposits from soot and smoke can ignite and cause severe burns and injuries, even if the materials are normally flame resistant.

Even though the number of specialized hazardous materials response teams is growing, individual fire fighters can still encounter various chemicals in their normal fire-fighting activities. Exposures to oils, gasoline, and lubricants can occur around fire station vehicles. During responses, exposures to liquids ranging from pesticides to acids to chemical solvents can occur, knowingly or unknowingly. These contaminants, in addition to being hazardous, can also degrade ensembles and ensemble elements as follows:

(1) Clothing fabrics can become weakened and tear more easily.

(2) Thread or seam sealing tape can become loose.

(3) Flame-retarding or water-repelling treatments can be removed.

(4) Visibility markings can lose reflective properties or markings, becoming less visible.

(5) Helmet shells, helmet faceshields, or goggles can pit or craze.

(6) Ensemble and ensemble elements hardware can become corroded.

**Substantiation:** The added statement supports the information that is already present in the annex (like the list of degradation that may occur from negligence of cleaning and maintenance), yet adds emphasis on the importance of making sure that garments are properly cleaned and maintained in order to extend their life cycle. Studies completed and in progress at the University of Kentucky have shown the importance of cleaning and maintaining fire fighting garments.

The Fire Fighter Durability Study Phase I completed at the University of Kentucky found that 66% of the sixty-seven garments tested showed leakage during the Water Penetration Barrier Evaluation. Questionnaires used for purposes of

the study found that 30% of respondents replied that cleaning of their garment was voluntary.

Furthermore, the Firefighter Durability Study Phase II in progress at the University of Kentucky has so far found that 9 of 12 garments tested showed leakage during the Water Penetration barrier Evaluation. The questionnaire in accordance with Phase II showed that 55% of respondents answered that the cleaning of their garments was voluntary. This is not original material; its reference/source is as follows:

Deena Cotterills Thesis, The Firefighter Durability Phase I is available upon request.

---

1851- Log #36 FAE-SPF  
(10.1.2 and 10.1.2.1 (New) )

Final Action:

---

Submitter: Stacy Trenkamp, University of Kentucky Textile Testing Laboratory

Recommendation: Revise text to read as follows:

10.1.2\* Structural fire fighting ensembles and ensemble elements shall be retired in accordance with 10.2.1, no more than 10 years from the date the ensembles or ensemble elements were manufactured.

10.1.2.1 Structural fire fighting garments shall also be retired prior to the 10 years from date of manufacture in the event the garment has sustained damage such that it is beyond repair. Additional factors to consider shall include but not be limited to physical damage, thermal damage, or excessive soil build up to any or all of the layers.

Substantiation: According to the Fire Fighter Durability Study Phase I completed at the University of Kentucky, 23 of the 40 retired garments collected were retired prior to the 10 years from the date of manufacture. The reason for retirement varied and 57% of these retired garments did not meet one or more of the NFPA 1851 Advanced Inspection Requirements.

Soiled ensembles and ensemble elements typically reflect less radiant heat. After materials are saturated with hydrocarbons, they tend to absorb rather than reflect the radiant heat from the surrounding fire. Ensemble and ensemble elements contaminated with hazardous bodily fluids could spread contaminants in the fire station and or living areas if a firefighter wears it again. Ensembles and ensemble elements impregnated with oil, grease, and hydrocarbon deposits from soot and smoke can ignite and cause severe burns and injuries, even if the materials are normally flame resistant.

This is not original material; its reference/source is as follows:

Deena Cotterills Thesis, The Firefighter Durability Phase I is available upon request.

---

1851- Log #37 FAE-SPF  
(A.6.3.5.1(9))

Final Action:

---

Submitter: Stacy Trenkamp, University of Kentucky Textile Testing Laboratory

Recommendation: A.6.3.5.1(9) Visibility markings can appear to the human eye to be undamaged when actually they have lost much of their ability to reflect. Retroflective properties can be checked with the following simple flashlight test:

(1) Stand approximately 12 m (40 ft) from a sample of the trim being tested and a sample of new trim.

(2) Hold a bright, focused flashlight at eye level, either next to the temple or on the bridge of the nose, and aim the light beam at the samples.

(3) Compare the brightness of the reflected lights. If the reflected light from the trim being tested is substantially less than the light reflected from the new trim, the trim should be replaced.

This field evaluation test provides effective and timely results while allowing the evaluator to physically view the reflective trim as it is seen by the naked in eye in real, working situations.

While this simple test provides a practical evaluation of trim retroflective performance, it does not evaluate trim fluorescence or mean that the trim will provide adequate fire fighter visibility. Trim can lose fluorescence (daytime visibility) and still remain retroflective. Trim can also appear to be retroflective and not have sufficient intensity for nighttime visibility at far distances. Only testing under laboratory conditions can provide an accurate determination of trim visibility properties.

Substantiation: The Fire Fighter Durability Study Phase I completed at the University of Kentucky completed this field evaluation test on 67 garments used in the study. All garments passed the field evaluation test, and it was noted that some of the samples that did not perform as well had soiling or thermal damage visible to the eye. This information supports that the field evaluation on trim is effective and gives the fire fighter confidence that their gear will perform the way it's supposed to.

This is not original material; its reference/source is as follows:

Deena Cotterills Thesis, The Firefighter Durability Phase I is available upon request.

---

1851- Log #38 FAE-SPF  
(6.5.4.2, 12.3.5.1, 12.3.5.2)

Final Action:

---

Submitter: Daniel J. Gohlke, W.L. Gore & Assoc., Inc.

Recommendation: Revise text to read as follows:

6.4.5.2 delete "and shall show no leakage."

Delete old 12.3.5.1.

New 12.3.5.1 Moisture barriers shall be repaired or replaced if leaks appear in every test site or 4 or more leaks appear in any one test site.

Delete old 12.3.5.2.

New 12.3.5.2 After testing, and before repairing if needed, the liner shall be allowed to dry completely before being returned to service.

Substantiation: The existing criteria for determining whether a moisture barrier needs to be repaired or replaced has led to unnecessary repairs and replacements of moisture barriers. This proposition is supported by observations in the industry of garments performing very satisfactorily or effectively in use, but still incurring repair costs when maintained according to NFPA 1851. Some departments have chosen not to implement NFPA 1851, or not to implement it fully, because of this discrepancy. There also seems to be no evidence or correlation between the level of scrutiny required by NFPA 1851 and actual exposure of the fire fighter on the fire ground to liquids, whether by rain, chemical or blood. In fact, NFPA 1851 actually creates a higher level of scrutiny than does NFPA 1971 for the new garment. Is it unreasonable to have a zero defect exception, when even the FDA does not require zero defects in barriers used in operating room gowns? Even vapor tight suits (NFPA 1991) are allowed to leak, i.e. they are allowed a pressure decay rate in the inflation test. NFPA 1994 garments specify different levels of protection, non of them absolute. Therefore, it seems reasonable to conclude that for structural fire fighting garments not every and all water leaks found according to Clause 12.3 lead to exposure on the fire ground. There are multiple possible modifications to the inspection regime that would alter the current level of required scrutiny. This proposal suggests that the criterion for implementing repairs be graded, so that serious flaws and failures get required as they should be but that inconsequential ones (e.g. single pinholes?) do not mandate repair or replacement.

---

1851- Log #39 FAE-SPF  
(10.1)

Final Action:

---

Submitter: Daniel E. Nichols, Roosevelt Fire District

Recommendation: Revise text to read as follows:

10.1.2 Structural fire fighting ensembles and ensemble elements protective garments, structural firefighting protective gloves, and structural fire fighting protective hoods shall be retired in accordance with 10.2.1, no more than 10 years from the date the ensembles or ensemble elements were manufactured.

10.1.3 Proximity fire fighting ensembles and ensemble elements protective garments, proximity fire fighting protective gloves, and proximity fire fighting protective hoods shall be retired in accordance with 10.2.1, no more than 10 years from the date the ensembles or ensemble elements were manufactured.

10.1.4 Structural fire fighting protective helmets and proximity fire fighting protective helmets shall be retired at a time frame determined by the organization, taking into consideration to condition and maintenance record of such elements.

10.1.4.1 Ear covers of fire fighting protective helmets and proximity fire fighting protective helmets shall be retired in accordance with 10.2.1, no more than 10 years from the date the ensemble elements were manufactured, and shall be replaced in accordance with Chapter 8.

[Re-number subsequent sections]

Substantiation: The 2007 edition placed a finite retirement date on firefighting gear, 10 years from manufacturer. Reviewing the committee documents from last cycle and the information found in the 1851 annex, the information seems to stem from the maintenance and care of textile-based gear components; namely coats and pants. I did not see any compelling information to the need to retire helmets after 10 years of manufacturer. Helmets are not susceptible to sunlight and UV rays as garments, do not flex like garments, and are not degraded by the cleaning process as garments (1851 has specific cleaning processes for helmets). Helmet inspections are much easier to complete than garments, as the failure points found in 1851 include many things that you can see with the naked eye (cracks, bulges, broken hardware, chipped paint, missing components, separating shells and outer layers).

Furthermore, helmets are crafted using various materials; leather, Kevlar, and fiberglass-composites. I did not find any information that these materials degraded similar to the outer shell or liners of protective garments.

This issue is important to us for two reasons. First, we buy helmets at a bulk rate to get a lower price since we do not need to buy a sized helmet for most of our incoming volunteer members. We have helmets that may be in their original factory boxes for 2-3 years prior to distribution. Being subjected to absolutely no hazards, we have needlessly lost out on using these helmets for their intended lifespan. Secondly, we have bought helmets that we have seen last longer than other, particularly leather helmets. We made a significant investment in some of our helmets being leather due to the increased durability we have seen with these helmets.

To specifically address the ear covers, which are made and have the similar properties of garments, we have proposed the 10 year retirement and mandatory replacement of these in this proposal.

It is our opinion that a blanket 10 years for all helmets is not warranted due to the vast difference between garments and helmets as well as the current blanket requirement not taking into account the different materials a helmet can be constructed from. The proposed language allows the organization to determine the life cycle of helmets, based on maintenance, use, materials, and idle (storage) time.

Thank you for your consideration.

---

1851- Log #40 FAE-SPF  
(Table 11.3.7(b))

Final Action:

---

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: Revise text to read as follows:

In Table 11.3.7(b), insert "(Major B)" after "5 ft felled seam" and "(Minor)" after "5 ft overedge seam."

Substantiation: Clarification of the appropriate seam requirements is required in the table on Thermal Liner Repairs. An overedge seam is a hem type seam and does not result in immediate danger to the wearer when it ruptures.

---

1851- Log #41 FAE-SPF  
(Table 11.3.7(a))

Final Action:

---

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: Revise text to read as follows:

In Table 11.37(a), insert (“Major A)” after “5 ft felled seam” and “(Minor)” after “5 ft overedge seam.”

Substantiation: Clarification of the appropriate seam requirements is required in the table on Outer Shell Repairs. An overedge seam is a hem type seam, sometimes used in pockets, and does not result in immediate danger to the wearer when it ruptures.

---

1851- Log #42 FAE-SPF  
(3.3.x Patch and A.3.3.x (New) )

Final Action:

---

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: New text to read as follows:

3.3.X Patch. An additional layer of outer shell, moisture barrier, thermal barrier, and visibility marking material that is placed on top of a damaged area of a garment for the purposes of making a repair.

A.3.3.X Patch. Patches do not include moisture barrier seam sealing tape in the case of repairs made on moisture barrier material using moisture barrier seam sealing tape.

Substantiation: A definition of patch is needed. It could be misconstrued that a patch includes moisture barrier seam sealing tape. The definition is needed for clarification for the acceptability of repairs.

---

1851- Log #43 FAE-SPF  
(8.2.3.4)

Final Action:

---

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: New text to read as follows:

8.2.3.4 Where moisture barrier tears, holes, or abrasions are being repaired, the applied seam tape shall extend at least 18 mm (3/4 in.) in all directions beyond the edge of the patch or the repaired damage.

Substantiation: The current language in 8.2.3.1 implies that the moisture barrier seam sealing tape must extend 1 inch beyond the edge of the patch or the repaired area of damage; however, the majority of moisture barrier sealing tapes are not sufficiently wide enough to provide this amount of overlap. Furthermore, the required test for efficacy of repairs addressed in Table 11.3.7(c) provides a relatively rigorous demonstration of continued moisture barrier performance.

---

1851- Log #44 FAE-SPF  
(11.3.7.x (New) )

Final Action:

---

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: New text to read as follows:

11.3.7.X Outer shell, thermal barrier, and moisture barrier material shall be selected for verification testing such that the materials have breaking strengths that are in excess of the respective seam requirements for seams constructed of these materials.

A.11.3.7.X For example, if an outer shell is evaluated for seam strength and is required to have a seam strength that is greater than 667 N (150 lb), then the outer shell material must have a breaking strength that is at least 667 N (150 lb).

Substantiation: In the evaluation of repaired seams, it is important that the quality of the seam be evaluated through its ability to meet the respective strength requirements in paragraph 7.1.1.3, as specified in NFPA 1971, if seams are constructed of a fabric that has a breaking strength that is less than the required seam strength, the breaking of the fabric along the seam does not permit an adequate evaluation of the organization of ISP’s ability to properly repair the seam.

1851- Log #45 FAE-SPF  
(11.3.7.1 (New) )

Final Action:

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: New text to read as follows:

11.3.7.X Sample seams shall be prepared by the organization or the ISP that have been certified as compliant with the applicable requirements of NFPA 1971.

11.3.7.X.1 It shall be permitted that sample seams be provided to the certification organization from a manufacturer of NFPA 1971 compliant garments.

11.3.7.X.2 If an ISP provides repairs for several different manufacturers, then only one set of seam samples shall be required for testing.

Substantiation: No instructions are currently provided in NFPA 1851 for how and who creates the seam samples for verifying the repair capabilities of the organization of ISP. The above instructions are intended to clarify the responsibilities for the source of seam samples and issues related to testing ISPs that service multiple manufacturer garments.

1851- Log #46 FAE-SPF  
(11.3.7.4)

Final Action:

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: New text to read as follows:

11.3.7.4 For repairs to moisture barrier seams, the certification organization shall create defects in sample seams by cutting multiple stitches through the seam tape such that the seam would no longer be compliant in terms of its seam strength.

Substantiation: No instructions are currently provided in NFPA 1851 for how and who creates the seam samples for verifying the repair capabilities of the organization or ISP. The above instructions are proposed so that the certification organizations can consistently provide samples for verification of seam repair.

1851- Log #47 FAE-SPF  
(11.4.3.1)

Final Action:

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: New text to read as follows:

11.4.3.1 If the ISP changes the designated person, the ISP shall notify the certification organization of the change and provide information to demonstrate that the person's understanding of the ISP's quality system.

Substantiation: The current language appears to imply that the verification is contingent on a single individual as responsible for the quality system and does not account for changes made by the ISP for this responsibility.

1851- Log #48 FAE-SPF  
(11.2.12)

Final Action:

Submitter: Jason L. Allen, Intertek Testing Services

Recommendation: Revise text to read as follows:

11.2.12\* The certification organization shall have a follow-up inspection program of the organization's or the ISP's facilities of the compliant services with at least one random and unannounced visit per 12 month period annually to verify continued compliance.

Substantiation: The proposed change will permit more flexibility in the scheduling of audits.

---

1851- Log #49 FAE-SPF  
(11.3.7.3)

**Final Action:**

---

**Submitter:** Jason L. Allen, Intertek Testing Services

**Recommendation:** New text to read as follows:

11.3.7.3 For repairs to outer shell and thermal barrier seams, the certification organization shall create defects in sample seams by removing multiple stitches such that the seam would not longer be compliant in terms of its seam strength.

**Substantiation:** No instructions are currently provided in NFPA 1851 for how and who creates the seam samples for verifying the repair capabilities of the organization or ISP. The above instructions are proposed so that the certification organizations can consistently provide samples for verification of seam repair

**MINUTES OF THE MEETING**  
**TECHNICAL COMMITTEE ON**  
**STRUCTURAL AND PROXIMITY FIRE FIGHTING**  
**PROTECTIVE CLOTHING AND EQUIPMENT**  
**NEW ORLEANS, LOUISIANA**  
**5 -- 7 APRIL 2011**

**5 APRIL 2011**

**Agenda Item 1-3: Call to Order, Introduction of Members and Guests, and Committee Procedures**

Acting Chairman Bill Haskell called the meeting to order at 09.00. Bill noted that Chairman King had a health issue and was unable to attend the meeting. Bill introduced the new members on the committee, and Jeff Stull's 25 years of service to NFPA was recognized. Bill then called for an introduction of members and guests.

The following members and guests were present:

**Members Present:**

Bill Haskell, Acting Chairman	NIOSH
Benjamin Mauti, Secretary	MSA
David Trebisacci	NFPA Staff Liaison
Jason Allen	Intertek Testing Services
Dr. Roger Barker	North Carolina State University
Steve Corrado	Underwriters Labs Inc.
Nick Curtis	Lion
Paul Curtis	LN Curtis & Sons
Tim Durby	City of Phoenix (IFSTA)
Richard Edinger	Chesterfield Fire & EMS (IAFC)
Dave Fanning	Bullard
Bill Fithian	Safety Equipment Institute
Richard Ford	Chicago Fire Department
Pat Freeman	Globe Manufacturing
A. Ira Harkness	U.S. Dept. of the Navy
Emeral Earl Hayden	El Paso TX FD (IAFF)
Tricia Hock	Fire-Dex / Chieftain
Pam Kavalesky	Intertek Testing Services
Steve Lakey	Verified Independent Services Providers
Michael Laton	Honeywell / Sperian Protective Apparel
Karen Lehtonen	Lion Apparel
Lance Matiste	Fire-Dex
Mike McKenna	Special Expert
Daniel Melia	Fire Department City of New York
Andrew Oliver	Gear Wash
Louis Ott	Gentex Corporation
Matthew Pegg	Ontario Association of Fire Chiefs
Tom Ragan	Shelby Specialty Gloves

John Rihn  
Robin Royster  
Angie Shepherd  
Douglas Sloan  
Grace Stull  
Jeff Stull  
Robert Tutterow  
Harry P. Winer

MSA  
Underwriters Labs Inc.  
NIOSH National Personal Protection Technical Laboratory (NPPTL)  
Honeywell First Responder Products  
International Personal Protection  
International Personal Protection  
Charlotte Fire Department  
HIP Consulting

**Guests Present:**

Chantal Adam  
Diane Bible  
Holly Blake  
Michael Boersen  
Bill Burke  
Brian Burton  
Jacques Cantin  
Anthony Shawn Deaton  
Charles Dunn  
Tom Flaherty  
Tim Gardner  
Chris Gaudette  
Tyler Griffith  
Lisa Grover  
Christine Habicht  
Kim Henry  
Diane Hess  
Wendy Horowitz  
Christian Jaehrling  
Roland Landry  
Harrish Lilani  
Kathleen McNutt  
Brent Merriam  
Rob Mills  
Patrick Miner  
Mike Mondoux  
Kirk Owen  
Kathleen Rouse  
Stephane Rouse  
Marni Schmid  
Andrew Shapiro  
Brian Shiels  
Mike Strader  
Tim Tomlinson  
Bob Towe  
Richard Weise  
Mark Williams  
Richard Young

Difco Performance Fabrics  
Honeywell First Responder Products  
W.L. Gore & Associates, Inc.  
STC Footwear Inc.  
Fire-Dex  
Stedfast  
Safety Components  
North Carolina State University  
Tencate Protective Fabrics  
Reflexite  
3M Occupational Health  
Reflexite  
Sturges Mfg.  
Offray Specialty Narrow Fabrics  
Tencate Protective Fabrics  
PBI Performance Products  
PBI Performance Products  
ACW  
Haix North America  
Falcon Performance Footwear  
NORFAB Corp.  
Globe Manufacturing  
Novation North America / COSMAS  
Black Diamond Group  
Thorogood Footwear  
Innotex, Inc.  
Tencate Protective Fabrics  
Teijin Aramid  
Honeywell First Responder Products  
Fortunes Collide Marketing  
Techtrade LLC / Pro-Tech 8 Gloves  
PBI Performance Products  
Pharr Yarns, LLC  
Gear Cleaning Solutions  
W.L. Gore & Associates, Inc.  
Southern area Fire / Equipment Research  
W.L. Gore & Associates, Inc.  
DuPont

NFPA Staff Liaison David Trebisacci then read the NFPA Committee Operating Procedures, and passed out the sign-in sheets for both Members and Guests. David also reviewed the NFPA procedures applicable to the business of processing of the 2012 Edition, along with the new features of the NFPA website.

## **Agenda Item 4: Approval of the TC Minutes of the 15 – 17 June 2010 Meeting in Palm Springs, California**

### **MOTION BY EARL HAYDEN, SECOND BY HARRY WINER**

To approve the Minutes of the 15-17 June 2010 Committee meeting in Palm Springs, CA.

### **MOTION CARRIED**

## **Agenda Item 5: Chairman's Remarks**

Acting Chairman Haskell acknowledged that a significant amount of work would need to be done over the span of the meeting and thanked the committee in advance for their hard work.

Bill noted that in previous committee meetings comments were addressed in numerical order. Chairman King's request was that at this meeting public comments be addressed first, followed by action on specific topic areas.

## **Agenda Item 6: Glove modification issue – Bill Fithian**

Bill was contacted by a fire fighter who was missing a ring finger, and needed to have a modified glove that was also NFPA compliant. Currently if glove manufacturers make a modified glove, they remove the NFPA certification label. This practice puts the fire fighter in the position of using non-NFPA compliant PPE.

Jeff Stull informed the committee that language had been submitted to the Glove Task Group, but that this issue may apply to other PPE besides gloves. Jeff recommended that the issue be elevated to the TCC so that it could be discussed from a broader point of view. Primary issues include accepted modifications, labeling, and testing.

The committee discussed the issue further, and it was determined that it could not be addressed in the upcoming edition of NFPA 1971 and would be elevated to the TCC.

Bill's proposed language will be attached to the minutes for committee review, in addition to being reviewed during the meeting.

## **Agenda Item 7: Physiological Consequences of Boot Weight and sole type in Men and Women Fire Fighters – Dr. Nina Turner**

Dr. Turner thanked the committee for supporting her research and continuing to allow her the opportunity to present the results to the group. Dr. Turner also acknowledged her research partner, Dr. Sharon Chiou.

There were three phases of the study: 1) effect of boot weight and material (leather vs. rubber), 2) effects of sole type (stitched vs. cement), and 3) effects of weight, sole flexibility, and material on risk of slips/trips.

Both physiological and biomechanical impact was measured in each phase and the results for each phase were reported.

The high level summary conclusions of the study are that boot characteristics in addition to weight, such as sole flexibility, may influence physiological and biomechanical variables, ultimately affecting fatigue and risk of trips/falls. Additionally, the effects of such boot characteristics as weight and sole flexibility may depend on task and gender.

Dr. Turner's full presentation is attached to the minutes for reference.

## **Agenda Item 8: Actions on Public and Committee Comments**

Acting Chairman Haskell led the committee through a review of the public comments in the ROC document, going in numerical order. David Trebisacci took notes in the Travel File of all committee actions and substantiations.

There was committee discussion and several motions regarding action on certain logs in the ROC document, which are noted as follows:

### Discussion on Log 2:

#### **MOTION BY JEFF STULL, SECOND BY STEVE CORRADO**

To hold for further study Log 2

**MOTION FAILED**

#### **MOTION BY TIM DURBY, SECOND BY MIKE MCKENNA**

To accept Log 2

**MOTION CARRIED**

### Discussion on Log 86:

#### **MOTION BY JEFF STULL, SECOND BY STEVE CORRADO**

To hold log 86

**MOTION CARRIED**

### Discussion on Logs 6, 26, and 77:

#### **MOTION BY PAUL CURTIS, SECOND BY PATRICIA FREEMAN**

To reject Log 6, 26, and 77

**MOTION CARRIED**

### Discussion on Log 8:

#### **MOTION BY JEFF STULL, SECOND BY PAM KAVALESKY**

To reject Log 8

**MOTION CARRIED**

### Discussion on Log 83:

The committee discussed whether or not it was appropriate for manufacturer's to conduct any of their own certification testing. It was noted that the ISO standard governing this process is quite rigorous and the certifying bodies support it. It was also noted that this issue has been discussed and agreed upon previously at the TCC level.

#### **MOTION BY JEFF STULL, SECOND BY STEVE CORRADO**

To reject Log 83

HAND COUNT: 18 AFFIRMATIVE, 7 NEGATIVE

**MOTION CARRIED**

Discussion on Log 21, 88, and 107:

**MOTION BY JEFF STULL, SECOND BY MIKE MCKENNA**

To accept Logs 88 and 107 and to accept in principle Log 21

HAND COUNT: 13 AFFIRMATIVE, 9 NEGATIVE, 4 ABSTAIN

**MOTION CARRIED**

Discussion on Log 89:

**MOTION BY DAN MELIA, SECOND BY PATRICIA FREEMAN**

To reject Log 89

**MOTION CARRIED**

Discussion on Log 25:

**MOTION BY MIKE MCKENNA, SECOND BY HARRY WINER**

To reject Log 25

**MOTION CARRIED**

Discussion on Log 117:

**MOTION BY JEFF STULL, SECOND BY RICHARD FORD**

To Accept Log 117

**MOTION CARRIED**

Discussion on Log 130:

**MOTION BY PAUL CURTIS, SECOND BY TIM DURBY**

To reject Log 130

**MOTION CARRIED**

Discussion on Log 109:

**MOTION BY JEFF STULL, SECOND BY HARRY WINER**

To accept Log 109

HAND COUNT: 11 AFFIRMATIVE, 10 NEGATIVE, 5 ABSTAIN

**MOTION CARRIED**

Acting Chairman Haskell requested a roll call vote.

ROLL CALL VOTE: 9 AFFIRMATIVE, 12 NEGATIVE, 5 ABSTAIN

**MOTION FAILED**

**MOTION BY TIM DURBY, SECOND BY MIKE MCKENNA**

To reject Log 109

ROLL CALL VOTE: 14 AFFIRMATIVE, 8 NEGATIVE, 4 ABSTAIN

**MOTION CARRIED**

Discussion on Log 11:

**MOTION BY HARRY WINER, SECOND BY GRACE STULL**

To accept Log 11

**MOTION CARRIED**

Discussion on Log 105:

**MOTION BY ANGIE SHEPHERD, SECOND BY TIM DURBY**

To reject Log 105

**MOTION CARRIED**

Discussion on Log 95:

**MOTION BY ANGIE SHEPHERD, SECOND BY PATRICIA FREEMAN**

To accept in principle in part Log 95

**MOTION CARRIED**

Discussion on Log 55:

**MOTION BY ANGIE SHEPHERD, SECOND BY MICHAEL LATON**

To reject Log 55

**MOTION CARRIED**

Acting Chairman Haskell recessed the meeting for the day at 17:25 and informed the committee that the meeting would reconvene at 08:00.

## **6 APRIL 2011**

Acting Chairman Haskell reconvened the meeting at 08:00, 6 April 2011. He introduced Dr. Nina Turner, to present work on the Physiological and Biomechanical Effects of Firefighter Boot Weight and Sole Flexibility (Agenda Item 7).

The committee then continued discussion on the public comments in the ROC document. David Trebisacci took notes in the Travel File of all committee actions and substantiations.

There was committee discussion and several motions regarding action on certain logs in the ROC document, which are noted as follows:

Discussion on Logs 19, 32, 35, and 113:

The committee discussed the merits of the logs and the inclusion of the Whole Glove Thermal Protective Performance Test (Pyrohands) in the 2012 edition of the standard. The test method is not ready for the standard, but there was committee feeling that the test method is reasonably well developed and should continue to be actively pursued.

**The committee agreed to form a task group called “Pyrohands Task Group” to continue work on the test method. The task group will be chaired by Dr. Roger Barker, with members including: Harry Winer, Tom Ragan, Tricia Hock, Michael Laton, Pam Kavalesky, Jeff Stull, Robin Royster, Rich Ford, Mike McKenna, Shawn Deaton, and Mark Williams.**

Discussion on Log 99:

The committee rejected the comment. It was noted that information and data was provided by NC State to some members of the Gloves Task Group to show the value of the test method. NCSU's work was sponsored by a DHS-AFG grant. The information and data can be shared with any committee member.

Discussion on Log 102:

Some members believe the proposed 30 second time value is too long for glove donning, even when wet. It was noted that there may be some differences in the test lab technician's ability to don gloves which can effect the time measured. The committee discussed the tradeoff between glove dexterity (and associated tightness) and the ability to quickly don a glove. There was some general dissatisfaction expressed with the ease of donning wet gloves in the field.

It was noted that if 15 seconds were the requirement, then a significant portion of currently certified gloves not pass the test. There was also discussion about the potential negative changes to the product if the comment is rejected and 15 seconds is used.

There are other logs associated with this log that would remove the second glove on the non-donning hand. It was expressed that the second glove is perhaps more important than the donning time.

Jeff Stull noted that the original intention of this test was to measure liner pull out or inversion, and not glove donning time. The test has evolved over the years to include glove donning time.

**MOTION BY JEFF STULL, SECOND BY TOM RAGAN**

To accept Log 102

**MOTION CARRIED**

Discussion on Logs 28 and 112:

**MOTION BY MIKE MCKENNA, SECOND BY HARRY WINER**

To reject Logs 28 and 112

**MOTION CARRIED**

Discussion on Log 61 and 121:

The committee discussed changing from the Bunsen burner test to the open pan test. There was discussion about the data behind the test method change, as well as the efficacy, and the repeatability and the testing at both labs.

There was a request that the test data created by UL that was previously shared with the task group be shared with the full technical committee. Mike McKenna will make the videos available via a weblink, which will be emailed to the committee. The videos will not be emailed or attached to the minutes due to the large file size.

**MOTION BY TIM DURBY, SECOND BY RICHARD FORD**

To reject Log 61

**MOTION CARRIED**

Discussion on Log 63:

**MOTION BY MIKE MCKENNA, SECOND BY RICHARD FORD**

To reject Log 63

**MOTION CARRIED**

Discussion on Log 134:

**MOTION BY PATRICIA FREEMAN, SECOND BY KAREN LEHTONNEN**

To reject Log 134

**MOTION CARRIED**

Discussion on Log 74:

The committee discussed the impact of smoothing misbehaving fabric. Issues included interrupting the test for all samples vs. only misbehaving samples, the impact of smoothing on variability of test results, and whether or not a test should be restarted after the chamber had been opened for smoothing.

**MOTION BY JEFF STULL, SECOND BY IRA HARKNESS**

To accept Log 74

**MOTION CARRIED**

Discussion on Log 108 and 126:

**MOTION BY PATRICIA FREEMAN, SECOND BY STEVE CORRADO**

To reject Logs 108 and 126

HAND COUNT: 15 AFFIRMATIVE, 8 NEGATIVE

**MOTION CARRIED**

Discussion on Log 135:

**MOTION BY JEFF STULL, SECOND BY DOUG SLOAN**

To accept Log 135

HAND COUNT: 13 AFFIRMATIVE, 7 NEGATIVE,

**MOTION CARRIED**

Discussion on Log 20:

**MOTION BY GRACE STULL, SECOND BY LOUIS OTT**

To accept Log 20

**MOTION CARRIED**

Discussion on Log 49:

**MOTION BY TIM DURBY, SECOND BY DAN MELIA**

To accept Log 49

**MOTION CARRIED**

Discussion on Log 50:

**MOTION BY JEFF STULL, SECOND BY TIM DURBY**

To accept Log 50

**MOTION CARRIED**

Discussion on Log 53:

**MOTION BY TIM DURBY, SECOND BY RICK ERDINGER**

To accept Log 53

**MOTION CARRIED**

Discussion on Log 52:

**MOTION BY NICK CURTIS, SECOND BY ANGIE SHEPHERD**

To accept Log 52

**MOTION CARRIED**

Discussion on Log 51:

**MOTION BY NICK CURTIS, SECOND BY RICH FORD**

To accept in principle Log 51 and to move the Note to the Annex

**MOTION CARRIED**

Discussion on Log 46:

**MOTION BY NICK CURTIS, SECOND BY MIKE MCKENNA**

To accept Log 46

**MOTION CARRIED**

Discussion on Log 47:

**MOTION BY ANGIE SHEPHERD, SECOND BY MICHAEL LATON**

To accept Log 47

**MOTION CARRIED**

Discussion on Log 69:

**MOTION BY NICK CURTIS, SECOND BY MIKE MCKENNA**

To accept Log 69

**MOTION CARRIED**

Discussion on Log 56:

**MOTION BY TIM DURBY, SECOND BY PATRICIA FREEMAN**

To reject Log 56

**MOTION CARRIED**

Discussion on Log 106:

**MOTION BY RICH FORD, SECOND BY PATRICIA FREEMAN**

To accept Log 106

**MOTION CARRIED**

The committee completed its discussion on the public comments in the ROC document. The committee then began to discuss committee comments. David Trebisacci took notes in the Travel File of all committee actions and substantiations.

The task group items noted are from documents created by the task groups that were previously distributed to the technical committee. There was committee discussion about the committee proposals and motions to accept the proposals as committee comments, which are noted as follows:

Discussion on Boot Task Group Item 1:

**MOTION BY MIKE MCKENNA, SECOND BY ANGIE SHEPHERD**

To accept Boot Task Group Item 1 as Committee Comment 1

**MOTION CARRIED**

Discussion on Boot Task Group Item 3:

**MOTION BY ANGIE SHEPHERD, SECOND BY RICH FORD**

To accept Boot Task Group Item 3 as Committee Comment 2

**MOTION CARRIED**

Discussion on Boot Task Group Item 4:

**MOTION BY ANGIE SHEPHERD, SECOND BY TIM DURBY**

To accept Boot Task Group Item 4 as Committee Comment 3

**MOTION CARRIED**

Discussion on Boot Task Group Item 5:

**MOTION BY ANGIE SHEPHERD, SECOND BY STEVE CORRADO**

To accept Boot Task Group Item 5 as Committee Comment 4

**MOTION CARRIED**

Discussion on Boot Task Group Item 6:

**MOTION BY ANGIE SHEPHERD, SECOND BY STEVE CORRADO**

To accept Boot Task Group Item 6 as Committee Comment 5

**MOTION CARRIED**

Discussion on Boot Task Group Item 7:

**MOTION BY MIKE MCKENNA, SECOND BY ANGIE SHEPHERD**

To accept Boot Task Group Item 7 as Committee Comment 6

**MOTION CARRIED**

Discussion on Boot Task Group Item 23:

**MOTION BY PAM KAVALESKY, SECOND BY KAREN LEHTONNEN**

To accept Boot Task Group Item 23 as Committee Comment 7

**MOTION CARRIED**

Discussion on Boot Task Group Item 26:

**MOTION BY MIKE MCKENNA, SECOND BY ANGIE SHEPHERD**

To accept Boot Task Group Item 26 as Committee Comment 8

**MOTION CARRIED**

Acting Chairman Haskell recessed the meeting for the day at 17:30 and informed the committee that the meeting would reconvene at 08:00.

## 7 APRIL 2011

Acting Chairman Haskell reconvened the meeting at 08:00, 7 April 2011.

David Trebisacci updated the committee and confirmed that Patricia Freeman's public comment was received, but was not logged. As such, it is considered a public comment and as a result actions associated with that classification are available.

### Discussion on Patricia Freeman's Log:

Harry noted that work on this subject area has been ongoing since the 1970's. It was also noted that by definition radiant heat is line of sight, and that after it contacts the outer shell it is no longer radiant heat. Harry further noted that the standard did not say that aluminized fabric had to be used and is not design restrictive.

Harry pointed out that if the test was to go into the standard, there would need to be additional tests to go along with it and that the radiant heat would end up being pre-conditioning.

### **MOTION BY JEFF STULL, SECOND BY HARRY WINER**

To hold Patricia Freeman's Log

### **MOTION CARRIED**

The committee then discussed certain logs in the ROC document that had additional work completed since their initial committee discussion. David Trebisacci took notes in the Travel File of all committee actions and substantiations.

There was committee discussion and several motions regarding action on certain logs in the ROC document, which are noted as follows:

### Discussion on Log 135:

Action on Log 135 needed to be modified based on the committee's actions on Log 132.

### **MOTION BY RICH FORD, SECOND DOUG SLOAN**

To reopen Log 135

### **MOTION CARRIED**

### **MOTION BY DOUG SLOAN, SECOND BY RICH FORD**

To accept in principle Log 135

### **MOTION CARRIED**

The committee then discussed committee comments. David Trebisacci took notes in the Travel File of all committee actions and substantiations.

There was committee discussion about the committee proposals and motions to accept the proposals as committee comments, which are noted as follows:

Discussion on Helmet Task Group Item 2:

**MOTION BY MIKE MCKENNA, SECOND BY RICH FORD**

To accept Helmet Task Group Item 2 as Committee Comment 9

**MOTION CARRIED**

Discussion on Helmet Task Group Item 15:

This Helmet TG item reverses the accept actions on logs 1971-45 and 1971-79 to reject actions. Mike McKenna will carry this action to the NFPA 1500 Committee.

**MOTION BY STEVE CORRADO, SECOND BY PAUL CURTIS**

To accept Helmet Task Group Item 15 as Committee Comment 10

**MOTION CARRIED**

Discussion on Helmet Task Group Item 18:

**MOTION BY JEFF STULL, SECOND BY DAN MELIA**

To accept Helmet Task Group Item 18 as Committee Comment 11

**MOTION CARRIED**

Discussion on Helmet Task Group Item 19:

**MOTION BY MIKE MCKENNA, SECOND BY RICH FORD**

To accept Helmet Task Group Item 19 as Committee Comment 12

**MOTION CARRIED**

Discussion on Helmet Task Group Item 21:

**MOTION BY STEVE CORRADO, SECOND BY RICK ERDINGER**

To accept Helmet Task Group Item 21 as Committee Comment 13

**MOTION CARRIED**

Discussion on Gloves Task Group Item 1:

**MOTION BY MIKE MCKENNA, SECOND BY PAUL CURTIS**

To accept Gloves Task Group Item 1 as Committee Comment 14

**MOTION CARRIED**

Discussion on Gloves Task Group Item 5:

**MOTION BY MIKE MCKENNA, SECOND BY STEVE CORRADO**

To accept Gloves Task Group Item 5 as Committee Comment 15

**MOTION CARRIED**

Discussion on Gloves Task Group Items 11 & 12:

**MOTION BY PAM KAVALESKY, SECOND BY HARRY WINER**

To accept Gloves Task Group Items 11 & 12 as Committee Comment 16

**MOTION CARRIED**

Discussion on Gloves Task Group Item 13:

**MOTION BY HARRY WINER, SECOND BY RICH FORD**

To accept Gloves Task Group Item 13 as Committee Comment 17

**MOTION CARRIED**

Discussion on Gloves Task Group Item 14:

**MOTION BY PAUL CURTIS, SECOND BY ANGIE SHEPHERD**

To accept Gloves Task Group Item 14 as Committee Comment 18

**MOTION CARRIED**

After passing the motion there was additional committee discussion on the dryer specification language. It was determined that additional changes needed to be made.

**MOTION BY TIM DURBY, SECOND BY RICK EDINGER**

To reopen Committee Comment 18

**MOTION CARRIED**

The committee then discussed and modified the language in Committee Comment 18.

**MOTION BY PAUL CURTIS, SECOND BY TIM DURBY**

To accept Gloves Task Group Item 14 as Committee Comment 18

**MOTION CARRIED**

Discussion on Gloves Task Group Item 16:

**MOTION BY ANGIE SHEPHERD, SECOND BY PAM KAVALESKY**

To accept Gloves Task Group Item 16 as Committee Comment 19

**MOTION CARRIED**

Discussion on Gloves Task Group Item 18:

**MOTION BY MIKE MCKENNA, SECOND BY PAUL CURTIS**

To accept Gloves Task Group Item 18 as Committee Comment 20

**MOTION CARRIED**

Discussion on Gloves Task Group Item 20:

**MOTION BY ANGIE SHEPHERD, SECOND BY RICH FORD**

To accept Gloves Task Group Item 20 as Committee Comment 21

**MOTION CARRIED**

Discussion on Gloves Task Group Item 27:

**MOTION BY MIKE MCKENNA, SECOND BY JASON ALLEN**

To accept Gloves Task Group Item 27 as Committee Comment 22

**MOTION CARRIED**

Discussion on Gloves Task Group Item 28:

**MOTION BY MIKE MCKENNA, SECOND BY PAUL CURTIS**

To accept Gloves Task Group Item 28 as Committee Comment 23

**MOTION CARRIED**

Discussion on Gloves Task Group Item 31:

**MOTION BY PAUL CURTIS, SECOND BY ANGIE SHEPHERD**

To accept Gloves Task Group Item 31 as Committee Comment 24

**MOTION CARRIED**

Discussion on Gloves Task Group Item 33:

**MOTION BY STEVE CORRADO, SECOND BY PAUL CURTIS**

To accept Gloves Task Group Item 33 as Committee Comment 25

**MOTION CARRIED**

Discussion on Gloves Task Group Item 22:

**MOTION BY MIKE MCKENNA, SECOND BY RICK ERDINGER**

To accept Gloves Task Group Item 22 as Committee Comment 26

**MOTION CARRIED**

Task group generated committee comment processing was completed. Chairman Haskell then solicited the committee for any additional proposals for committee comment.

Discussion on the Wicker Test:

There was additional committee discussion regarding whether the test should be completed with a base composite or with the composite used in the garment itself. It was also discussed and generally agreed upon that the intention was not to have every possible combination of material layers tested.

There was discussion about the overall readiness of the test methodology proposed by this committee comment.

The proposal is to change what was agreed upon during the processing of the logs---which would utilize a generic base composite with each knee reinforcement, as opposed to every combination possible by each manufacturer. The proposal also makes the wicker test a structural garment test only and not a proximity garment test.

**MOTION BY TIM DURBY, SECOND BY RICH FORD**

To accept the proposal as Committee Comment 27

HAND COUNT: 15 AFFIRMATIVE, 3 NEGATIVE

**MOTION CARRIED**

There was continued committee discussion after the vote, and it came up that this issue was very sensitive and could be subject to NITMAM action. Acting Chairman Haskell requested that the committee continue discussion and work towards a full committee consensus solution.

**MOTION BY TIM DURBY, SECOND BY MATT PEGG**

To revisit the previous committee action on Log 109

**MOTION CARRIED**

**MOTION BY TIM DURBY, SECOND BY HARRY WINER**

To accept Log 109

**MOTION CARRIED**

As a result of the vote to accept Log 109, the committee agreed to modify the results of the following logs to the noted action: 101 (accept), 110 (accept), 49 (reject), 50 (reject), 53 (reject), 52 (reject), 51 (reject), 46 (reject), 47 (reject), 48 (reject), 16 (reject). The substantiation for all of these new actions is to see the action taken on Log 109.

The fire service caucus within the committee was commended for being proactive and creating a solution that was agreeable to all parties. This action averted possible damaging actions to the standard and created a pathway forward for an important test for firefighter safety.

The technical committee Chairman Steve King will write a letter of endorsement for the completion of the Water Immersion Compression Heat Resistance Test. This test is presently a work item in ASTM sub-committee F23.80.

Discussion on Shower Test Committee Proposal:

The proposed committee comment would eliminate the use of cans in the shower test. This change will reduce the variability of the test. This proposal is related to Log 1971-24.

**MOTION BY ANGIE SHEPHERD, SECOND BY PAM KAVALESKY**

To accept the committee proposal related to Log 1971-24 as Committee Comment 27

**MOTION CARRIED**

The committee's work on the ROC document was completed. Acting Chairman Haskell thanked and recognized the Task Groups for the work completed, especially Mike McKenna, Robin Royster, and Karen Lehtonen. Acting Chairman Haskell then thanked the committee and guests for all of their hard work on preparing this document.

**MOTION BY JEFF STULL, SECOND BY RICH FORD**

To submit the actions of the technical committee on comments to a letter ballot

**MOTION CARRIED**

**Agenda Item 9: Old Business**

There is no old business of the committee.

**Agenda Item 10: New Business**

Next TC meeting for NFPA 1851 ROP, NLT 5 August 2011:

The committee discussed possible dates and locations for the NFPA 1851 ROP meeting. The technical committee recommends 26-27 July for the meeting with 25 July reserved for travel. Recommended locations are downtown Chicago, Providence, R.I., and Portland, ME.

Dan Melia commended the work of Jeff and Grace Stull on the Glove Corp. issue experienced by FDNY.

Michael Laton updated the committee on the work of the NFPA 1500 committee. One of the updates is that 1500 recommends that FD's complete a risk assessment per NFPA 1851 to determine whether or not to use structural or proximity turnout gear. The risk assessment area of 1851 will receive attention due to this change during the upcoming 1851 standard revision.

**Agenda Item 12: Adjournment**

**MOTION BY HARRY WINER, SECOND BY ANGIE SHEPHERD**

To adjourn

**MOTION CARRIED**

Acting Chairman Haskell adjourned the meeting at 13:15 on 7 April 2011.

Respectfully submitted,



Benjamin A. Mauti, Secretary  
TC on SPFFPCE

## Physiological and Biomechanical Effects of Firefighter Boot Weight and Sole Flexibility

Nina Turner, Ph.D.  
National Personal Protective Technology Laboratory  
Pittsburgh, PA

Sharon Chiou, Ph.D.  
Division of Safety Research – Morgantown, WV

National Institute for Occupational Safety and Health

Meeting of the NFPA Technical Committee on Structural and Proximity Fire Fighting Protective Clothing and Equipment  
New Orleans, LA  
April 6, 2011



## 3 Phases of Study

- **Phase 1** – Effects of boot weight and material (leather vs. rubber)
- **Phase 2** – Effects of sole type (stitched vs. cement)
- **Phase 3** – Effects of weight, sole flexibility, and material on risk of slips/trips

Variables: O<sub>2</sub> consumption, CO<sub>2</sub> production, minute ventilation, heart rate, peak flows, joint forces, gait analysis



## Phase 1

To determine the effects of boot weight and material (rubber vs. leather) on 25 men and 25 women firefighters' physiology and biomechanics during simulated firefighting tasks (stair climbing and treadmill walking)

Boot	Material	Mean Weight	Height	Heel Area
L1	Leather	2.6 kg men 2.4 kg women	36.8 cm	81.3 cm <sup>2</sup>
L2	Leather	2.9 kg men 2.5 kg women	36.6 cm	83.2 cm <sup>2</sup>
R1	Rubber	3.3 kg men 3.0 kg women	40.6 cm	71.0 cm <sup>2</sup>
R2	Rubber	3.9 kg men 3.4 kg women	39.4 cm	71.6 cm <sup>2</sup>



## Task 1 - Physiology

- Walking at 4.8 km/hr (3 mph) on level treadmill
- Six minutes of walking with last minute used for analysis
- Full turnout gear + 10.5-kg backpack + 9.5 kg-hose
- Boot models were randomized
- Repeated measures analysis of covariance model



## Significant % Increase per kg Increase in Boot Weight

Task	VE (L/min, BTPS)	VO <sub>2</sub> (L/min, STPD)	VCO <sub>2</sub> (L/min, STPD)	VO <sub>2</sub> /kg (ml/kg/min, STPD)	R	HR (bpm)
Treadmill						
Combined	5.7%	4.8%	6.2%	4.7%	1.2%	3.4%
Men	9.2%	5.8%	7.8%	5.9%		5.7%
Women		3.0%	3.6%	3.4%		



## Phase 1 Conclusions - Treadmill

- Significant 6% increase in oxygen consumption per kg increase in boot weight in men with 9% increase in minute ventilation, which could reduce a typical SCBA's duration by 3 – 4 minutes
- Smaller, significant 3% increase for women
- Gender difference could be due to greater relative weight of gear for women (42% body weight) vs. men (33% body weight) or due to military data (Martin, 1986) showing that women shorten stride length while carrying load on back



## Phase 1 Conclusions - Walking

### Biomechanics:

- **Boot type had significant effects on gait characteristics:**
  - Reduction in walking speed when wearing rubber boots
  - Increased step width with rubber boots
  - Increased double stance period (%) with rubber boots
- **Resultant joint loadings at hips and knees were significantly increased when wearing rubber boots during normal gait**

## Task 2 - Physiology

- Climbing at 45 steps per min on stair ergometer
- Step height of 15.2 cm (6 in)
- Six minutes of climbing with last minute used for analysis
- Full turnout gear + 10.5-kg backpack
- Boot models were randomized
- Repeated measures analysis of covariance model



## Significant % Increase per kg Increase in Boot Weight

Task	VE (L/min, BTPS)	VO <sub>2</sub> (L/min, STPD)	VCO <sub>2</sub> (L/min, STPD)	VO <sub>2</sub> kg (ml/kg/min, STPD)	Inhaled Peak Flow (L/min, BTPS)
Stairs					
Combined	3.1%	2.6%	3.2%	2.2%	4.1%
Men		3.8%	3.1%	3.4%	
Women			3.3%		

## Conclusions – Stair Ergometer

- Significant 3.5% increase in oxygen consumption per kg increase in boot weight in men
- Insignificant increases for women
- 3.5% increase observed for men is less than the 5% increase seen in previous study (Neeves, 1989) where subjects wore gym shorts
- Significant 4% increase in inhaled peak flow

Turner *et al.*, Physiological Effects of Boot Weight and Design on Men and Women Firefighters, *JOEH*, 7: 477-482 (2010)

## Phase 2 - Purpose

Evaluate physiological and biomechanical variables during simulated firefighting tasks with 14 men and 13 women firefighters wearing Goodyear welt and cement-soled boots.

Boot	Sole Type	Mean Weight	Height
S1	Stitched	2.6 kg men 2.4 kg women	36.8 cm
S2	Stitched	2.9 kg men 2.5 kg women	36.6 cm
C1	Cement	2.8 kg men 2.4 kg women	36.8 cm
C2	Cement	3.0 kg men 2.6 kg women	30.2 cm

## Percent Decrease with Cement Sole

Task	VE (L/min, BTPS)	VO <sub>2</sub> (L/min, STPD)	VCO <sub>2</sub> (L/min, STPD)	VO <sub>2</sub> kg (ml/kg/min, STPD)	R	HR (bpm)
Treadmill						
Men	-4.4%	-4.5%*	-2.0%	-4.6%*	2.4%	-1.7%
Women	-4.2%	-4.8%*	-1.9%	-4.0%*	2.2%	-1.5%

\*p ≤ 0.05 for sole effect

### Percent Decrease with Cement Sole

Task	VE (L/min, BTPS)	VO <sub>2</sub> (L/min, STPD)	VCO <sub>2</sub> (L/min, STPD)	VO <sub>2</sub> kg (ml/kg/min, STPD)	R	HR (bpm)
Stairs						
Men	-2.8%	-1.9%	0.0%	-2.0%	2.2%	-0.7%
Women	-3.0%	-2.2%	0.0%	-1.8%	2.2%	-0.6%

### Phase 2 Conclusions

- Significant 4 – 5% decrease in oxygen consumption observed for cement-soled boots compared to stitched-soled during treadmill walking
- Insignificant 2 – 3% decrease in oxygen consumption and VE observed for cement-soled boots compared to stitched-soled during stair climbing
- % changes are almost identical for men and women; changes are not affected by gender-dependent walking strategies

### Phase 2 Conclusions - Walking

Biomechanics:

- Significantly greater peak hip and knee joint angles in the frontal and transverse planes when wearing stitch-soled boots:
  - Increase in peak hip abduction/adduction angles
  - Increase in peak knee external angles
- Significant increases in ankle range of motion in frontal and transverse planes when wearing cement-soled boots

### Phase 3

Rubber, leather and fabric/leather boots were worn during obstacle crossing and ladder climbing to determine effects of weight and sole type on risk of trips/falls



### Phase 3 Tasks

- 1) Climbing up and down 3.7-meter ladder at 25 rungs per minute for five minutes wearing gear and 10.5-kg backpack
- 2) Walking at 34 m/min with fixed-length stride while stepping over two 15-cm and two 30-cm obstacles for 5 minutes wearing gear, 10.5-kg backpack, and carrying 9.5-kg hose




### Boot Models and Characteristics

Model	Sole Type	Weight	Max Angle	Stiffness Index	Height	Heel Area
HS	Hybrid/Stitched	2.5 kg men 2.0 kg women	<50°	15.6	36.8 cm	84.6 cm <sup>2</sup>
LS	Leather/Stitched	2.9 kg men 2.5 kg women	<50°	19.2	36.6 cm	83.2 cm <sup>2</sup>
LF	Leather/Flexible	3.1 kg men 2.6 kg women	50°	6.8	30.2 cm	82.6 cm <sup>2</sup>
RF	Rubber/Flexible	3.8 kg men 3.4 kg women	<50°	12.8	39.4 cm	71.6 cm <sup>2</sup>

Longitudinal stiffness testing performed by SATRA (Northamptonshire, UK)

### Subject Characteristics




	Age (yrs)	Weight (kg)	Height (cm)
Men n = 14	28 ± 5	94 ± 14	178 ± 4
Women n = 14	33 ± 5	68 ± 8	167 ± 5

### Phase 3 Results – Ladder Climbing




Task	VE (L/min, BTPS)	VO <sub>2</sub> (L/min, STPD)	VO <sub>2</sub> kg (ml/kg/min, STPD)	VCO <sub>2</sub> (L/min, STPD)	HR (bpm)
Boot Weight					
Men	3.3%	8.7%*	5.7%*	6.1%	-1.0%
Women	3.8%	1.9%	5.0%*	4.7%	-1.0%

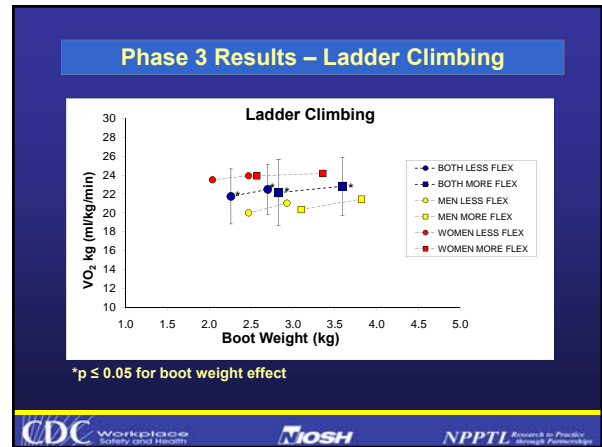
\*p ≤ 0.05 for boot weight effect

### Phase 3 Results – Ladder Climbing

Task	VE (L/min, BTPS)	VO <sub>2</sub> (L/min, STPD)	VO <sub>2</sub> kg (ml/kg/min, STPD)	VCO <sub>2</sub> (L/min, STPD)	HR (bpm)
Sole Flexibility					
Men	1.7%	-4.6%	-2.4%	-1.4%	1.7%
Women	2.0%	-1.2%	-2.1%	-1.6%	1.7%










### Phase 3 Results – Obstacle Crossing

Task	VE (L/min, BTPS)	VO <sub>2</sub> (L/min, STPD)	VO <sub>2</sub> kg (ml/kg/min, STPD)	VCO <sub>2</sub> (L/min, STPD)	HR (bpm)
Boot Weight					
Men	6.9%*	11.0%*	8.7%*	13.2%*	-0.5%
Women	7.3 %*	6.3%*	7.1%*	7.6%*	-0.5%




\*p ≤ 0.05 for boot weight effect

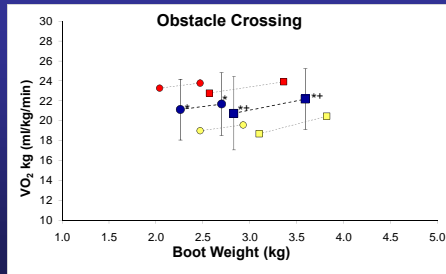
### Phase 3 Results – Obstacle Crossing

Task	VE (L/min, BTPS)	VO <sub>2</sub> (L/min, STPD)	VO <sub>2</sub> kg (ml/kg/min, STPD)	VCO <sub>2</sub> (L/min, STPD)	HR (bpm)
Sole Flexibility					
Men	-2.7%	-7.2%	-6.1%*	-9.0%	1.8%
Women	-2.8%	-5.0%*	-5.0%*	-6.8%*	1.8%

\*p ≤ 0.05 for sole effect

### Phase 3 Results – Obstacle Crossing

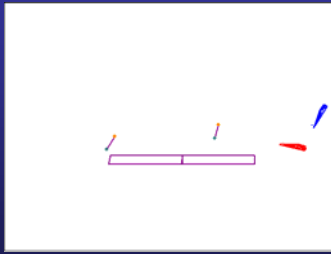


\*  $p \leq 0.05$  for boot weight effect, †  $p \leq 0.05$  for sole effect

### Phase 3 Conclusions

- 5 – 11% increases in per one kg increase in boot weight were demonstrated for metabolic variables during both ladder climbing and obstacle crossing in men and women
- During obstacle crossing, significant 5 – 6% decreases in metabolic variables were observed in more flexible soles
- A lack of significant interaction indicates that effects are not influenced by gender-dependent strategies for these tasks

### Phase 3 Results – Obstacle Crossing



### Phase 3 Conclusions – Obstacle Crossing

#### Biomechanics:

- **Boot weight affected trailing toe obstacle clearances:**
  - A decrease of 2.8 cm per kg increase in boot weight for the high obstacle and a decrease of 3.6 cm per kg increase in boot weight for the low obstacle
- **Sole flexibility affected trailing toe obstacle clearances:**
  - An increase of 2.5 cm for more flexible sole for the high obstacle
- **Significant differences in crossing strategies between by gender:**
  - Larger lateral foot displacement found for women

### Summary

- Boot characteristics in addition to weight, such as sole flexibility, may influence physiological and biomechanical variables, ultimately affecting fatigue and risk of trips/falls
- The effects of such boot characteristics as weight and sole flexibility may depend on task and gender
- NFPA 1971 technical committee will consider these findings as they update boot standards

### Contact

Nina L. Turner, Ph.D.  
NTurner@cdc.gov

Conclusions in this presentation have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy.