

**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%

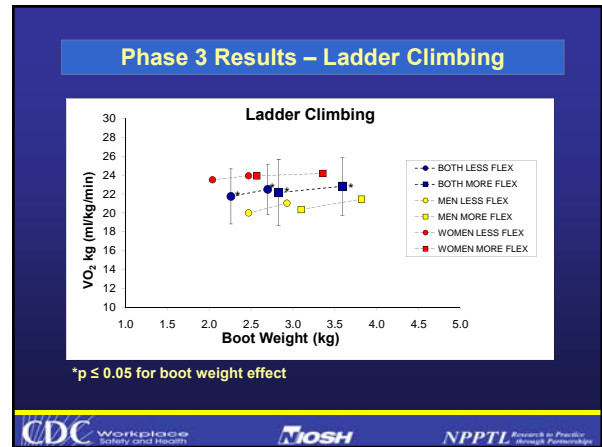
\*p ≤ 0.05 for boot weight effect

### 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

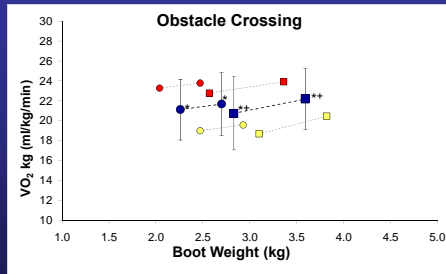
### Phase 3 Results – Obstacle Crossing

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

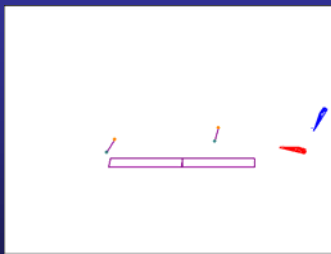


\*p ≤ 0.05 for boot weight effect, † p ≤ 0.05 for sole effect

### 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

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