Incorporating Standards Education into Courses in Textile Protection and Comfort 2014-NIST SSCD-01

NIST Standards Education Research
November 6, 2015

Center for Research on Textile Protection and Comfort (T-PACC)

Mission

Improve safety and health for the military, emergency responders, law enforcement, medical community, industrial & agricultural workers and the general public

Strategies:

- Research collaborations and partnerships
- Development of educational opportunities
- Building research infrastructure

TPACC Testing & Research

Strong involvement in standards development and evaluation of test methods

Professional Organization Involvement

National Fire Protection Association
The authority on fire, electrical, and building safety

International Organization for Standardization

INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

- NFPA Correlating Committee on Protective Clothing and Equipment
  - TCS on Structural Fire, Wildlands, Station Wear, Technical Rescue, Surface Water, CBRN, Respiratory Protection, EMS Ops, Thermal Imaging, PASS, Life Safety Ropes
- ASTM Technical Committee F23 (Personal Protective Clothing and Equipment)
- ISO Protective Clothing and Equipment Standards Groups
- IOM Committee on Personal Protection

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NIST Project Objectives

- To create new course content
  - the need for standards for performance and protective technologies
  - role of standards in field performance and protection
  - the processes used to create standards
  - Making standards work in practice (user interface)
- To incorporate new pedagogical procedures to deliver the knowledge to students

Methodology

- Standards education modules incorporated into traditional MS, PSM and Institute PhD program
- Traditional & Virtual labs/multi-media graphic tools being prototyped in 2016
- Distance education/on-line courses will be created for PSM: DELTA—Distance Education& Learning Technology Applications
  - Expertise in Analysis, Design, Development, Implementation, and Evaluation
  - Learning objectives developed for each module
  - Graphics, “scripts” and demonstrations support
  - Utilize Moodle learning management system
  - Test instruments developed to assess learning outcomes

Program Accomplishments

- Course Development
  - Two Graduate courses added to Textile Engineering Curriculum (35 students in 2013-2015)
    - TE 550 Principles of Human Protection and Comfort
    - TE 551 Human Physiology for Clothing and Wearables
  - Syllabi completed for two Special Topics Couses
    - Thermal and physical protection clothing systems
    - Chemical, biological and mechanical prottive technologies
    - Standards content has beeng developed
  - Incorporation of Standards
    - All Courses Incorporate Standards Instructional materials
    - Student learning assessments include initial survey of standards knowledge and mastery of standards content
    - Courses include student projects on standards and test methods incorporated into clothing systems

Program Accomplishments

- Other Accomplishments
- Added standards and test methods principles to undergraduate Textile Testing Course
- Short courses versions of all four courses will be added to the Textile Extension Program (2016-2017)
  - A Certificate in Human Protection and Comfort Completion requires completion of all four plus Technical Textiles short course
- Surveys of manufacturers and user groups at professional meetings and through trade publications will be used to assess content for distance education and short courses
- Recording TE 550 & 551 for DE will occur in 2016
  - Recording of laboratory tests has begun
  - Editing and revisions for use as exercises for courses will follow testing and evaluation with student groups

Principles of Human Protection and Comfort (TE 550): Roger Barker

- Graduate/advanced undergraduate course
  - an introduction to materials and clothing systems
  - protection against occupational exposures [hazardous environment
- Comfort & heat stress of clothing systems
- Standardized and advanced test methods
  - physical properties
  - comfort
  - protective performance
- Demonstrations with unique TPACC laboratory facilities
- Basics foundation for
  - clothing physiology
  - thermal protection
  - chemical and biological protection
  - other hazards protection

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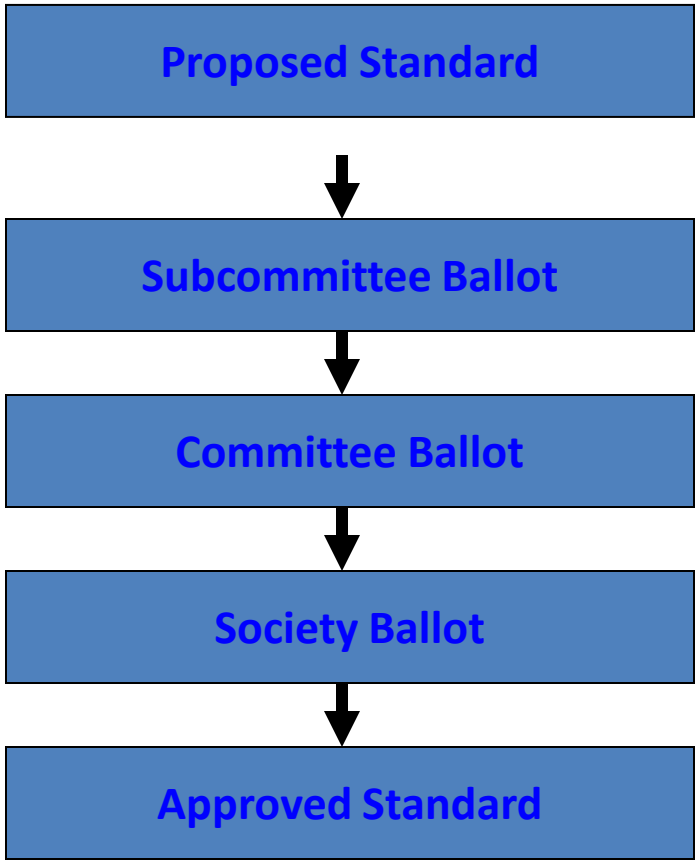
Incorporation of Standards

- Introduction to the role and use of standards in PPE
- Development of performance criteria for PPE based on risk assessment
- Processes used to create standards for PPE
- Identification and mission of standards organizations relevant to PPE(ASTM,NFPA, ISO, NIOSH)
- Procedures used to propose and adopt test methods within standards
- Case studies based on actual standards for PPE

ASTM Approval Process



- Standard can be proposed by anyone
- Ballots can be run concurrently
- Strict consensus process (all negatives must be resolved)
- 5-year review cycle

Comparison of Standards Organizations

Organization	*Membership*	*Development Process*	*Consensus Type*	*Focus*
ASTM	Open	Open-ended (3 years)	Full	Test methods
NFPA	By appt. (limited)	Fixed length (2 ½ years)	2/3 majority	Product specs.
CGSB	By appt. (limited)	Open-ended (3 years)	2/3 majority	Product specs.
CEN	By EEC or EFTA nation	Fixed length (3 years)	based on ballot	Product specs.
ISO	By country	Fixed length (4 years)	based on ballot	Methods & specs.

TE 551 Human Physiology of Clothing and Wearables

Understanding main processes in the body that interact with clothing & outside world

- Important physiology and body functions
- Relevance of measurements
- Human performance
- Maintaining homeostasis
- Limitations of Humans

TE 551 Human Physiology of Clothing and Wearables: Emiel Den Hartog

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Clothing Standards – Human Subjects

- Physiology:
- ASTM: ASTM F 2668 & ASTM F 2300
- EU: EU469 – Annex F (Protective clothing for fire fighting)
- Ergonomics:
- ASTM: F1154 – limited usability test
- NFPA: Limited Usability tests in some standards (HazMat suits)
- EU - Ergonomics: prEN14876-1

Thermal Protection Course Objective

- Protective technologies
- Risk assessment
- Standardized test methods
  - Thermal protective performance of materials
  - Clothing
  - Other gear
- Other threats in hot environments

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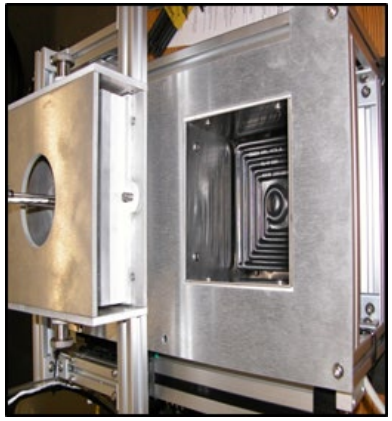

CBRN Course Summary

- Material-level and full ensemble perspectives on CBRN PPE
- Evaluation methods
- analytical chemistry
- Toxicology
- Physiological and psychological burdens
- Standards & test methods
- Risk Assessments
- Standards processes
- Garment design & materials selection
- Medical and EMS applications

Communication: Publications and Presentations

- Standards Engineering Article in Press:
- Presentation: Gaps in Personal Protective Technology Standards (ASTM, January, 2016)
- Student Standards Paper Award at ASTM 2015
- Summary Publication Planned: Survey Outcomes and NIST Project Review

Communication: Publications and Presentations

- Standards Engineering Article in Press: Don B. Thompson, Roger L. Barker, Emiel DenHartog, *Integrating Standards into Courses on High Performance Garment Systems and Human Protection and Comfort at North Carolina State Unviersity*
- William Gabler: Student Second Place Award at ANSI "World Standards Day," *Building Community: Innovation through Consensus*
- Presentation: Gaps in Personal Protective Technology Standards (ASTM, January, 2016)
- Summary Publication Planned: Survey Outcomes and NIST Project Review

Evaluations

- Course Assessments: Surveys and Course Assignment versus learning objectives
  - Undergraduate (Textile Testing Courses & Senior Engineering Design Project Course)
  - Short Courses (Questionnaires before and after)
  - Makers & Users: Trade Publications and Professional Meetings
- Project Assessment:
  - Consolidate learnings into report/publication
  - Comparison of project objectives versus accomplishments in Final Report

Outcomes

- Addition of Two Graduate Courses with strong Standards emphasis
- Addition of Two Special Topics Courses
- Addition of Standards to Undergraduate Testing Course
- Support for New Institute & PSM
  - Future courses
- Creation of Short Courses including Certification
- Publications and Presentations

Future Outcome:
Institute for Human Protection & Comfort Sciences:
Safety, Security, Health and Economic Development Through Interdisciplinary Research and Education

Professional Science Masters

- Both traditional and distance education students
- Career development focus (technology, project or organizational management specialization)
- Curriculum has been developed
- Collaborate with industry and government partners : internships, research projects, etc.
- Enthusiastic response from potential industry/government partners:

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Program Mangement

- Working with NIST was not difficult
  - Some internal management confusion, but easily resolved when recognized
  - Good support from NIST Team
- Administrative Challenges for Institute and PSM have been greater than expected
  - Resulted in acceleration of Short Courses
  - Expected to resolve in future
  - Issues have hindered expansion beyond College of Textiles

Development of Short Courses

- **Certificate in Human Protection and Comfort Science**
- **Required Courses (3)**
  - **Technical Textiles (Spring, 2016)**
  - **Human Comfort and Protection (Fall, 2016)**
  - **Clothing Physiology (Spring 2017)**
- **Optional Courses (Select 2)**
  - **Thermal and Mechanical Protective Textiles (Spring 2017)**
  - **Chemical, Biological and Medical Textiles (Fall, 2017)**
  - **Testing and Standards for Technical Textiles (Fall '17 or Spring '18)**
  - **Design, Development and Validation of Performance Clothing (Spring 2018)**

Conclusion

Key Project Outcome: Creation of unique courses on Human Protection and Comfort that are key parts of

--A new Institute

--A new Professional Sciences Masters

--Certificate Program for Users and Industry

We wish to express our thanks to NIST for helping us move toward our vision