

6th ECPC
and
NOKOBETEF 11

Conference Book

6th European Conference on Protective Clothing

Bruges - Belgium 14th, 15th & 16th of May 2014

Sponsors:



Organisation:



in association with



Dear Ladies and Gentlemen,

We have the pleasure to welcome you at this 6th European conference on protective clothing.

This conference is organised in cooperation with Fedustria, the Belgian federation of textile and wood manufacturers, ESF and Febelsafe, the European and Belgian associations of manufacturers and distributors of safety equipment, ETSA, the European association of textile service companies and Centexbel, research and innovation centre for the textile industry.

We are also grateful for the support of our sponsors: Textelligence (BE), Thermo-Analytics (US), Measurement Technology (US), TÜV (DE), Bekaert/Bekintex (BE) and Concordia Textiles (BE).

This conference is the continuation of a long tradition of ESPC and Nokobetef conferences, under the umbrella of the European Society on Protective Clothing "ESPC".

We chose to give this conference the title: "New pathways for protective clothing: safe, smart, sustainable". This is not just a coincidence or a slogan but a deliberate choice.

Protective textiles were put forward by the European Commission several years ago as a lead market for Europe, a market segment where Europe could excel and play the role of innovator and market leader worldwide.

End 2012, as a result of this lead market initiative, the EU Commission issued a standardization request to the European standardization organisations. The central themes of this request were:

- Comfort and ergonomics as an integral factor of safety: SAFE
- The integration of new technologies in protective equipment as part of ensembles and protective systems: SMART
- Sustainable use of materials and resources: SUSTAINABLE

These three key words reflect and summarize major aspects of what is going on in the development of protective equipment today. They are also central concepts in the content of the lectures and posters that will be presented to you in the next three days.

Protective equipment, ensembles, systems: these words suggest that we are no longer dealing with individual items such as jackets, trousers, hoods or coveralls but with a much larger set of elements. Some elements are even located outside and at a distance of the protective equipment user. This creates an increasingly complex environment, where the safety and well-being of a person remain central but stand at the crossing of several fields of interest.

This is not just a coming together of technologies and scientific competences, such as electronics, ICT, material sciences, ergonomics, etc. It holds also implications for legislators and standardizers, who are used to look at the same reality from different angles and with different terminologies.

Last but not least, these new developments touch different user groups as well. Not only people at work are concerned by these developments but also athletes in training or competition, elderly people who need assistance and health monitoring, hospital patients etc. It means that we will have to keep an open mind to bring in all necessary expertise in order to achieve optimal solutions for all these user groups. Events like this congress are a good opportunity to serve as a forum for broad interaction.

You will also have noticed that we tend to come back to Bruges, when we organise a conference on protective clothing as we did in 2008. This serves a purpose, since this beautiful city creates for most people an out-of-time sensation and probably this is what we need to get a maximum result from what we hear and see at a conference.

Ladies and gentlemen, enjoy the conference, enjoy the networking with your colleagues, enjoy Bruges!

Jan Laperre, general manager Centexbel

Programme

6th European Conference on Protective Clothing

Safe, Smart, Sustainable... New pathways for protective clothing

Wednesday 14/05/2014

- 13:30 Opening
- 14:00 Opening lecture
- 14:30 Session 1: Thermal comfort
- 15:30 Break
- 16:00 Session 2: Innovation
- 17:30 Oral poster presentation - session 1 (poster 1 – 13)
- 18:30 ESPC General meeting

Thursday 15/05/2014

- 9:00 Session 3: Comfort
- 10:15 Break
- 11:00 Session 4: Innovation
- 12:30 Lunch
- 13:30 Session 5: Ergonomics & Comfort
- 15:00 Break
- 15:30 Session 6: Comfort
- 17:00 Oral poster presentation - session 2 (poster 14 – 26)
- 18:30 Reception at Bruges town hall
- 20:00 Conference dinner at conference hotel

Friday 16/05/2014

- 9:00 Session 7: Comfort
- 10:15 Break
- 10:45 Session 8: Sustainability - Standardisation & New Test Method
- 12:30 ESPC Award ceremony & Closing remarks
- 12:45 Closing & Lunch

6th European Conference on Protective Clothing

Safe, Smart, Sustainable... New pathways for protective clothing

Wednesday 14/05/2014

1. Opening by *Jan Laperre, director general Centexbel (BE)*
2. Opening lecture: Thermal stress at work and protective clothing, *Jacques Malchaire, UCL (BE)*

Session 1 THERMAL COMFORT - Chairperson : René ROSSI

3. Thermo-physiological impact of protective clothing for fire fighters, *Simon Annaheim, Empa (CH)*
4. Prediction of head sweat rates for assessing the thermal comfort of bicycle helmets, *Peter Bröde, IfADo (DE)*
5. Insulation of traditional Indian clothing: Estimation of climate change impact on productivity from PHS (predicted heat strain) model, *Kalev Kuklane, Lund University (SE)*
6. Requirements for cold protective clothing at arctic open-pit mines, *Kirsi Jussila, FIOH (FI)*

Session 2 INNOVATION - Chairperson: Helena MÄKINEN

7. Intelligent firefighter suit with real-time monitoring system, *Miklos Kozlovsky, Obuda University (HU)*
8. Development and evaluation of a cooling vest for firefighters, *Dominic Tessier, CTT GROUP (CA)*
9. Use of sports underwear under heat protective clothing: determination of critical heat transfer, *René Rossi, Empa (CH)*
10. Actual slip resistance of shoes worn by visitors of a national exhibition - Gilla Jobbet, *Chuansi Gao, Lund University (SE)*
11. An investigation of temperature and industrial contaminant on mechanical and physico-chemical properties of butyl rubber, *Phuong Nguyen-Tri, ÉTS (CA)*
12. Rupture mechanisms and mechanics of protective glove materials under combined puncture and cutting, *Ennouri Triki, ÉTS (CA)*

Thursday 15/05/2014

Session 3 COMFORT - Chairperson: Kalev KUKLANE

13. A numerical simulation study on the thermal performance of ventilated clothes, *Soraia F. Neves, Nanolayer Coating Technologies (PT)*
14. Effect of cycling pads on total body sweat production and local thermal responses at the perineum, *Guy De Bruyne, University of Antwerp (BE)*
15. Efficacy of ventilation vest or resting in a cool space for reducing heat strain while wearing a ballistic vest, *Sirkka Rissanen, FIOH (FI)*
16. Development of the combat sleeping bag system of the Latvian National Armed Forces, *Igors Sitvjenkins, Latvian National Armed Forces (LV)*
17. Effect of the fiber properties on the performance of PPE for high thermal strain, *Edith Classen, Hohenstein Institut für Textilinnovation (DE)*

Session 4 INNOVATION - Chairperson: Helmut EICHINGER

18. Smart@Fire/Enprotex, *Tommy Verminck, Federal Public Service (BE)*
19. Revolutionizing the modern firefighter turnout suit, *Roger Barker, North Carolina State University (US)*
20. PPE against Laser and UV-radiation: requirements and measurement procedure, *Dirk Wenzel, STFI (DE)*
21. Relationship between air gap and clothing protective performance upon hot liquid spray, *Yehu Lu, Soochow University (CN)*
22. Flame-retardant clothing and industrial washing: solutions for combining both, *Stefan Feys, Utexbel (BE)*
23. Multi-garment solution approach for arc protection for jobs with different hazard levels, by which an optimal combination of protection and comfort can be achieved, *Jean-Claude Duart, DuPont (CH)*

Session 5 ERGONOMICS & COMFORT - Chairperson: Peter HEFFELS

24. An anthropometric shape model as a design tool for sport helmets, *Daniël Lacko, University of Antwerp (BE)*
25. Development of functional pressure ulcer preventive garments, *Maria Suong Tjønnås, SINTEF (NO)*
26. A survey on sailing-related injuries and usage of personal protective equipment (PPE), *JuYoun Kwon, UNIST (KR)*
27. Effects of personal protective equipment on wearer's balance ability and range of motion, *Su-Young Son, Kyushu University (JP)*
28. Physiological burden on a CBRN decontamination unit in a crisis management system exercise, *Ronald Heus, Institute for Safety (NL)*
29. Modeling assessment of human immersion and submersion in cold water, *Irena Yermakova, International Centre for Information Technologies (UA)*

Session 6 COMFORT - Chairperson: Grażyna BARTKOWIAK

30. Determination of 'wet' thermal insulation of fabrics on a guarded hotplate: effects of moisture content and air gap size, *Guowen Song, University of Alberta (CA)*
31. Evaluating Total Heat Loss (THL) as a predictor heat stress in wildland firefighter clothing, *Shawn Deaton, North Carolina State University (US)*
32. Workwear for molten metal protection, *Bengi Kutlu, Dokuz Eylül University (TR)*
33. Development of a public tool and database for validation of physiological models and adaptive manikins, *Agnes Psikuta, Empa (CH)*
34. A numerical analysis on the transport phenomena across horizontal clothing microclimates, *Tiago Sotto Mayor, Empa (CH)*
35. Cold protective clothing and protection for mineworkers in the Barents region – a field study at the open-pit mine at Stjernøya, Norway, *Hilde Færevik, SINTEF (NO)*

Friday 16/05/2014

Session 7 COMFORT - Chairperson: Roger BARKER

36. Active cooling garment intended for use in a hot environment, *Grażyna Bartkowiak, CIOP-PIB (PL)*
37. Short term heat acclimation. How does it affect thermal and perceptual responses during exercise wearing personal protective garments? *Aitor Coca, NIOSH (US)*
38. Towards virtual engineering of protective clothing comfort, *Peter Van Ransbeeck, University College Gent (BE)*
39. A novel CBRN PPE concept: scalable protection and thermal strain, *Niels Bogerd, TNO (NL)*
40. Evaluation of physiological response of turnout gear wearer using a new heat absorption system based on phase change material, *Chantal Gauvin, IRSST (CA)*

Session 8 SUSTAINABILITY - STANDARDISATION & NEW TEST METHOD - Chairperson: Fred FOUBERT

41. Comparison of measurements on Hexagon device to benchscale tests for firefighter clothing, *Martin Camenzind, Empa (CH)*
42. Measuring dermal exposure to textiles – refinement of model estimations, *Lieve Geerts, VITO (BE)*
43. Washing as pretreatment simulating ageing of high-visibility fluorescent materials, *Erja Tammela, FIOH (FI)*
44. A study of alternative ageing methods of welder's protective clothing, *Helena Mäkinen, FIOH (FI)*
45. Protective clothing against cold – Why is it so difficult to write a new standard? *Jean Léonard, Centexbel (BE)*
46. Challenges for European standardisation of protective clothing, *Peter Heffels, BG Bau (DE)*
47. Personal Protective Systems: the role of standardisation, *Henk Vanhoutte, ESF (BE)*
48. ESPC Award Ceremony & Closing Remarks, *Fred Foubert, Centexbel (BE)*

<p>LATVIAN NATIONAL ARMED FORCES</p> <p><i>Main task is to ensure the inviolability of the State territory, territorial waters and airspace, participate in international military operations, ensure NAF and reserve personnel training and participate in operations to avert national threat situations</i></p>	<p>Vienibas alley 56 LV-1004, Riga Republic of Latvia</p> <p>+37167601217 lcod@mil.lv www.mil.lv</p>	
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Development of the combat sleeping bag system of the Latvian National Armed Forces

Igors Sitvjenkins, Kalev Kuklane, Ausma Vilumsons, Iveta Abele

Latvian National Armed forces (LNAF) in cooperation with Lund University, Sweden and Riga Technical University, Latvia has developed the combat sleeping bag system (CSBS) of the LNAF under the Soldier System platform (SSP) 2009 – 2013 modernization program.

Protection from the cold and thermal infrared surveillance during the low level metabolic heat rate of sleeping (40 W/m^2) is the key aspect of the survivability of the soldier in combat and training operation to maintain task fulfilled. Three level CSBS were evaluated in conjunction with eleven combinations of the combat dress uniform system (CDU) of the LNAF Combat individual protection system (CIPS). There is no existing standard for the requirements of the combat sleeping bags.

The evaluation was done under the modified civil standard EN 13537:2002 “Requirements for sleeping bags” in the climatic chamber of the Lund University. LNAF had special needs of the location of the mannequin according to the operation using and possible location of the soldier inside sleeping bag, closing mode of the sleeping bag, as well as area of the sleeping bag contact points to the ground during the combat and training.

Parallel calculation method was used and the values were corrected for standard. CSBS providing protection comply with the requirements of NATO AECTP-230 “Climatic conditions” cold climate categories C0, C1, representing actual climatic condition of the Republic of Latvia, as well as ISAF operation region.

The following range of the quality was established during evaluation – lowest level $I_{\text{tot, parallel}}=0.824 \text{ m}^2\text{K/W}$, $I_{\text{tot, serial}}=0.881 \text{ m}^2\text{K/W}$, $I_{\text{tot, standard}}=0.758 \text{ m}^2\text{K/W}$, comfort temperature 8.8°C , limit temperature 4.4°C , extreme temperature – 9°C ; highest level $I_{\text{tot, parallel}}=1.612 \text{ m}^2\text{K/W}$, $I_{\text{tot, serial}}=1.819 \text{ m}^2\text{K/W}$, $I_{\text{tot, standard}}=1.383 \text{ m}^2\text{K/W}$, comfort temperature – 10.5°C , limit temperature – 18.1°C , extreme temperature – 40.2°C . Increasing number of layers doesn't provide adequate increase of the thermal insulation, due to compressing of the layers and decreasing amount of the static air.

Physiological model for calculation of extreme temperature of the standard EN 13537:2002 “Requirements for the sleeping bags” utilizes 25 years old female with weight of 60 kg, height of 1.60 m, and body area of 1.62 m^2 . LNAF average soldier's corresponding parameters are male, 24 years old, weight 81 kg, height 1.81 m and body area 2.0 m^2 . Difference between physiological model of the standard EN 13537:2002 and LNAF soldier should be evaluated during the field trial under the life weather condition.

The high level of the CSBS protection against thermal infrared surveillance was defined during the field evaluation. There is no any standard defines requirements of the thermal infrared protection level. Difference in ergonomic models and customizing of the thermal infrared protection evaluation making limitation of the logistics system in order to provide ability of making open tenders.