

Protect what gives PROTECTION

10–12 May 2021 | Online-Conference | Hosted by Hohenstein

9th European
Conference
on Protective
Clothing



Programme

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SESSION 1

OPENING SESSION

11:00 - 11:10	Opening Jan Beringer Hohenstein, Germany
11:10 - 11:20	Welcome Stefan Mecheels Hohenstein, Germany
11:20 - 12:00	PPE in challenging times: lessons (to be) learned Henk Vanhoutte ¹ , Jan Vincent Jordan ² ¹ European Safety Federation ivzw, Belgium ² ITA RWTH Aachen, Germany
12:00 - 12:10	Discussion

PARALLEL SESSIONS 2 & 3

SESSION 2

SMART TEXTILES

12:15 - 12:45	Smart Textiles for professional use – use cases, potential and risks Manuela Bräuning, Hochschule Sigmaringen-Albstadt, Germany
12:45 - 13:00	Evaluation of mental load due to a use of smart protective clothing with warning signalization Anna Dąbrowska, Łukasz Kapica Central Institute for Labour Protection National Research Institute, Poland
13:00 - 13:15	Smart clothing for surfing G. Santos ¹ , R. Marques ¹ , S. Mateus ¹ , P. Ferreira ² , R. Graça ³ ¹ CITEVE - Technological Centre for the Textile and Clothing Industries of Portugal, V. N. Famalicão, Portugal ² DAMEL - Confecção de Vestuário Lda., Póvoa de Varzim, Portugal ³ Fraunhofer Portugal AICOS, Portugal
13:15 - 13:30	European User Survey on smart PPE for Firefighters Rahel Krause, Thomas Gries. Kalev Kuklane, Maurice Kemmeren ITA RWTH Aachen, Germany
13:30 - 13:40	Discussion

SESSION 3

FIT OF PPE AND TESTING

12:15 - 12:30	Using 3D/4D technology to investigate workwear fit in motion Anke Klepser, Angela Mahr-Erhardt, Simone Morlock Hohenstein, Germany
12:30 - 12:45	Investigation of design, comfort, and mobility issues for female firefighter PPC Cassandra Kwon ¹ , Meredith McQuerry ² ¹ Textile Protection and Comfort Center, North Carolina State University, Raleigh, NC, USA ² Flordia State University, USA
12:45 - 13:15	How STANDARD 100 by OEKO-TEX® brings additional safety for PPE Dominik Kinschel OEKO-TEX®, Switzerland
13:15 - 13:30	Discussion

PARALLEL SESSIONS 4 & 5

SESSION 4

PROTECTION
AGAINST MECHANICAL FORCES

- 14:00 - 14:30

Functional clothing for protection against puncture
G. Santos¹, R. Marques¹, M. Pinto², F. Pinheiro³, P. Ferreira⁴
¹CITEVE - Technological Centre for the Textile and Clothing Industries of Portugal, V. N. Famalicão, Portugal | ²LEMAR - Leandro Magalhães de Araújo (Filhos), Lda., Portugal | ³Oldtrading – OLDTRADING, Lda., V. N. Famalicão, Portugal | ⁴DAMEL - Confecção de Vestuário Lda., Portugal
- 14:30 - 14:45

New material combinations for stab- and bullet-proof safety vests
Lars Wollert, Lennart Jacobsen, Thomas Gries
ITA RWTH Aachen, Germany
- 14:45 - 15:00

Advanced fiber technology for cut and heat protective suits
Olivier Noth, DuPont Specialty Products Operations Sàrl, Switzerland
- 15:00 - 15:10

Discussion

SESSION 5

PROTECTION
AGAINST COLD

- 14:00 - 14:30

Standardisation work as a driver for new products and knowledge in occupational cold work
Hilde Færevik, Sandsund M., Wiggen Ø., Renberg J. Storholmen TC. and Næsgaard OP
Sintef Digital Health Research, Norway
- 14:30 - 14:45

Evaluation of cold protective clothing using a human thermoregulatory model
Xu Xionjing
US Army Research Institute of Environmental Medicine Biophysics/ Biomedical Modeling Division Natick, USA
- 14:45 - 15:00

Predicting regional thermal and evaporative resistances of military cold weather clothing ensemble
Timothy P. Rioux, Julio A. Gonzalez, Anthony J. Karis, Adam W. Potter, Xiaojiang Xu
US Army Research Institute of Environmental Medicine Biophysics/ Biomedical Modeling Division Natick, USA
- 15:00 - 15:10

Discussion

PARALLEL SESSIONS 6 & 7

SESSION 6

COMFORT OF PPE AND
PPE AGAINST DIFFERENT APPLICATIONS

- 15:15 - 15:30

Correct colour measurement on high visibility clothing
Binder, Manfred
x-rite GmbH, Germany
- 15:30 - 15:45

Intelligent multi-risk PPE for energy and ICT workers
A. Barros¹, S. Rodrigues¹, G. Santos¹, I. Silva², I. Sá², P. Abreu², J. Pimenta², S. Bogas², S. Reis², A. Pinto², M. Pinto³, R. Carvalho³, J. Sousa⁴, G. Silva ⁴, P. Soeiro⁴
¹CITEVE - Technological Centre for the Textile and Clothing Industries of Portugal, Portugal | ² CeNTI - Centre of Nanotechnology and Smart Materials, Portugal | ³ Scorecode Têxteis SA (SCOOP), Portugal | ⁴ VIATEL – Tecnologia de Comunicações S.A., Portugal
- 15:45 - 16:00

Protective clothing material for working with handheld ultra-high pressure water jet guns
Yvette Dietzel
Sächsische Textilforschungsinstitut (STFI), Germany
- 16:00 - 16:15

Impact of surrogate fluids‘ surface tension on the barrier performance of protective clothing
F. Selcen Kilinc-Balci, Ph.D.
HHS/Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health (NIOSH), National Personal Protective Technology Laboratory (NPPTL), USA
- 16:15 - 16:30

A novel method to evaluate the protection by garments against electric arc
Hichem Hassaine, Jean Leonard
CENTEXBEL, Belgium
- 16:30 - 16:45

Game-changing technology for firefighter protective hoods
Noth Olivier
DuPont Specialty Products Operations Sàrl , Switzerland
- 16:45 - 17:00

Discussion

MONDAY 10 MAY 2021

PARALLEL SESSIONS 6 & 7

SESSION 7

COMFORT OF PPE AND
PPE AGAINST DIFFERENT APPLICATIONS

15:15 - 15:45	Body mapping of physiological and perceptual responses for informing clothing design George Havenith Loughborough Design School, Loughborough University, UK
15:45 - 16:00	Development and evaluation of wearing suit based on muscle activity analysis in repetitive lifting exercise Nam Yim Kim, Gin Ah Park Dept. of Clothing & Textiles, Changwon National University, Korea
16:00 - 16:15	Thermophysiological comfort of personal protective equipment Bianca-Michaela Wölfling Hohenstein, Germany
16:15 - 16:30	Innovative lead-free medical X-ray protective apparel G. Santos ¹ , R. Marques ¹ , S. Mateus ¹ , T. V. Pinto ² , P. S. F. Ramalho ³ , O. S. G. P. Soares ³ , C. Freire ² , C. Pereira ² , M. F. R. Pereira ³ , I. Ribeiro ⁴ , M. Pinto ⁵ ¹ CITEVE, Portugal ² REQUIMTE/ LAQV, Departamento de Química e Bioquímica, Universidade do Porto, Portugal ³ Laboratório Associado LSRE-LCM, Universidade do Porto, Portugal

	⁴ POSSIBLE ANSWER S.A., Guimarães, Portugal ⁵ EMAR – Leandro Magalhães de Araújo (Filhos), Lda., Portugal
16:30 -16:45	Innovative high-visibility textiles G. Santos ¹ , R. Marques ¹ , S. Silva ² , J. Oliveira ² , P. Castro ³ , C. Pereira ⁴ , S. Cunha ⁵ , M. Pinheiro ⁶ ¹ CITEVE - Technological Centre for the Textile and Clothing Industries of Portugal, V. N. Famalicão, Portugal ² CeNTI - Centre for Nanotechnology and Smart Materials, V. N. Famalicão, Portugal ³ A. Sampaio & Filhos - Têxteis S. A., Portugal ⁴ Pafil Confeções, Lda, Portugal ⁵ Têxtil António Falcão, S. A., Portugal ⁶ TINAMAR – Tinturaria Têxtil, S. A., Portugal
16:45 - 17:00	Discussion

TUESDAY 11 MAY 2021

PARALLEL SESSIONS 8 & 9

SESSION 8

PPE WITH COOLING AND TESTING

10:00 - 10:15	Climate neutral cooling material for protective clothing Thomas Keiser, Gabriele Renner Pervormance international GMBH, Germany
10:15 - 10:30	Cooling protective clothing utilizing water evaporative Tomonori Sakoi, Satoru Nagasawa, Yosuke Horiba, Shin-ichi Sawada, Chuansi Gao, Satoru Iizuka Shinshu University, Japan
10:30 - 10:45	Physiological and subjective responses during fire training Kalev Kuklane, Maurice Kemmeren, Lyda Kistemaker, Ronald Heus Institute for Safety (IFV), The Netherlands
10:45 - 11:00	New SUCAM of smart garments for protection against heat and flame Kalev Kuklane Institute for Safety (IFV), The Netherlands
11:00 - 11:15	Discussion

PARALLEL SESSIONS 8 & 9

SESSION 9

FIRE FIGHTERS – STANDARDIZATION AND HEALTH ASPECTS

10:00 - 10:30 Heat and flame PPE standards, cancer and health issues!
Dave G. Matthews
Fire & Industrial PPE, Safety Services Ltd, Norfolk UK

10:30 - 10:45 Health risks and health effects of firefighter work: Exposures, diseases and preventive measures
Mariann Sandsund¹, Karolina Storesund², Raymond Olsen³, Ragni F. Mikalsen², Hilde Færevik¹, Julie Renberg¹, Edvard Aamodt², Kristina Kjærheim⁴
¹ SINTEF Digital, Health Research, Norway | ² RISE Fire Research, Norway | ³ National Institute of Occupational Health (STAMI), Norway | ⁴ Cancer Registry of Norway (CRN), Norway

10:45 - 11:00 Development of Toxicologically-Relevant Performance Requirements for Vapor-Protective Ensembles Evaluated via the Man-In-Simulant-Test (MIST)
R. Bryan Ormond
Textile Protection and Comfort Center, NC State University, USA

11:00 - 11:15 Discussion

SESSION 10

POSTER SESSION AND HOHENSTEIN

11:40-13:00

Development of a methodology to assess comfort and thermal tolerance of children exercising at sub-zero temperatures
L. A. Arlegui¹, J. W. Smallcombe¹, D. Fournet², K. Tolfrey³, G. Havenith¹
¹ Environmental Ergonomics Research Centre, Loughborough University, UK | ² Decathlon SportsLab, France | ³ School of Sport, Exercise and Health Sciences, Loughborough University, UK

Requirements for benchmarking the ergonomics of PPE systems
Peter Bröde¹, Kalev Kuklane², George Havenith³
¹ Leibniz Research Centre for Working Environment and Human Factors (IfADo), Germany | ² Institute for Safety (IFV), The Netherlands | ³ Environmental Ergonomics Research Centre, Loughborough University, Uk

TECHNOPHOS PNR-Powder - Innovative & multi-purpose flame retardant powder
Rule Niederstadt
Ecoatech GmbH, Germany

Particle penetration in firefighter clothing – a pilot study
Mariann Sandsund¹, Karolina Storesund², Tore Christian Storholmen¹, Ragni Fjellgaard Mikalsen²
¹ SINTEF Digital, Health Research, Norway | ² RISE Fire Research, Norway

Uruguay - polo shirt NOMEX® Comfort
Christian Schuster, Olivier Noth
Fuchshuber Techno-TEX GmbH, Germany, DuPont Speciality Products Operations Sarl, Switzerland

Hand and forearm cooling: exploring deep-body cooling in hyperthermic individuals
Seon-Hong Seol, Gyu-Tae Bae, Nigel A.S. Taylor and Joo-Young Lee Seoul National University, South Korea
Seoul National University, South Korea

Self-healing systems in polymeric materials
Agnieszka Adamus-Wlodarczyk, Emilia Irzmaska
Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Department of Personal Protective Equipment, Poland

Effects of air velocity on the thermal insulation of padded winter jackets
Yoon Jeong Baek & Joo-Young Lee
Seoul National University, Korea

SESSION 10

POSTER SESSION AND HOHENSTEIN

<p>Functional development materials of polymerprotective gloves: a biometric perspective Emilia Irzmaska¹,Agnieszka Adamus-Wlodarczyk¹, Łukasz Kaczmarek² ¹Central Institute for Labour Protection – National Research Institute (CIOP-PIB), Department of Personal Protective Equipment, Poland ²Technical University of Lodz Institute of Materials Science and Engineering, Poland</p>
<p>Inhalation resistance of face masks with different filtration efficiencies and designs at various flow rates and moisture saturation Joo-Young Lee, Jae-Yeon Jung South Korea Seoul National University, South Korea</p>
<p>Functionalization with mineral fibers of the cut resistant materials – a biometric perspective Paulina Kropidłowska¹, Emilia Irzmanska¹, Jacek Sawicki² ¹Central Institute for Labour Protection - National Research Institute (CIOP-PIB), Department of Personal Protective Equipment, Poland ²Technical Unz Institute of Materials Science and Engineering, University of Technology, Poland</p>

<p>Thermal insulation characteristics of NBC protective clothing Kamila Lunerova, Jan Pokorny, Robert Toma, Jan Fišer, Barbora Kopeckova, Michal Masin, Lukas Kralik National Institute for NBC Protec Ctizoench, Czechia</p>
<p>Re-usable face mask Nomex® Nano Flex, 3-layer Christian Schuster Fuchshuber Techno-Text GmbH, Germany</p>
<p>Balaclava - double layer for firefighters made of Nomex®Comfort with Nomex®Nanoflex Christian Schuster Fuchshuber Techno-Text GmbH, Germany</p>
<p>Teijin Active Cooling Vest Christian Norhausen TEIJIN LIMITED / TEIJIN ARAMID B.V., The Netherlands</p>
<p>Discussion</p>
<p>13:00-13:40</p>
<p>Personal Protective Equipment - Tests and Certifications for Extreme Requirements - including discussion Christof Madinger Hohenstein, Germany</p>

PARALLEL SESSIONS 11 & 12

SESSION 11

INNOVATIVE MATERIAL DEVELOPMENTS

<p>13:50 - 14:05 Project future hero Steffen Lüdemann, Ludger Budde, Thomas Seifert, Oliver Dorn Peppermint AMCC GmbH, Germany</p>
<p>14:05 - 14:20 Chemical protection properties of thermal workwear fabrics by repellent finishes enhanced by plasma treatment Dilara Sevindik¹, Bengi Kutlu^{1,2} ¹Dokuz Eylül University, Graduate School of Natural and Applied Sciences, Occupational Health and Safety Department ²Dokuz Eylül University, Engineering Faculty, Textile Engineering Department, Turkey</p>
<p>14:20 - 14:35 Opportunities and challenges in the use of graphene for PPE Sebastian Plebst, Thomas J. S. Schubert IOLITEC -Ionic liquids technologies, Germany</p>

<p>14:35 - 14:50 Functionalization of cotton fabric through coating of reduced graphene oxide and diffused nanoparticles using silane coupling agent Shovon Bhattacharjee¹, Chandini Raina Macintyre¹, Xinyue Wen², Prateek Bahl³, Uttam Kumar², Abrar Ahmed Chughtai⁴, Rakesh Joshi³, ¹Biosecurity Program, Kirby Institute, University of New South Wales, Australia ²SMaRT Centre, School of Materials Science and Engineering, University of New South Wales, Australia ³School of Mechanical & Manufacturing Engineering, University of New South Wales, Australia ⁴School of Public Health and Community Medicine, University of New South Wales, Australia</p>
<p>14:50 - 15:05 PVB/IF-WS₂ system for impregnation of polyester knitwear Aleksandra Samolov, Danica Simić Military Technical Institute, Serbia</p>
<p>15:05 - 15:20 Nomex® Nano Flex Laminates by ALPEX® Protection Laurent Cogez Alpex, France</p>

PARALLEL SESSIONS 11 & 12

SESSION 11

INNOVATIVE MATERIAL DEVELOPMENTS

15:35 - 15:50	Fluid leakage through glove and coverall interface F. Selcen Kilinc-Balci, Ph.D. HHS/Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health (NIOSH), National Personal Protective Technology Laboratory (NPPTL), USA
15:50 - 16:00	Discussion

SESSION 12

CLEANING AND HEAT COMFORT OF PPE FOR FIRE FIGHTERS

13:50 - 14:20	A broader understanding and implications for cleaning effectiveness of fire fighter protective clothing Jeffrey O. Stull International Personnel Protection, USA
14:20 -14:30	Discussion
14:30 - 15:00	Thermal degradation of fabrics exposed to radiant heat: A molecular scale study Anjani K. Maurya ^{1,2,4} , Sumit Mandal ¹ , Dean E. Wheeldon ¹ , Michel Schmid ¹ , Simon Annaheim ¹ , Martin Camenzind ¹ , Alex Dommann ^{2,4} , Antonia Neels ² , Amin Sadeghpour ^{1,2,3} , René M. Rossi ¹ ¹ Empa, Swiss Federal Laboratories for Materials Science and Technology, Laboratory for Biomimetic membranes and Textiles, Switzerland ² Empa, Swiss Federal Laboratories for Materials Science and Technology, Center for X-Ray Analytics, Switzerland ³ Empa, Swiss Federal Laboratories for Materials Science and Technology, Laboratory of Biointerfaces, Switzerland ⁴ Cellular and Biomedical Sciences, Faculty of Medicine, University of Bern, Switzerland

PARALLEL SESSIONS 11 & 12

SESSION 12

CLEANING AND HEAT COMFORT OF PPE FOR FIRE FIGHTERS

15:00 - 15:15	Considering the effect of liquid accumulation on heat transfer within a clothing stack Timofey Golubev ¹ , Mark Hepokoski ¹ , Scott Peck ¹ , Shailesh Gupta ² , Kevin Ward ² , Joel Coffel ² ¹ ThermoAnalytics, Inc., Calumet, MI, USA ² W. L. Gore & Associates, USA
15:15 - 15:30	Modeling of hot water and steam protective performance of fabrics used in firefighters’ clothing Sumit Mandal ¹ , Jane Batcheller ² , Guowen Song ³ , Indu Bala Grover ⁴ ¹ Department of Design, Housing, and Merchandising, Oklahoma State University, USA ² Department of Human Ecology, University of Alberta, Canada ³ Department of Apparel, Events, and Hospitality Management, Iowa State University, USA ⁴ Department of Computer Engineering, YMCA Institute of Engineering, Faridabad, India
15:30 - 15:45	CFD analysis of convective heat transfer coefficients of the hand Mengying Zhang ^{1, 2} , Rui Li ¹ , Jun Li ^{2,3} , Yulin Wu ¹ , Liwen Wang , James Lang ¹ , Guowen Song ¹ ¹ Iowa State University, Ames, Iowa, 50010, USA ² College of Fashion and Design, Donghua University, China ³ Key Laboratory of Clothing Design and Technology, Donghua University, Ministry of Education, China
15:45 - 16:00	Discussion

PARALLEL SESSIONS 13 & 14

SESSION 13

STANDARDIZATION AND HEAT AND MOISTURE TRANSPORT THROUGH MATERIALS

10:00 - 10:30	Latest developments and key challenges in standardization in CEN and ISO Eric v. Wely Protection Technology DuPont, Switzerland
10:30 - 10:45	Liquid moisture transport in textile packages M. Matusiak, D. Kamińska, O. Sukhbat Institute of Architecture of Textiles, Faculty of Material Technologies and Textile Design, Lodz University of Technology, Poland
10:45 - 11:00	Heat radiation protection of operator’s protective clothing Ronald Heus ¹ , Kalev Kuklane ¹ , Douwe Mol ² , Boris Kingma ² Presenter: Kalev Kuklane ¹ , Institute for Safety, The Netherlands ² TNO, The Netherlands
11:00 - 11:15	Clothing air gaps in various postures for firefighters at work Agnes Psikuta, Fawzy Sherif, Emel Mert, Sumit Mandal, Simon Annaheim Empa, Laboratory for Biomimetic Membranes and Textiles, Switzerland
11:15 - 11:30	Discussion

SESSION 14

FIRE FIGHTERS – NEW DEVELOPMENTS

10:00 - 10:30	Development on thermal insulation evaluation technique on firefighter clothing with 3D fabric structure Kaoru Wakatsuki, Jun Sakata, Kousuke Sashide, Norimichi Watanabe, Hideaki Morikawa Shinshu University, Japan
10:30 - 10:45	Making high temperature phase change materials functionable in FCPs André Fonseca, S. F. Neves, J. B. L. M. Campos CEFT center Engineering Faculty of Porto University, Portugal
10:45 - 11:00	Novel halogen free flame retardants for textiles and PSA Thomas Mayer-Gall, Wael Ali, Klaus Opwis, Torsten Textor, Jochen S. Gutmann Deutsches Textilinstitut Nord-West (DTNW), Germany
11:00 - 11:15	New finishing technology for durable FR Performance Rule Niederstadt Ecoatech GmbH, Germany
11:15 - 11:30	Discussion

PARALLEL SESSIONS 15 & 16

SESSION 15

MEDICAL APPLICATION

11:40 - 12:10	Medical face masks, protective gowns and antiviral fabrics – basic requirements and pragmatic testing approaches Timo Hammer Hohenstein, Germany
12:10 - 12:25	Flame retardant face coverings in time of social distancing Olivier Noth DuPont Specialty Products Operations Sàrl, Switzerland
12:25 - 12:40	Atopic dermatitis and superfine merino wool Hilde Færevik, Mariann Sandsund, Nina Vanvik Hansen SINTEF Digital, Health Research, Norway
12:40 - 12:50	Discussion

SESSION 16

FIRE FIGHTERS – FIRE MATERIAL TESTING

11:40 - 12:10	Development and validation of a bench-scale flash fire materials tester Richard Burke ¹ , Joshua Ingram ² ¹ Thermetrics LLC ² PBI Performance Products USA
12:10 - 12:25	Round robin ISO13506: comparison of sensor technologies for manikin flash fire testing Martin A. Camenzind ¹ , Gary Proulx ² , Margaret Auerbach ² , Roger Parry ³ , René M. Rossi ¹ ¹ Laboratory for Biomimetic Membranes and Textiles, Empa, Swiss Federal Laboratories for Materials Science and Technology, Switzerland ² U.S. Army Natick Soldier Research, Development and Engineering Center, USA ³ DuPont Protection Solutions, USA
12:25 - 12:40	System-level assessment of protective hoods for thermal protection, thermal burden, and particulate protection R. Bryan Ormond, Nigel Carlton, Madilynn Smith, Arash Kasebi North Carolina State University, USA
12:40 - 12:50	Discussion

WEDNESDAY 12 MAY 2021

SESSION 17

CLOSING SESSION

13:00 - 13:10 Summary of the presentations of the
9th ECPC
Edith Classen
Hohenstein, Germany

13:10 - 13:50 From challenges to opportunities:
next steps
Henk Vonhaupte¹, Jan Vincent Jordan ²
¹ European Safety Federation ivzw,
Belgium
² ITA RWTH Aachen, Germany

13:50 - 14:00 Next 10th ECPC
Kalev Kuklane
President of the European Society for
Protective Clothing ESPC,
The Netherlands

THE END OF THE 9TH ECPC