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Smernice za izbiro, uporabo, nego in vzdrževanje pametnih oblačil, ki varujejo pred učinki toplote in ognja

Guidelines for selection, use, care and maintenance of smart garments protecting against heat and flame

Leitfaden für Auswahl, Gebrauch, Pflege und Instandhaltung von smarter Schutzkleidung gegen Hitze und Flammen

Lignes directrices relatives à la sélection, l'utilisation, l'entretien et la maintenance des vêtements intelligents contre la chaleur et la flamme

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Leitfaden für Auswahl, Gebrauch, Pflege und Instandhaltung von smarter Schutzkleidung gegen Hitze und Flammen

This Technical Report was approved by CEN on 12 March 2021. It has been drawn up by the Technical Committee CEN/TC 162.

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European foreword

This document (CEN/TR 17620:2021) has been prepared by Technical Committee CEN/TC 162 “Protective clothing including hand and arm protection and lifejackets”, the secretariat of which is held by NBN.

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This document has been prepared under mandate M/553 given to CEN by the European Commission and the European Free Trade Association.

Introduction

For manufacturers and users of personal protective equipment (PPE) the following European Regulation and Directive are important:

— Regulation (EU) 2016/425 of the European Council of 9th March 2016 on personal protective equipment;

— Directive 89/656/EEC on use of personal protective equipment.

Regulation (EU) 2016/425 indicates that in order to place PPE on the market it shall meet essential health and safety requirements, and not necessarily the various relevant EN or EN ISO standards. Nevertheless, nearly all PPE meet the essential requirements through standards, as harmonized standards give presumption of conformity with the requirements of the regulation. This is the reason why we will spend some time explaining certain standards and what information they provide on smart garments protecting against heat and flame.

The interest in and the use of smart or electronic solutions in professional garments increases exponentially. Individual smart (intelligent) solutions integrated into garments have a large variety of functions, e.g. improving protection against various risks, in-built communication systems etc., but also drawbacks, e.g. connection cables acting as heat transfer medium, risks of a protective system failure due to damage in a component, data security risks during communication, etc. The smart equipment that employ a variety of physical functions and response effects integrated into garments allow reduction of workplace risks. Requirements and test methods should, as far as possible, be representative of the risks posed to the user under the foreseeable conditions.

The reader should be aware that for most PPE intended for use in a place of work, national and union legislation towards ensuring the safety of employees applies. When one mentions PPE, it is essential that it meets the requirements of Regulation (EU) 2016/425. Based on the above mentioned regulation and directive, the national legislations may postulate that if the employer fails to provide suitable PPE then it may be considered as a criminal offence, and an employee suffering foreseeable injury may trigger liability. Conversely, if the employee, after proper training and instructions, fails to wear the suitable PPE, the employee may also be prosecuted and/or dismissed and if injured or suffering disease in consequence may lose right to all or certain part of the reimbursement for damages.

For non-textile elements containing active medical devices, radio and electrical operated components, which might be integrated in the finished advanced garments or ensembles of garments that provide protection against heat and flame, the relevant Union legislation may apply, notably with Directive 2007/47/EC of the European Parliament and of the Council, Directive 2011/65/EU of the European Parliament and of the Council, Directive 2014/30/EU of the European Parliament and of the Council, Directive 2014/35/EU of the European Parliament and of the Council and Directive 2014/53/EU of the European Parliament and of the Council.

The provisions of other legal acts are also applicable to advanced garments and ensembles of garments that provide protection against heat and flame, notably Directive 2014/34/EU of the European Parliament and of the Council.

The information in this document has been produced to assist users, employers and purchasers (or the person advising the users, employers and/or purchasers) in making the necessary decisions regarding the selection, use, care and maintenance of protective clothing, for employees exposed to risks related to heat and flame (e.g. industrial welding, fire-fighting, first response). This information may also be of interest to manufacturers for designing their products and resellers to identify the products their clients need.

This guideline will furthermore be a basis for those who are committed to the development and conformity assessment of novel PPE for protection from heat and flame, hence including research and technology organizations (RTOs), notified bodies and other third parties that support activities in development and conformity assessment. Further groups of stakeholders involved in the life cycle of smart PPE against heat and flame include textile service providers (leasing and washing) as well as companies providing the labelling of smart PPE (care instructions).

The purpose of this document is to establish a guidance document for smart garments for protecting against heat and flames with the goal to evaluate and reduce the safety risks and potential health risks associated with poorly maintained, contaminated or damaged protective garments with integrated smart solutions. This selection, use, care and maintenance guidance provides basic answers, criteria, and options for the persons that are selecting or using smart protective garments through their life cycle with respect to the protection they provide, guidance related to heat and flame or damaged protective clothing.

The main topics that an employer needs to consider are highlighted in this document. Many paragraphs of the document contain bullet-lists as thought provokers and options that may need to be considered. A number of flowcharts have been created to help understand the flow of this document and these can be used as a process in the life cycle of smart garments for protection against heat and flame from selection to disposal. These flowchart(s) may need to be reiterated a number of times to come to the optimum solution or to ensure continued adequate protection. The Annexes A to H include additional details that would make the main body too complicated to read, but are necessary to describe hazards and risks, the value of the test methods for the end user, etc.

Annex A gives details of the current European Standards relating to clothing designed to provide protection from heat and flame, smart textiles and solutions that may be integrated into the garments. In the areas where European Standards are not yet available, for example, testing smart systems in harsh environments, some other documents are listed for reference.

Compatibility with other items of PPE that protect against heat and flames and integrate smart features should be considered. Simultaneously, other risks in the related jobs, e.g. exposure to UV radiation, pollutants, mechanical impact, etc., should also be taken into account.

Selection of smart garments for protection against heat and flames should be based on your own risk assessment and should not be copied from other procurement documents.

1 Scope

The purpose of this document is to assist employers (or the person who advises the employer such as suppliers of PPE or services, inspection, insurance companies, etc.) in taking the necessary decisions regarding the selection, use, care and maintenance (SUCAM) of advanced garments and ensembles of garments that provide protection against heat and flame, with integrated smart textiles and smart non-textile elements for enhanced health, safety and survival capabilities that are compliant with the European legislation.

This document supports developers and manufacturers in designing and producing garments with smart textiles and smart non-textile elements that will meet the user's needs during the whole life cycle of the garment and comply with standard requirements set for protective clothing on use, care and maintenance up to and including the disposal of the protective gear.

This document is not exhaustive in addressing all the safety concerns associated with the use of compliant protective equipment for protection against heat and flames and other related risks.

It is essential not to construe this document as addressing all the safety concerns, if any, associated with the use of this document by testing or repair facilities. It is the responsibility of the persons and organizations that use this document and any other standards or technical report related to PPE:

— to conduct a risk assessment at the workplace;

— to select the protective clothing and other PPE, including those with smart (intelligent) features, and to verify that the manufacturer has indicated the selected PPE to be suitable for the identified risks at the workplace;

— as well as to ensure that these provide a holistic protection, only when the compatibility has been assessed including understanding the workplace and the work environment to determine the properties of protective clothing against heat and flames to establish health and safety practices;

— to verify that the manufacturer has provided information for risk assessment of the potential risks that may occur due to the smart (intelligent) features in the intended working environment, and that the manufacturer has suggested measurements to compensate such new risks, whilst the employer has to ensure that these measurements are brought to action;

— and to determine the applicability of regulatory limitations prior to using this document for any designing, manufacturing, and testing.

This document is meant for all end users that are using smart garments for protection against heat and flame. It contains information that can also be useful to other people, such as manufacturers, designers, service providers and educators who may be confronted with smart garments used to protect against heat and flame risks although it will focus on the first four in the list below:

— petrochemical and chemical industry;

— welders and foundries;

— utilities (electrical, gas, water);

— firefighters and emergency response;

— sports (motor sports, boating, etc.);

— security forces (military, police and private).

It is essential that nothing herein restricts any jurisdiction from exceeding the minimum requirements as provided in the relevant standards.

This document is not intended to cover the aspects related to data security and privacy. For employers using smart garments that monitor and/or collect data, the General Data Protection Regulation (GDPR, Regulation (EU) 2016/679) and national regulations can apply. It is essential that the smart protective garments are selected, used, taken care and maintained in a way that will neither compromise the safety and privacy of the user nor the security of the enterprise or authority using the smart garment systems.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CEN/TR 17512, *Personal protective equipment — Smart garments — Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN/TR 17512 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
aging
change of one or more initial properties of the materials during the passage of time

3.2
component assembly
combination of all materials of a multi-layer garment presented exactly as the finished garment construction

3.3
care
to keep protective clothing in good condition, including procedures for cleaning, decontamination, storage and registration

3.4
char
formation of a brittle residue when material is exposed to thermal energy

3.5
cleaning
act of removing soils and contaminants from ensembles and ensemble elements by mechanical, chemical, thermal, or combined processes

3.6
coat
element of the protective ensemble that provides protection to the upper torso and arms, excluding the hands and head

3.7
compatibility
ability of clothing (protective clothing and other clothing) to be used in conjunction with other parts of PPE

3.8
contamination/contaminated
process by which ensembles and ensemble elements are exposed to hazardous materials, body fluids, or CBRN (chemical, biological, radiological, nuclear) agents

3.9
coverall
element of the protective ensemble that provides protection to the torso, arms, and legs, excluding the head, hands, and feet

3.10
cross-contamination
transfer of contamination from one item to another or to the environment

3.11
decontamination
act of removing contaminates from protective clothing and equipment by a physical, chemical, or combined process

Note 1 to entry: See also 3.5 cleaning.

3.12
deterioration
downgrading of the effectiveness or physical characteristics of textile materials due to use, care, maintenance or storage conditions

3.13
disinfectant
agent that destroys, neutralizes, or inhibits the growth of harmful biological agents

3.14
ensemble
combination or assembly of multiple items that are individually compliant and provide protection to the head, upper torso together with arms and hands, the lower torso (below waist) together with feet, and respiratory protection, and that together fulfil all the requirements

3.15
ergonomics
scientific discipline concerned with the understanding of the interactions among human and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance

3.16
field evaluation
non-laboratory assessment of an ensemble, ensemble element, or item

3.17
fit
quality, state, and manner in which clothing, when worn, relate to the individual human body or other PPE

3.18
flame resistance
property of a (protective clothing and equipment) material whereby combustion is prevented, terminated, or inhibited following the application of a flaming or non-flaming source of ignition, with or without subsequent removal of the ignition source

3.19
functional
ability of an ensemble element or component of an ensemble element to continue to be utilized for its intended purpose

3.20
garment
single item of clothing which may consist of single or multiple layers

3.21
hardware
non-fabric items used in protective clothing including those made of metal or plastic

Note 1 to entry: Examples for hardware are fasteners, rank markings, and buttons.

3.22
hazard
situation which can be the cause of harm or damage to the health of the human body

3.23
hazardous substance
substance (solid, liquid, or gas) that when released is capable of creating harm to people, the environment, and property

3.24
hygiene
any practice or activity that keeps protective clothing healthy and clean

3.25
inherent flame resistance
flame resistance that is derived from the essential characteristics of the fibre or polymer

3.26
inner liner
inner garment designed to be attached or to be worn separately under an outer garment and filling a special function, e.g. providing thermal insulation, moisture transport

3.27
integrity
construction of the protective clothing that guarantees the proper functioning of the protective clothing

Note 1 to entry: Seams, zippers and other closures should provide solid barriers to provide suitable protection as well as be constructed in a manner which provides some flexibility.

3.28
levels of care and maintenance
four levels of care and maintenance are recognized, level one is inspection by the user before use, level two is care after use, level three is regular periodical maintenance by trained personnel and level four is professional maintenance by specialists

3.29
liner
optional component layer that provides added protection, e.g. against rain or chemicals and/or against cold

3.30
maintenance
procedures to preserve from loss or deterioration including for inspection, repair and ultimate removal from service

3.31
multilayer garment
garment consisting of different material layers intimately combined prior to the garment manufacturing stage, e.g. by weaving, quilting, coating or gluing, or of individual separable layers mechanically connected to each other, e.g. by zippers, buttons, etc.

3.32
protective clothing
clothing which covers or replaces personal clothing, and which is designed to provide protection against one or more hazards

3.33
rapid deterioration
unexpected loss of the essential requirements listed in the PPE regulation

3.34
risk
probability of a specific undesired event occurring so that a hazard is realized

3.35
risk assessment
overall process that identifies hazards, estimates the potential severity of injury or damage to health, estimates the likelihood of occurrence of injury or danger to health, determines the protective clothing against heat and flame risks and other protection measures required

3.36
selection
process of determining the type of protective equipment (garments) that is necessary for the required protection

3.37
single layer
individual layer of material being a part of a multilayer assembly or used separately

3.38
smart garment
intelligent garment
functional garment, which interacts actively with its environment, i.e. it responds or adapts to changes in the environment

Note 1 to entry: The term "smart garment" may refer to either a "smart garment" or a "smart garment system". Only the context, in which the term is used, will determine which one of the two is intended.

Note 2 to entry: Intelligent garment is a smart garment with a step towards artificial intelligence (AI) features or machine learning, however, in the context of this Technical Report they are considered as smart garments in general.

3.39
smart garment system
garment system which exhibits an intended and exploitable response as a reaction either to changes in its surroundings/environment or to an external signal/input

3.40
tensile strength
force at which a fibre or fabric will break when pulled in one dimension either in cross direction or in machine direction

3.41
textile fabric
planar structure consisting of yarns or fibres

3.42
thermal barrier
component of an ensemble element or item that principally provides thermal protection

3.43
toxic industrial chemical
toxic solid, liquid or gaseous chemical from an industrial origin that has been identified as mass casualty threats that could be used to inflict casualties, generally on a civilian population, e.g. during a terrorist attack

3.44
trouser
element of the protective ensemble that provides protection to the lower torso and legs, excluding the ankles and feet

3.45
universal precautions
approach to infection control in which human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other blood borne pathogens

3.46
use
application of protective clothing including its limitations

3.47
verified independent service provider verified ISP
independent service provider verified by a third-party certification organization to conduct any one or a combination of advanced inspection, advanced cleaning, basic repair, or advanced repair service

3.48
visibility
retro-reflective and fluorescent conspicuity enhancements

Note 1 to entry: Retro-reflective enhancements improve night-time conspicuity, and fluorescent enhancements improvement daytime conspicuity.

3.49
wristlet
interface component of the protective element or item that provides limited protection to the coat/glove interface area

4 Total process

4.1 Introduction flow charts

The flowchart diagram below shows the complete SUCAM process (Figure 1). The process will be described in detail in the following clauses. Functional requirements, selection, use, care and maintenance clauses correspond to the coloured blocks in the diagram (Figure 1). Functional requirements do support the selection process. They are based on the current practices, but also on the requirements for the future needs. Clause 4 (red) describes the selection process of the smart garments for heat and flame protection (SGHF). Clause 5 (green) describes the use of the SGHF. Clause 6 (yellow) describes the care process of SGHF. Finally, Clause 7 (blue) describes maintenance of SGHF.