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Protective clothing for firefighters - Physiological impact - Part 1: Measurement of coupled heat and moisture transfer with the sweating torso (ISO 18640-1:2018)

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 10/18

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English Version

Protective clothing for firefighters - Physiological impact - Part 1: Measurement of coupled heat and moisture transfer with the sweating torso (ISO 18640-1:2018)

Vêtements de protection pour sapeurs-pompiers - Impact physiologique - Partie 1: Mesurage du transfert de masse et de la chaleur couplé de chaleur et d'humidité à l'aide du torse transpirant (ISO 18640-1:2018)

Schutzkleidung für die Feuerwehr - Physiologische Wärmebelastung - Teil 1: Messung von gekoppelter Wärme und Stoffaustausch mit dem schwitzenden Torso (ISO 18640-1:2018)

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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EN ISO 18640-1:2018 (E)

Contents

Page

European foreword

This document (EN ISO 18640-1:2018) has been prepared by Technical Committee ISO/TC 94 "Personal safety - Personal protective equipment" in collaboration with Technical Committee CEN/TC 162 “Protective clothing including hand and arm protection and lifejackets” the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2018, and conflicting national standards shall be withdrawn at the latest by December 2018.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

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Endorsement notice

The text of ISO 18640-1:2018 has been approved by CEN as EN ISO 18640-1:2018 without any modification.

INTERNATIONAL STANDARD

ISO 18640-1

First edition
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Protective clothing for firefighters — Physiological impact —

Part 1: Measurement of coupled heat and moisture transfer with the sweating torso

Vêtements de protection pour sapeurs-pompiers — Impact physiologique —

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 94, *Personal safety*, Subcommittee SC 14, *Firefighters PPE*.

A list of all parts in the ISO 18640 series can be found on the ISO website.

Introduction

The main functions of protective clothing are protection against hazards and maintenance of health and comfort for the wearer. Furthermore, protective clothing against heat and flame prevents the wearer from health risks or even life threatening heat stress in extreme environmental conditions. Today's standards provide requirements for the protective properties of protective clothing against heat and flame. However, the higher the protective properties of such clothing, the less the heat originating from the human body is dissipated. Firefighters reach metabolic rates above 500 W/m^2 during their work[5][6]. Thereof 75-85 % is released as heat[7], which has to be dissipated from the human body by thermo-regulative processes to avoid an increase in body core temperature. If heat dissipation is not restricted, the human body is able to maintain its temperature in the range of 36,5 °C to 37,5 °C (normothermia)[8]. However, in harsh environmental conditions and/or in situations of restricted heat dissipation due to protective clothing the human body is not able to maintain body core temperature within normothermia and suffers from heat stress. The working performance is gradually reduced and any further increases in body core temperature can become life threatening[16]. To reduce the risk of heat stress during high intensity physical activities, protective clothing should additionally be assessed with regard to its impact on human thermoregulation and heat stress.

Different approaches exist for the assessment of thermo-physiological impact. On the one hand, established standard parameters such as water vapour resistance, R_{et}, and thermal insulation, R_{ct}, of fabric samples are considered with regard to thermo-regulative impact. However, these parameters do not fully reflect the real impact of protective clothing; for example, moisture management properties and the combined effect of heat and moisture transfer are not considered. On the other hand, human subject trials reveal real thermo-physiological responses for a specific environmental condition and protective clothing ensemble. However, the outcome of this methodology does not only refer to the intrinsic properties of material samples but are influenced also by the design of the clothing and trapped air layers within the clothing. Furthermore, human subject trials are very time consuming and expensive, constricted by ethical guidelines and provide findings related to the collective of participants included. Thus, reproducibility between laboratories might be limited. The use of thermal manikins overcomes the limitations for human subject trials. As for human subject trials, full body manikins provide findings on ready-made protective garments including design and fit. Hence, the attribution to intrinsic material properties remains difficult.

A methodology referring to intrinsic clothing properties and taking into account combined heat and moisture transfer is the Sweating torso[9][10]. Sweating torso device is an upright standing heated cylinder, representing the surface of a human trunk, with the ability for perspiration[11]. The clothing sample is investigated by wrapping specimens around the sweating torso. Three phases are run to measure dry thermal insulation, dry and wet heat transfer and drying properties. Findings from the Sweating torso have been validated with standard methodologies, such as sweating guarded hotplate, and were shown to be highly reproducible[11]. Furthermore, validation studies have been conducted to relate human thermos-physiological measurements to Sweating torso findings under realistic environmental conditions and activities for firefighters. Based on this knowledge, guidelines are provided for intrinsic textile properties based on thermo-physiological responses. In addition to the standard procedure described above, the impact of more complex protective clothing systems including underwear, air gaps and/or design features is investigated optionally applying the same experimental protocol described in this document.

INTERNATIONAL STANDARD **ISO 18640-1:2018(E)**

Protective clothing for firefighters — Physiological impact —

Part 1: Measurement of coupled heat and moisture transfer with the sweating torso

1 Scope

This document provides a test method for evaluating the physiological impact of protective fabric ensembles and potentially protective clothing ensembles in a series of simulated activities (phases) under defined ambient conditions. This standard test method characterizes the essential properties of fabric assemblies of a representative garment or clothing ensemble for thermo-physiological assessment:

— dry thermal insulation;

— cooling properties during average metabolic activity and moisture management (dry and wet heat transfer);

— drying behaviour.

Default measurements are done on fabric samples representing the garment or protective clothing combination. Optionally and in addition to the standard test method, the same testing protocol can be applied to characterise more complex protective clothing ensembles including underwear, air layer and certain design features[1)]. In addition, measurements on readymade garments are possible.

This test method is intended to be used to measure and describe the behaviour of fabric assemblies of a garment or clothing ensemble in response to a simulated series of activities under controlled laboratory conditions, with the results used to optimize garment combinations and material selection. Furthermore, this document together ISO 18640-2, is intended to be used to describe the thermo-physiological impact of protective clothing but not the risk for heat stress under actual fire conditions. The results of this test can be used as elements of a risk assessment with respect to thermo-physiological load.

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.

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

