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Ships and marine technology — Shipboard fire-fighters' outfits (protective clothing, gloves, boots and helmet)

Navires et technologie maritime — Équipement du marin pompier (vêtements de protection, gants, bottes et casque)

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 22488 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 1, *Lifesaving and fire protection*.

Introduction

A fire on board a ship will be fought firstly and, in most cases, only by the ship's crew. Although they may have some training in fire-fighting activities, most crewmembers cannot be considered to be professional firefighters. In addition, fire-fighting operations on ships take place in environmental conditions (narrow paths, limited spaces, adverse sea conditions) in which free and easy movement is essential.

Existing International Standards for various components of firefighters' outfits, intended for use by professional firefighters in shore-based fire-fighting operations, are not well suited to use by firefighters on board ships, either in terms of the skill level of the user, or the environmental conditions typically found on ships. This International Standard, while drawing heavily on those International Standards for basic performance requirements, is intended to address the specific needs of non-professional firefighters in the shipboard environment.

Ships and marine technology — Shipboard fire-fighters' outfits (protective clothing, gloves, boots and helmet)

1 Scope

This International Standard specifies the protective clothing, gloves, boots and helmet to be used by ships' crews in fighting fires on board ships. These outfits are appropriate for the fighting of small- to medium-magnitude fires, before the operation of any installed fixed fire-fighting systems, and are not intended or suitable for entry into flames.

2 Normative references

The following referenced documents are indispensable for the application 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 1421:1998, *Rubber- or plastics-coated fabrics — Determination of tensile strength and elongation at break*

ISO 4674-1:2003, *Rubber- or plastics-coated fabrics — Determination of tear resistance — Part 1: Constant rate of tear methods*

ISO 4920, *Textiles — Determination of resistance to surface wetting (spray test) of fabrics*

ISO 6487:2002, *Road vehicles — Measurement techniques in impact tests — Instrumentation*

ISO 6330:2000, *Textiles — Domestic washing and drying procedures for textile testing*

ISO 6942:2002, *Protective clothing — Protection against heat and fire — Method of test: Evaluation of materials and material assemblies when exposed to a source of radiant heat*

ISO 9151, *Protective clothing against heat and flame — Determination of heat transmission upon exposure to flame*

ISO 11612:—[1)], *Clothing for protection against heat and flame — Test methods and performance requirements for heat-protective clothing*

ISO 13934-1, *Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method*

ISO 15025:2000, *Protective clothing — Protection against heat and flame — Method of test for limited flame spread*

ISO 15383:2001, *Protective gloves for firefighters — Laboratory test methods and performance requirements*

1) To be published. (Revision of ISO 11612:2008)

ISO 17493, *Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven*

ISO 20344:2004, *Personal protective equipment — Test methods for footwear*

ISO 20345:2004, *Personal protective equipment — Safety footwear*

EN 471:2003, *High-visibility warning clothing for professional use —Test methods and requirements*, as amended in 2007

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
afterflame time
length of time for which a material continues to flame, under the specified test conditions, after the ignition source has been removed

3.2
afterglow time
length of time for which a material continues to glow under specified test conditions, after cessation of flaming or, if no flaming occurs, after removal of the ignition source

3.3
closure system
method of fastening openings in the garment, including combinations of more than one method of achieving a secure closure

NOTE A closure system does not include seams.

3.4
flame-resistant
material or treatment feature which delays the transmission of flaming

3.5
flaming debris
material separating from the specimen during the test procedure with flaming

3.6
garment
single item of clothing which may consist of single or multiple layers

3.7
hardware
non-fabric components of protective clothing, including those made of metal or plastic material

EXAMPLE Zippers, hook-and-loop and other fasteners.

3.8
heat stress
rise in the wearer's temperature, caused by the restraining of radiation from the body such as sweating when protective clothing is worn, producing a range of potentially serious effects to the wearer's body

3.9
hole
break in the test specimen or material at least 5 mm by 5 mm in size caused by melting, glowing or flaming

3.10
inherently flame-resistant material
material made of fibres that are themselves non-combustible or flame-resistant

3.11
innermost material
material on the innermost face of a component assembly

3.12
innermost surface of garment
body side of the innermost material

3.13
molten debris
molten material separating from the specimen during the test procedure and falling from the specimen without flaming

3.14
multilayer clothing assembly
series of layers of garments arranged in the order as worn, which may contain multilayer materials, material combinations or separate layers of clothing material in single layers

3.15
outer material
outermost material of which the protective clothing is made

3.16
protective clothing
specific garments providing protection for the firefighter's upper and lower torso, neck, arms and legs, but excluding the head, hands and feet

3.17
retroreflective material
material which reflects in the opposite direction a beam of light directed on it

3.18
seam
junction of two edges of material which are permanently attached in the garment by sewing or any other method

3.19
self-extinguishing
feature which suspends the flaming under the specified test conditions after the ignition source has been removed

4 Design requirements

4.1 General

4.1.1 The protective clothing, gloves, boots and helmet shall be designed taking into consideration the mobility needed for shipboard fire-fighting, and the need to be able to wear breathing apparatus over the protective clothing.

4.1.2 Hardware fitted on the protective clothing, gloves, boots and helmet shall be designed and attached so as not to injure the wearer by heat transfer. Hardware shall also be designed and attached taking into consideration corrosion resistance, as well as the performance required by this International Standard for the complete outfit.

4.2 Protective clothing

4.2.1 The protective clothing, which consists of a single garment or a two-piece suit consisting of a jacket and pair of trousers, shall provide protection for the wearer's upper and lower torso, neck, arms and legs, but not head, hands and feet.

4.2.2 Where the protective clothing, gloves or boots consist of multiple layers, the layers shall be either permanently attached or else clear instructions for wearing them together shall be provided.

4.2.3 Closure systems shall be selected and installed such that they do not compromise the level of protection of the clothing.

4.2.4 The neck and cuffs of the protective clothing shall be designed and sized so as not to permit sparks or flame to enter into the protective clothing. This may be achieved in combination with the helmet and gloves. All pockets and slits with external openings shall be provided with a closure system or covered with a protective flap, which shall be stitched down or capable of fastening the pocket closed, so as to prevent sparks or flame entering.

4.2.5 The overlap between jacket and trousers shall not be less than 300 mm when worn by a test subject wearing garments of the correct size, standing upright with arms at sides. The wearer's skin at the overlap between the protective clothing and gloves or the protective clothing and boots shall not be easily exposed in use.

4.2.6 The protective clothing shall be designed to cover the upper part of the boots.

4.2.7 Protective clothing shall be fitted with combination retroreflective/fluorescent materials having a minimum combined width of 50 mm and giving all-round visibility, as specified in Annex F. When tested in accordance with EN 471:2003, 6.1, the coefficient of retroflection of retroreflective/fluorescent materials at an entrance angle of 5° and an observation angle of 0,2° shall comply with the requirements of EN 471. The fluorescent component of retroflective/fluorescent materials shall be in accordance with EN 471:2003, 5.1.1.

4.3 Gloves

Gloves shall conform to ISO 15383:2001, type 2.

4.4 Boots

Footwear for shipboard firefighters' outfits shall

— be of a boot design as specified in Annex A,

— comply with ISO 20345:2004, classification I or II, and

— comply with the additional performance and test requirements of this International Standard.

4.5 Helmets

4.5.1 The helmet shall be provided with a neck protector and visor, and shall protect the wearer's face, head and neck from heat and projections.

4.5.2 The helmet shall be designed taking into account the need to accommodate the use together with the helmet of a breathing apparatus.

4.5.3 The helmet shall be provided with a chin strap or other suitable means for fitting it securely on the wearer's head.

4.5.4 The inside of the helmet shall be provided with a means of adjusting the fit of the helmet. This means it shall be easily adjustable by the wearer without the use of tools. When this adjustment covers several sizes of head circumference, a relevant instruction shall be given in the information supplied by the manufacturer.

4.5.5 Helmet materials shall be flame-resistant or self-extinguishing.

4.5.6 The helmet shall provide protection against electric transmission to the wearer.

4.5.7 The helmet shall be designed to provide for air space between the wearer's head and the neck protector, and between the wearer's head and the helmet.

4.5.8 There shall be no sharp edges, roughness or projection on any part of the helmet in contact or potential contact with the head when worn, such as is likely to cause discomfort or injury to the wearer.

4.5.9 The visor shall be substantially colourless and transparent, and free of distortion.

5 Performance requirements and test methods for firefighter outfit components

5.1 General and sampling requirements

5.1.1 General

5.1.1.1 All tests shall be carried out on materials as received unless otherwise specified.

5.1.1.2 In all surface tests, the outermost surface is to be exposed unless otherwise specified.

5.1.2 Sampling

5.1.2.1 Samples shall be taken so as to be representative of the materials and garment construction employed.

5.1.2.2 Except as otherwise specified herein, the number and size of specimens for each test shall be in accordance with the respective referenced standards.

5.2 Protective clothing

5.2.1 Pre-treatment

5.2.1.1 Metalized materials

Before carrying out the tests specified in 5.2.2, 5.2.3, 5.2.4 and 5.2.7, metalized materials shall be mechanically pre-treated in accordance with ISO 11612:—, Annex A, except that the mechanical pre-treatment shall be carried out 1 000 times.

5.2.1.2 Non-metalized materials

5.2.1.2.1 Before carrying out the tests specified in 5.2.2, 5.2.3, 5.2.4 and 5.2.7, inherently flame-resistant materials shall be washed and dried in accordance with ISO 6330:2000, procedure 2A, at (60 ± 3) °C and drying procedure E (tumble drying), or dry-cleaned in accordance with ISO 3175-1[1] for five cycles unless otherwise specified in the care labelling. If washing is permitted as well as dry cleaning, then the sample shall only be washed.

5.2.1.2.2 Before carrying out the tests specified in 5.2.2, 5.2.3, 5.2.4 and 5.2.7, materials that are not inherently flame-resistant shall be washed and dried in accordance with ISO 6330:2000, procedure 2A, at (60 ± 3) °C and drying procedure E (tumble drying), or dry-cleaned in accordance with ISO 3175-1[1] for 50 cycles unless otherwise specified in the care labelling. If washing is permitted as well as dry cleaning, then the sample shall only be washed.

5.2.1.3 After pre-treatment, shrinkage shall not be more than 3 %.

5.2.2 Flame resistance test

5.2.2.1 Materials, including retroreflective/fluorescent materials, shall be tested in accordance with ISO 15025:2000, procedure A. All materials used for visibility shall be tested, as specified, in combination with the outer layer, in order to make possible the taking of samples with the dimensions specified in ISO 15025. The following acceptance criteria apply.

a) No specimen shall exhibit flaming on the top or either of the side edges.

b) No specimen shall exhibit hole formation in any layer, except for a layer — other than the outer material or innermost lining — used for a specific type of protection other than heat protection (e.g. a layer providing protection against liquid penetration).

c) No specimen shall exhibit flaming or molten debris.

d) The mean value of afterflame time shall not be more than 2 s.

e) The mean value of afterglow time shall not be more than 2 s.

5.2.2.2 Internal parts of the legs and sleeves which may be easily reversed, and other internal materials which may be exposed to flame, such as materials within 10 cm of the jacket hem, and which are different from external parts, shall also be tested in accordance with 5.2.2.1.

5.2.2.3 Tested specimens shall include any materials or labels fitted to the outermost surface of the clothing.

5.2.3 Heat transfer (flame) test

When tested in accordance with ISO 9151 at an incident heat flux of 80 kW/m^2, the mean heat transfer index (HTI) shall be

a) mean $HTI_{24} \geq 13$, and mean $(HTI_{24} - HTI_{12}) \geq 4$, for a component assembly or multilayer clothing assembly,

or may be reduced to

b) mean $HTI_{24} \geq 10$, and mean $(HTI_{24} - HTI_{12}) \geq 3$, for the trousers of a two-piece suit and the legs of a coverall garment below the crotch.

NOTE Heat transfer indexes HTI_{24} and HTI_{12} are the times needed to raise the temperature on the innermost surface of the garment from the temperature at start of test by 24 °C and 12 °C respectively.

5.2.4 Heat transfer (radiation) test

When tested in accordance with ISO 6942 at a heat flux density of 40 kW/m^2, the mean radiant heat transfer index (RTHI) shall be

a) mean $RHTI_{24} \geq 18$ and mean $(RHTI_{24} - RHTI_{12}) \geq 4$ for a component assembly or multilayer clothing assembly,

or may be reduced to

b) mean $RHTI_{24} \geq 10$ and mean $(RHTI_{24} - RHTI_{12}) \geq 3$, for the trousers of a two-piece suit and the legs of a coverall garment below the crotch.

NOTE Radiant heat transfer indexes $RHTI_{24}$ and $RHTI_{12}$ are the times needed to raise the temperature on the innermost surface of the garment from the temperature at start of test by 24 °C and 12 °C respectively.

