भारतीय मानक

Indian Standard

IS 16890 : 2024

वस्त्रादि — अग्निशामकों के लिए सुरक्षात्मक कपड़े — विशिष्ट

(पहला पुनरीक्षण)

Textiles — Protective Clothing for Firefighters — Specification

(First Revision)

ICS 13.340.10

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Textile Protective clothing Sectional Committee, TXD 32

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Textiles Protective Clothing Sectional Committee had been approved by the Textile Division Council.

The role of firefighters is very extensive in our society. Firefighters not only play a pivotal role to rescue human lives during fire accident but also save properties from extensive damage by extinguishing hazardous fires. It is one of the most life threatening occupations that require intensive physical work in hazardous environment. For fighting fire accident more effectively and saving their precious life, it is needed to provide suitable personal protective equipment (PPE). The firefighting suit is one of the important parts of PPE.

Fire fighter suit mostly comprises following three components:

a) *Outer shell* — The outer shell resists ignition upon being exposed to thermal radiation or very short periods of direct flame contact. It also provides safety to the wearer from chemical hazards;

b) *Inner shell* — The inner shell is generally composed of moisture barrier and a thermal barrier:

   1) *Moisture barrier* — Moisture barriers may totally prevent the passage of moisture, whether liquid or vapour; and

   2) *Thermal barrier* — The thermal barrier is a layer of insulating material which retards heat flow through the garment.

c) *Inner liner* — It is light weight flame retardant fabric.

This standard covers the general clothing design, the minimum performance levels of the materials used, and the methods of test for determining these performance levels.

This standard was first published in 2018. It is revised again to incorporate a second category of protective clothing for firefighters with stricter requirements for convective and radiant heat along with higher mechanical performance test requirements in terms of tensile strength and tear strength so that the protective clothing can be deployed for more intense firefighting and rescue applications.

In the formulation of this standard, considerable assistance has been derived from ISO 11613 : 2017 ‘Protective clothing for firefighters — Laboratory test methods and performance requirements’ and EN 469 : 2020 ‘Protective clothing for firefighters — Performance requirements for protective clothing for firefighting activities’ on the subject.

The Committee has reviewed the provisions of the following International Standards referred in this standard and has decided that it is acceptable for use in conjunction with this standard:

International Standard	*Title*
ISO 811 : 2018	Textile — Determination of resistance to water penetration — Hydrostatic pressure test
ISO 3175-2 : 2017	Textiles — Professional care, drycleaning and wetcleaning of fabrics and garments — Part 2: Procedure for testing performance when cleaning and finishing using tetrachloroethene
ISO 4920 : 2012	Textile fabrics — Determination of resistance to surface wetting (spray test)
ISO 5077 : 2007	Textiles — Determination of dimensional change in washing and drying
ISO 11092 : 2014	Textiles — Physiological effects — Measurement of thermal and water-vapour resistance under steady-state conditions (sweating guarded-hotplate test)

(*Continued on third cover*)

Indian Standard

TEXTILES — PROTECTIVE CLOTHING FOR FIREFIGHTERS — SPECIFICATION

(First revision)

1 SCOPE

This standard specifies test methods and minimum requirements for protective clothing for two categories (Category 1 and Category 2) of protective clothing for firefighters to be worn during firefighting and associated activities where there is a risk of heat and/or flame and covers the general clothing design, the minimum performance levels of the materials used, and the methods of test for determining these performance levels.

The Category 1 of protective clothing is recommended for work associated with outdoor firefighting as well as support activities. While Category 2 of protective clothing is recommended to be worn during intense structural firefighting, close firefighting operations and associated activities like rescue operations. Category 2 addresses protection requirements for increased risk of convective and radiant heat and/or flame exposures as compared to Category 1 protection requirements. Also, Category 2 covers higher mechanical performance test requirements in terms of tensile strength and tear strength so that the protective clothing can be deployed for more intense firefighting and rescue applications. To facilitate flexibility and comfort for firefighting and rescue applications, the Category 2 protective clothing also stipulates lighter garment assembly compared to Category 1 garment using lower weight of fabric layer assembly without lowering the performance requirements related to protection against convective and radiant heat.

This standard does not cover special clothing for use in other high risk situations such as specialized firefighting (fire entry application), or clothing for use in long term firefighting operations in high ambient temperature, for example brush, wildland, or forest firefighting. It does not cover protection for the head, hands and feet or protection against other hazards, for example biological, radiation and electrical hazards. These aspects may be dealt with in other standards.

NOTES

1 Additional personal protective equipment to protect the head, hands, and feet should be worn with clothing specified in this standard and in majority of situations breathing apparatus is also required to be worn. Firefighters should be trained in the use and care of protective clothing covered by this standard including an understanding of its limitations and of the other items of personal protective equipment that may be required depending on the risks encountered.

2 The protective clothing for firefighters under this standard is commonly referred to as fire proximity suits, firefighters' suits and turn out gears

3 ISO 23616 may be referred for guidance regarding the cleaning, inspection and repair of this protective clothing.

2 REFERENCES

The standards listed in Annex A contain provisions, which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards.

3 TERMINOLOGY

For the purposes of this standard, the following terms, definitions and symbols shall apply.

3.1 Terms and Definitions

3.1.1 *Cargo Pockets* — Pockets located on the protective garment exterior.

3.1.2 *Char* — Formation of a brittle residue when material is exposed to thermal energy.

3.1.3 *Collar Lining* — That part of the collar fabric composite that is next to the skin when the collar is closed in the raised position.

3.1.4 *Composite* — Layer or layers that provide protection required of outer shell, moisture barrier, and thermal barrier.

3.1.5 *Closure System* — Method of fastening openings in the garment including combinations of more than one method of achieving a secure closure, for example a slide fastener covered by an overlap fastened down with a touch and close fastener.

NOTE — This term does not cover seams.

3.1.6 *Component Assembly* — Material combination found in a multilayer garment arranged in the order of the finished garment construction and including any inner liner.

3.1.7 *Drip* — To run or fall in drops or blobs.

3.1.8 *Firefighter's 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.

3.1.9 *Garment* — Single item of clothing which may consist of single or multiple layers.

3.1.10 *Hardware* — Non-fabric components of protective clothing including those made of metal or plastic material.

NOTE — Examples include fasteners, rank markings, buttons, etc.

3.1.11 *Innermost Lining* — Lining found on the innermost face of a component assembly.

3.1.12 *Integral Melting* — Liquefaction of a material when exposed to heat to the extent of causing a hole in its structure, either by shrinking and/or dripping away under specified test conditions.

3.1.13 *Interface Area* — Area of the body not protected by a protective garment, helmet, gloves, footwear, or self-contained breathing apparatus (SCBA) facepiece; the area where the protective garments and the helmet, gloves, footwear, or SCBA facepiece meet, that is the protective coat/helmet/SCBA facepiece area, the protective coat/glove area, and the protective trouser/footwear area.

3.1.14 *Interface Component* — Item(s) designed to provide limited protection to interface areas.

3.1.15 *Interlining* — Layer found between the outermost layer and the innermost lining in a multilayer garment, not next to the wearer's skin.

3.1.16 *Manufacturer* — Entity that assumes the liability and provides the warranty for the compliant product.

3.1.17 *Material Combination* — Material produced from a series of separate layers, intimately combined prior to the garment manufacturing stage.

Example:

A quilted fabric.

3.1.18 *Melt* — To change from solid to liquid form, or become consumed by action of heat.

3.1.19 *Moisture Barrier* — That portion of the protective garment designed to prevent the transfer of liquid water from the environment to the thermal barrier.

3.1.20 *Multilayer Clothing Assembly* — Series of layers of garments arranged in the order as worn.

NOTE — It may contain multilayer materials, material combinations or separate layers of clothing material in single layers.

3.1.21 *Outer Material* — Outermost material of which the protective clothing is made.

3.1.22 *Outer Shell* — Outside facing portion of the composite with the exception of trim, hardware, reinforcing material, and wristlet material.

3.1.23 *Protective Clothing* — Protective garments, configured as a coat and trousers or as a coverall, and interface components that are designed to provide protection to the firefighter’s body.

3.1.24 *Protective Coat* — Protective garment designed and configured to protection to upper torso and arms, excluding the hands and head.

3.1.25 *Protective Coverall* — Protective garment designed and configured to provide protection to the torso, arms, and legs, excluding the head, hands, and feet.

3.1.26 *Protective Garment* — Single item of clothing which may consist of single or multiple layers, for example protective coat, protective trouser, or protective coverall.

3.1.27 *Protective Hood* — Interface component that provides limited protection to the protective coat/helmet/SCBA facepiece interface area.

3.1.28 *Protective Trouser* — Provides protection to lower torso and legs excluding the feet.

3.1.29 *Protective Uniform Garment* — Garment designed and configured to be both the thermal barrier or portion of the thermal barrier of a protective garment, and a station/work uniform.

3.1.30 *Protective Wristlet* — Interface component that provides limited protection to the protective garment/glove interface area.

3.1.31 *Removable Inner Liner* — Inner garment designed to be attached or to be worn separately under an outer garment in order to provide thermal insulation.

3.1.32 *Seam* — Junction of two edges of material which are permanently attached in the garment by sewing or any other method.

3.1.32.1 *Major A Seams* — Outer-shell seam assemblies where rupture could reduce the

protection of the garment by exposing the moisture barrier, thermal barrier, the wearer's station/work uniform, other clothing, or skin.

3.1.32.2 *Major B Seams* — Moisture barrier or thermal barrier seam assemblies where rupture could reduce the protection of the garment by exposing the next layer of the garment, the wearer's station/work uniform, other clothing, or skin.

3.1.32.3 *Minor Seams* — Remaining seam assemblies that are not classified as major A or major B seams.

3.1.33 *Thermal Barrier* — That portion of the composite designed to provide thermal protection.

3.1.34 *Trim* — Retroreflective and fluorescent material attached to the outer shell for visibility enhancement; retroreflective materials enhance night-time visibility, and fluorescent materials improve daytime visibility.

3.1.35 *Inner Garment* — Garment which is worn under an outer garment.

3.1.36 *Winter Liner* — Optional composite layer designed to provide added insulation against cold.

4 CLASSIFICATIONS

This standard specifies two categories of protective clothing thatis, Category 1 and Category 2. Both the categories have differing performance characteristics. Selection of category of protective clothing should be determined considering the operational practices, environmental conditions, and local building standards.

5 DESIGN REQUIREMENTS

5.1 General

This clause specifies test methods and minimum requirements for protective clothing to be worn during firefighting and associated activities where there is a risk of heat and/or flame for both Category 1 and Category 2 of protective clothing.

It covers the general clothing design, the minimum performance requirements of the materials used, and the methods of test for determining these performance requirements for both Category 1 and Category 2 of protective clothing.

NOTE — Outer layer, thermal layer and moisture barrier are the critical components of the protective clothing for firefighters. In case the above raw materials used for the manufacturing of the protective clothing for firefighter is changed, all the requirements shall again be verified for compliance.

5.2 Design Requirements

5.2.1 *Configuration*

The firefighter's protective clothing shall provide protection for the firefighter's upper and lower torso, neck, arms, and legs, but excluding the head, hands, and feet. It shall consist of:

a) a single outer garment; or

b) an outer two-piece suit consisting of a jacket and a pair of trousers with a minimum overlap of 30 cm; or

c) a series of outer and inner garments designed to be worn together.

This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.2 *Restriction of Movement*

The clothing shall be designed to minimize restrictions of movement. It shall be compatible with other protective equipment which may be necessary, for example boots, helmet, gloves and breathing apparatus. Details for checking the basic ergonomic features of protective clothing by doing practical performance tests are given in Annex B. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.3 *Multilayer Clothing Assemblies*

Where multilayer clothing assemblies are used to achieve the specified requirements, the layers shall be either permanently attached or the various garments shall be clearly labelled that they must always be used in combination. Multilayer assembly for Category 1 and Category 2 shall consists of the following three layers:

a) *Multilayer clothing assemblies for Category* 1:

1) *Outer layer* — Mass shall not be more than 270 g/m^2;

2) *Moisture barrier* — Mass shall not be more than 150 g/m^2; and

3) *Thermal layer* — Thermal layer may be a single layer or two layers and the mass (including lining) shall not be more than 380 g/m^2.

b) *Multilayer clothing assembly for Category* 2 :

1) *Outer layer — Mass* shall not be more than 240 g/m^2;

2) *Moisture barrier* — Mass shall not be more than 140 g/m^2; and

3) *Thermal layer* — Thermal layer may be a single layer or two layers and the mass (including lining) shall not be more than 300 g/m^2.

5.2.4 *Seams*

Seams on the outer layer of the garment shall be constructed to give the minimum loss in strength and protection and to maintain the integrity of the garment. Seam breaking strength, when tested in accordance with IS/ISO 13935-2, shall have minimum seam breaking force of 300 N. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.5 *Hardware*

Hardware penetrating the outer material shall not be exposed on the innermost surface of the component assembly. The hardware when tested in accordance with the method given in ISO 17493 at a test temperature of 180 °C ± 5 °C, shall not melt, drip, separate, or ignite, and shall not shrink more than 5 percent. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.6 *Closure Systems*

Closure systems shall be constructed so as to fulfil the performance requirements of the garment. Closure system when tested in accordance with the method given in ISO 17493 at a test temperature of 180 °C ± 5 °C, shall not melt, drip, separate, or ignite, and shall not shrink more than 5 percent. The closure system shall be of positive fastener type. Closure systems shall be protected by means of the component assembly, for example by overlapping or underlining storm flap that provides secure and complete moisture and thermal protection. Where buttonholes are used, the maximum interval distance shall be 150 mm and if zippers are used, the slide fastener shall be designed to lock when completely closed. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.7 *Retroreflective Elements*

The clothing shall have retroreflective elements/ combined performance materials to the user's requirements provided that they do not affect the performance of the clothing. Visibility requirements shall conform to the requirements specified in Annex C. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.8 *Sleeve Ends*

The ends of the sleeves shall be designed to protect the wrist and to prevent the entry of burning debris. They shall not hinder the donning of the garment and shall be compatible with the wearing of protective gloves. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.9 *Clothing Mass*

The clothing shall be as light as possible while still maintaining the required performance levels. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.10 *Ease of Cleaning*

The clothing shall be designed to promote ease of cleaning. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.11 *Labels*

Any labels or trim shall not adversely affect the performance of the garment. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

5.2.12 *Size Designations*

The size of each protective clothing shall be designated by height and chest or bust girth as two control dimensions, in cm. The height and the girth ranges for different size designations shall be as given in Table 1. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

6 SAMPLING AND PRE-TREATMENT

6.1 Samples

Samples shall be taken so as to be representative of the materials and garment construction employed. Sampling and criteria for conformity shall be as given in Annex D. The sampling procedure is applicable for both Category 1 and Category 2 of protective clothing.

6.2 Number and Size of Specimens

The number and size of specimens for the different tests shall be in accordance with the respective standards.

6.3 Exposure Surface

In all surface tests, the outermost surface shall be exposed, except for flame spread testing of the innermost lining (*see* **7.2.2**) and testing of water vapour resistance (*see* **7.13**) when the innermost surface is exposed. This requirement is applicable

for both Category 1 and Category 2 of protective clothing.

6.4 Pre-treatment

The test materials shall be washed five times in a front-loading horizontal drum machine with 1 g/l IEC reference detergent (Annex B of IS 15370) in hard water (hardness of water 160 ± 20 mg/l expressed as calcium carbonate) and dried in accordance with the procedures of IS 15370. Washing shall be carried out by procedure 2A at (60 ± 3) °C and drying by procedure E (tumble drying) unless otherwise specified in the care labelling. Drying shall be in accordance with the procedures specified in IS 15370. A total of five washing and drying cycles shall be used. Materials which are labelled as dry cleanable only shall be dry cleaned five times in accordance with ISO 3175-2. The pretreatment is applicable for both categories (Category 1 and Category 2) of protective clothing. All the requirements specified in 7.2, 7.3, 7.4, 7.5, 7.10, 7.12, and 7.13 shall be testes in as received condition and after pretreatment.

7 PERFORMANCE REQUIREMENTS

7.1 The performance requirements specified in this clause are applicable for both Category 1 and Category 2 of the protective clothing.

7.2 Flame Resistance

7.2.1 Flame spread shall be tested in accordance with IS 15758 (Part 4), using the procedures for face ignition and bottom ignition and the following requirements shall be satisfied:

a) No specimen shall give flaming to top or either side edge;

b) No specimen shall give hole formation in any layer;

c) No specimen shall give flaming or molten debris;

d) The mean value of after flame time shall be ≤ 2 s; and

e) The mean value of the afterglow time shall be ≤ 2 s.

This requirement is applicable for both Category 1 and Category 2 of protective clothing.

7.2.2 The component assembly of the outer garment shall be tested by applying the flame to the outer surface of the garment. If the outer garment has a lining material, the component assembly of the outer garment shall also be tested with the flame applied to the innermost lining of the outer garment. If the clothing assembly consists of several separate garments and the inner garment may be exposed to flame, the component assembly of this inner garment shall also be tested applying the flame to the outer surface of this inner garment. If the clothing assembly incorporates wristlet material, this shall be tested separately applying the flame to the outer surface of the wristlet material. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

7.2.3 For seams, 3 specimens containing a structural seam shall be tested separately by applying the flame to the seam portion of the component assembly with the seam oriented vertically in accordance with IS 15758 (Part 4), using the procedures for face ignition and shall pass the requirement specified in 7.2.1 and the seam shall not open. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

7.2.4 Sewing thread when tested as per IS 13360 (Part 6/sec 10) at a temperature of 260 °C (± 5 °C) shall not melt. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

Table 1 Height and Girth Ranges of Body Measurements

(*Clause* 5.2.12)

Sl No.	Size Designations	Chest or Bust Girth cm	Height cm
(1)	(2)	(3)	(4)
i)	S	80 to 88	152 to 158
ii)	M	88 to 96	158 to 164
iii)	L	96 to 104	164 to 176
iv)	XL	104 to 112	176 to 182
v)	XXL	112 to 120	182 to 188
vi)	XXXL	120 to 124	188 to 194

7.3 Heat Transfer (Flame Exposure)

7.3.1 *Heat Transfer* (*Flame Exposure*) *for Category* 1

The component assembly or multilayer clothing assembly when tested in accordance with IS 15758 (Part 1) shall give a mean $HTI_{24} \geq 13$ s and a mean $HTI_{24} - HTI_{12} \geq 4$ s.

7.3.2 *Heat Transfer* (*Flame Exposure*) *for Category* 2

The component assembly or multilayer clothing assembly when tested in accordance with IS 15758 (Part 1) shall give a mean heat transmission index $HTI_{24} \geq 17$ s and a mean $HTI_{24} - HTI_{12} \geq 6$ s.

7.4 Heat Transfer (Radiant Exposure)

7.4.1 *Heat Transfer* (*Radiant Exposure*) *for Category* 1

The component assembly or multilayer clothing assembly when tested in accordance with Method B of IS 15758 (Part 2) at a heat flux density of 40 kW/m^2, shall give a mean $RHTI_{24} \geq 18$ s, a mean $RHTI_{24} - RHTI_{12} \geq 4$ seconds, and a mean transmission factor ≤ 60 percent.

7.4.2 *Heat Transfer* (*Radiant Exposure*) *for Category* 2

The component assembly or multilayer clothing assembly when tested in accordance with Method B of IS 15758 (Part 2) at a heat flux density of 40 kW/m^2 shall give a mean $RHTI_{24} \geq 26$ s, a mean $RHTI_{24} - RHTI_{12} \geq 8$ s, and a mean transmission factor ≤ 60 percent.

7.5 Contact Heat

The component assembly or multilayer clothing assembly when tested in accordance with method specified in IS 17462 (Part 1) at a temperature of 250 °C shall have a maximum threshold of 10 seconds. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

7.6 Residual Strength of Material when Exposed to Radiant Heat

One machine and one cross machine specimen of the outer material shall be tested in accordance with IS 1969 (Part 1) before and after pre-treatment of the complete assembly by Method A of IS 15758 (Part 2) at a heat flux density of 10 kW/m^2. Each specimen of Category 1 shall have a tensile strength ≥ 450 N. Each specimen of Category 2 shall have a tensile strength ≥ 600 N.

7.7 Heat Resistance

Each material used in the clothing assembly when tested in accordance with the method given in ISO 17493 at a test temperature of 180 °C ± 5 °C shall not melt, drip, separate, or ignite, and shall not shrink more than 5 percent. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

7.8 Tensile Strength

7.8.1 *Tensile Strength for Category* 1

The outer material when tested in accordance with IS 1969 (Part 1) shall give a breaking load in both machine and cross direction ≥ 450 N.

7.8.2 *Tensile Strength for Category* 2

The outer material when tested in accordance with IS 1969 (Part 1) shall give a breaking load in both machine and cross direction of ≥ 600 N.

7.9 Tear Strength

7.9.1 *Tear Strength for Category* 1

The outer material when tested in accordance with method specified in IS 6489 (Part 2), shall give a tear strength in both machine and cross direction ≥ 30 N.

7.9.2 *Tear Strength for Category* 2

The outer material when tested in accordance with method specified in IS 6489 (Part 2) shall give a tear strength in both machine and cross direction of ≥ 100 N.

7.10 Cleaning-Shrinkage Resistance

The materials of the outer garment assembly when tested in accordance with ISO 5077 using the cleansing pre-treatment specified in **6.4** shall give a dimensional change of ≤ 3 percent (for woven fabric) and ≤ 5 percent (for knitted and non-woven fabric) in both the machine and cross machine directions. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

7.11 Liquid-Chemical Penetration Resistance

The component assembly or multilayer clothing assembly when tested in accordance with IS 15758 (Part 3) shall give more than 80 percent run-off and no penetration to the innermost surface using the following liquids. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

a) 40 percent sodium hydroxide (NaOH) at 20 °C;

c) 36 percent hydrochloric acid (HCl) at 20 °C;

d) 30 percent sulfuric acid (H_2SO_4) at 20 °C; and

e) O-xylene, 100 percent

NOTE — Fabrics shall be conditioned for 24 h at (20 ± 2) °C and (65 ± 5) percent RH before testing. All tests shall be carried out with a pouring time of 10 s and at a temperature of 20 °C.

7.12 Water-penetration Resistance

Specimens of clothing assembly and its seams, when tested in accordance with ISO 811 at 20 kPa for a period of 5 min, shall not show appearance of water drops. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

7.13 Water-vapour Resistance

Specimens of clothing assembly and its seams, when tested in accordance with ISO 11092 shall have maximum water vapour resistance of 30 m^2 Pa/W. This requirement is applicable for both Category 1 and Category 2 of protective clothing.

NOTE — High water vapour resistance can lead to a higher risk of steam burns.

8 MARKING

8.1 Label

Each separable layer of each protective garment shall have a label permanently and conspicuously attached to each layer upon which at least the information given in Fig. 1 is printed in letters at least 1.5 mm high. At least one label shall be conspicuously located inside the garment in all possible configurations of garment utilization.

8.2 Label Legibility

All garment labels shall be clearly legible to the eye both before and after being subjected to the pre-treatment specified in **6.4**. Garment labels not meeting specimen size requirements for the procedure specified in **6.4** shall be sewn to a support fabric of required size.

8.3 Manufacturers Information

8.3.1 *The Manufacturer's Information shall contain the following*

a) Name, address and contact details of the manufacturer;

b) Model name and article number of the protective clothing which has been certified to this standard;

c) Indian Standard to which certified along with pictogram as given in Fig. 2;

d) Size information of the manufacturer for this protective clothing, that is, S – XXXL;

e) Care labeling symbols as specified in IS 14452; and

f) Declaration:

1) The manufacturer shall include a note in the information that in order to comply with the requirements of this standard, the upper and lower body including the neck, arms to the wrists and legs to the ankles, are protected and covered by the clothing described in this standard, but other parts of the body are not and need essential means in order to be fully protected;

2) These protective clothing has been designed to give a specified level of protection for use in firefighting operations and associated activities, in conjunction with other accessories like protective helmet, protective fire fighting boot, protective hood and fire fighting protective gloves; and

3) These protective clothing is not designed for use as fire entry suit.

THIS FIRE FIGHTING PROTECTIVE GARMENT MEETS THE REQUIREMENTS OF THIS INDIAN STANDARD
Manufacturer's name and address Country of manufacture Manufacturer's garment identification number Article number Model no. (along with information about outer layer) Moisture layer Thermal layer with inner liner Category of protective clothing Size Date of manufacture Batch/lot no. Care labelling symbols as specified in IS 14452 Garment material(s) Pictogram as given in Fig. 2 These protective clothing are not designed for use as fire entry suit **"DO NOT REMOVE THIS LABEL"**

FIG. 1 LABEL

FIG. 2 PICTOGRAM ISO 7000-2418

8.3.2 *Instructions and Information*

Protective clothing manufacturers shall also provide the following instructions and information with each garment:

a) Cleaning and instructions;

b) Maintenance criteria;

c) Methods of repair; and

d) Warranty information.

8.3.3 *Training Materials*

Protective clothing manufacturers shall furnish training materials that address, but are not limited to:

a) Safety considerations;

b) Storage conditions;

c) De-contamination procedures; and

d) Retirement considerations.

8.4 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed there under, and the products may be marked with the Standard Mark.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 1969 (Part 1) : 2018/ISO 13934 -1 : 2013	Textiles — Tensile properties of fabrics: Part 1 Determination of maximum force and elongation at maximum force using the strip method (*fourth revision*)
IS 6489 (Part 2) : 2011/ISO 13937 -2 : 2000	Textiles — Tear properties of fabrics: Part 2 Determination of tear force of trouser shaped test specimens (single tear method) (*second revision*)
IS 13360 (Part 6/ Sec 10) : 2023/ ISO 3146 : 2022	Plastics — Methods of test: Part 6 Thermal properties, Section 10 Determination of melting behaviour (melting temperature or melting range) of semi-crystalline polymers by capillary tube and polarizing-microscope methods (*second revision*)
IS/ISO 13935-2 : 2014	Textiles — Seam tensile properties of fabrics and made up textile articles: Part 2 Determination of maximum force to seam rupture using the grab method (*first revision*)
IS 14452 : 2023/ ISO 3758 : 2012	Textiles — Care labelling code using symbols (*second revision*)
IS 15370 : 2023/ ISO 6330 : 2021	Textiles — Domestic washing and drying procedures for textile testing (*second revision*)
IS 15758	Textiles — Protective clothing:
(Part 1) : 2020/ ISO 9151 : 2016	Determination of heat transmission on exposure to flame (*first revision*)
(Part 2) : 2007/ ISO 6942 : 2002	Assessment of material assemblies when exposed to source of radiant heat
(Part 3) : 2007/ ISO 6530 : 2005	Test method for resistance of material to penetration by liquids
(Part 4) : 2020/ ISO 15025 : 2016	Method of test for limited flame spread (*first revision*)
IS 15809 : 2017	High visibility warning clothes — Specification (*first revision*)
IS 17462 (Part 1) : 2020/ISO 12127 -1 : 2015	Clothing for protection against heat and flame — Determination of contact heat transmission through protective clothing or constituent materials: Part 1 Contact heat produced by heating cylinder

ANNEX B

(*Clause* 5.2.2)

CHECKING OF BASIC ERGONOMIC FEATURES OF PROTECTIVE CLOTHING — PRACTICAL PERFORMANCE TESTS

B-1 This Annex informs how some basic ergonomic features can be checked for many types of protective clothing in a pragmatic way. This annex is not intended to replace ergonomic testing required by the user for the individual assessment of protective clothing at a specific workplace. In general carrying out ergonomic assessments can help to improve protective clothing and detect major deficiencies.

B-2 In principle, one or more experienced assessors should examine the protective clothing after reading the information supplied from the manufacturer. The test clothing of a suitable size should be put on together with such normal clothing as is intended to be worn, and some ergonomic features relating to the practical performance of the protective clothing should be checked (for example, if no movement restrictions are caused). Some of the relevant questions that might be asked are set out below and it is desirable that responses given should be positive.

NOTE — An assessor may have difficulties deciding whether the product is acceptable or unacceptable. It is recommended that the product should be compared with similar items on the market. If it is significantly worse ergonomically, without redeeming features such as enhanced protection, it can be regarded as unnecessarily uncomfortable. Care will need to be taken if there are no directly comparable products. Care will also have to be taken when protection against mortal danger is intended and 'the state of the art' does not allow comfortable conditions for users, nor perhaps conditions free of harm caused by the protective clothing. Carrying out (subjective) ergonomic assessments will more often result in recommendations for changes to improve protective clothing, than in finding the clothing does not comply with the standard.

Question 1: Is the protective clothing free from any sharp or hard edges, rough surfaces or other items on the inner or outer surface of the clothing that are likely to cause harm to the user?

Protective clothing should be inspected manually and visually to ensure that no harmful points exist; for example, no protruding wire ends or other items that could seriously harm a person.

Question 2: Is it possible to put on and take off the protective clothing without difficulty?

The following points should be considered:

a) The ease of putting on and removing the clothing with or without assistance as is appropriate for the type of clothing;

b) The clothing is not too tight for comfort and deep breathing is not restricted and there is nowhere any blood flow restriction; and

c) Clothing design features at, for example, armholes and crotch are appropriately proportioned and positioned.

Question 3: Can the closures, adjusters and restraint systems be operated without difficulty?

The following points should be considered:

a) The adequacy of the range of adjustments available;

b) The ease and security of closures and adjusters; and

c) The closures, adjusters and restraint systems should withstand the forces they are likely to be exposed to during body movements.

Question 4: Can the following movements be carried out without difficulty?

a) Standing, sitting, walking, kneeling, crawling and stair climbing;

b) Raising both hands above the head; and

c) Bending over and picking up a small object, for example, a pencil.

The following points should be considered:

a) The arms and legs of the clothing are not so long that they interfere with hand and foot movements;

b) The clothing is not so loose it flaps about or moves independently and inconveniently;

c) Any point at which unexpected and unintended gaps open up between or within components of the clothing; and

d) Any unreasonable restriction of movements.

Question 5: Does the protective clothing cover the body area to be protected during movements?

The following points should be considered:

a) Coverage of specific protection zones of the intended body area by protective

material or special constructions; and

b) The coverage is maintained during movements as extreme as it is anticipated a user would make.

Question 6: Is the protective clothing compatible with other items of PPE?

The following points should be considered:

a) Protective clothing normally worn as part of an ensemble should be compatible with representative examples of the rest of the ensemble; and

b) Putting on and removing other items of PPE, for example, gloves, boots should be possible without difficulty.

B-3 Grounds for concluding that a product is unacceptable.

The following are obvious reasons for concluding that a protective clothing product is unacceptable and not fit for use:

a) Subject it should fit can not wear it;

b) It does not stay closed or it will not stay in place;

c) It compromises a vital function, such as breathing;

d) Simple tasks to be performed wearing it are impossible;

e) The subject refuses to continue this assessment due to pain; and

f) It prevents the wearing of other essential PPE.

ANNEX C

(*Clause* 5.2.7)

REQUIREMENTS FOR VISIBILITY

C-1 MINIMUM AREA OF VISIBLE MATERIALS

C-1.1 Separate performance retroreflective material shall be attached to the outermost surface of the protective clothing with a minimum area of not less than 0.13 m^2 and give all round visibility by encircling the arms, legs and torso regions of garment(s).

C-1.2 If non-reflective fluorescent or combined performance material is used, the minimum area of fluorescent material shall be not less than 0.2 m^2.

C-2 PHOTOMETRIC REQUIREMENTS

C-2.1 The minimum coefficient of retroreflection for new retroreflective material or combined performance material shall conform to the requirements specified in **5.4.1** of IS 15809.

C-3 The retroreflective/combined performance materials, in order not to affect the performance of the protective clothing, shall comply with the following test requirements:

C-3.1 Heat Resistance

The retroreflective/combined performance materials when tested in accordance with the method given in IS 17468 at a test temperature of 180 °C ± 5 °C, shall not melt, drip, separate, or ignite, and shall not shrink more than 5 percent.

C-3.2 Flame Spread

All materials used for visibility when tested in accordance with IS 15758 (Part 4), in combination with outer layer to make it possible to take samples of the specified dimensions, using the procedures for face ignition, shall not allow hole formation in the material.

ANNEX D

(*Clause* 6.1)

SAMPLING AND CRITERIA FOR CONFORMITY

D-1 LOT

For the purpose of conformance inspection and test sampling, a lot is defined as all the completed protective clothing of the same type, with same assemblies, produced in one facility, using the same production processes and materials, and being offered for delivery at one time to buyer against a dispatch note.

NOTE — Protective clothing of different sizes may be grouped in one lot.

D-2 For assessing the conformity of the lot to the requirements of this standard, the samples as given in col (3) of Table 2 shall be drawn at random from the lot.

D-2.1 A protective clothing shall be considered defective, if it does not meet any of the requirements specified in this standard.

D-3 The lot shall be declared as conforming to the requirements of this standard, if no defective protective clothing is found.

Table 2 Sample Size

(*Clause* D-2)

Sl No.	Number of Protective Clothing in the Lot	Sample Size (No. of Protective Clothing)	Permissible No. of Defectives
(1)	(2)	(3)	(4)
i)	Up to 90	3	0
ii)	91 to 150	3	0
iii)	151 to 280	5	0
iv)	281 to 500	5	0
v)	501 and above	5	0

ANNEX E

(*Foreword*)

COMMITTEE COMPOSITION

Textiles Protective Clothing Sectional Committee, TXD 32

Organization	*Representative(s)*
Northern India Textile Research Association, Ghaziabad	DR ARINDAM BASU **(*Chairperson*)**
Aeronav Industrial Safety Appliances, Noida	SHRI SANDEEP HORA
Arvind Limited, Ahmedabad	SHRI PABITRA SAHOO SHRIMATI PALAK KAKKAR (*Alternate*)
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Member Secretary
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SCIENTIST 'B'/ASSISTANT DIRECTOR
(TEXTILE), BIS

(*Continued from second cover*)

ISO 17493 : 2016	Clothing and equipment for protection against heat — Test method for convective heat resistance using a hot air circulating oven
ISO 23616 : 2024	Cleaning, inspection and repair of firefighters' personal protective equipment (PPE)

The composition of the Committee responsible for the formulation of this standard is given in Annex E.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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