

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)

Deletes

(Continued on third cover)

(Continued from second cover)

Delete ←

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.

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)
ISO 4528 : 2012	Test method for determining the weight of water vapor in a sample of air
ISO 3037 : 2007	Test method for determining the weight of water vapor in a sample of air
ISO 11092 : 2014	Test method for determining the weight of water vapor in a sample of air

Delete

- 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/m².

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

Replace with
IS 17462



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 $250 \text{ }^\circ\text{C}$ 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 $180 \text{ }^\circ\text{C} \pm 5 \text{ }^\circ\text{C}$

→ Replace with IS17468

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 $20 \text{ }^\circ\text{C}$;
- c) 36 percent hydrochloric acid (HCl) at $20 \text{ }^\circ\text{C}$;
- d) 30 percent sulfuric acid (H_2SO_4) at $20 \text{ }^\circ\text{C}$; and

- e) O-xylene, 100 percent

NOTE — Fabrics shall be conditioned for 24 h at $(20 \pm 2)^\circ\text{C}$ 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 $30 \text{ m}^2 \text{ Pa/W}$. 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.

ANNEX A

(Clause 2)

LIST OF REFERRED STANDARDS

IS No.	Title	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 (<i>fourth revision</i>)	IS 15370 : 2023/ISO 6330 : 2021	Textiles — Domestic washing and drying procedures for textile testing (<i>second revision</i>)
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) (<i>second revision</i>)	IS 15758 (Part 1) : 2020/ISO 9151 : 2016	Textiles — Protective clothing: Determination of heat transmission on exposure to flame (<i>first revision</i>)
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 (<i>second revision</i>)	(Part 2) : 2007/ISO 6942 : 2002	Assessment of material assemblies when exposed to source of radiant heat
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 (<i>first revision</i>)	(Part 3) : 2007/ISO 6530 : 2005	Test method for resistance of material to penetration by liquids
IS 14452 : 2023/ISO 3758 : 2012	Textiles — Care labelling code using symbols (<i>second revision</i>)	(Part 4) : 2020/ISO 15025 : 2016	Method of test for limited flame spread (<i>first revision</i>)
		IS 15809 : 2017	High visibility warning clothes — Specification (<i>first revision</i>)
		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

Insert the following references at appropriate places:

① IS 3911:2020/ISO 811:2018 Textiles Fabric — Determination of Resistance to water Penetration — Hydrostatic Pressure Test (*Second Revision*)

② IS 17376:2020/ISO 11092:2014 Textiles — Determination of physiological effect — Measurement of thermal and water vapour resistance under steady-state conditions (Sweating guarded-hot plate test)

To access Indian Standards click on the link below:

https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/knowyourstandards/Indian_standards/isdetails/

③ IS 17468 : 2020/ISO 17493 : 2016 Clothing and Equipment for protection Against Heat — Test Method for Convective Heat Resistance using a Hot Air Circulating oven.