**BUREAU OF INDIAN STANDARDS**

**(New Delhi)**

**AGENDA**

**Textiles Protective Clothing Sectional Committee, TXD 32 21st Meeting**

|  |  |  |
| --- | --- | --- |
| **Date/Day** | **Time** | **Venue** |
| 23 August 2024 | 1100 h | Through Video Conferencing |

**CHAIRMAN:** Dr. Arindam Basu, NITRA, Ghaziabad

**MEMBER SECRETARY:** Shri Mayur Katiyar

**Item 0 WELCOME AND INTRODUCTORY REMARKS BY THE CHAIRMAN**

**Item 1 CONFIRMATION OF THE MINUTES OF THE PREVIOUS MEETING**

**1.1** The minutes of the 20th meeting of the TXD 32 held on 08 July 2024 were circulated vide BIS DG letter No. TXD32/A2.20 dated 16 July 2024. No comments have been received.

* + 1. The Committee may **NOTE.**

**Item 2 COMPOSITION OF TXD 32**

**2.1** The present composition and scope of TXD 32 is given in **Annex 1 (P-5 to 7).**

* + 1. The committee may **DECIDE**.

**2.2** As directed by DG, BIS the memberships of the organizations which did not attend last two sectional committee meetings were terminated. The list of all such organizations is given below.

|  |
| --- |
| 1. Fire Retardant Association of India, Mumbai 2. JCT, Phagwara 3. Ministry of Textiles, New Delhi 4. MKU Limited, Kanpur 5. NBC Equipment Wing, Ministry of Defence (DGQA), Pune 6. Reliance Industries Limited 7. TUV Rhineland (India) Private Limited, Mumbai |

The following organizations have, however, requested to reconsider the termination of the membership. The request of reconsideration of the following members is given in the **Annex 2 (P 8 to 10)**:

* + 1. MKU Limited, Kanpur
    2. NBC Equipment Wing, Ministry of Defence (DGQA), Pune
    3. TUV Rhineland (India) Private Limited, Mumbai
    4. The committee may **DECIDE**.
  1. The Co-option request received from the following organizations are given in **Annex 3 (Page 11 to 25):**

1. M/s Star Wire (India) Limited, Faridabad,
2. Smt Shahi Garg
3. Sri Gopal Suryavanshi
   * 1. The committee may **DECIDE**.

**Item 3 ISSUES ARISING OUT OF THE PREVIOUS MEETINGS**

**3.1** Summary of actions taken on the various decisions of the previous meetings are given in **Annex 4 (Page 26).**

**3.1.1** The committee may **NOTE.**

**Item 4 DRAFT STANDARD FOR FINALISATION**

**4.1** As decided by the Committee, the following draft Indian Standards were issued under wide circulation for eliciting technical comments:

1. **[Doc : TXD/32/25492]** IS 12722 : 1989 Textile **—** Floor Coverings Determination of Flame Resistance by Tablet Test
2. **[Doc : TXD/32/25486]** IS 10054 : 1996 Textiles **—** High Density Polyethylene (HDPE) Monofilament Mosquito Netting Round Mesh **—** Specification (*first revision*)
3. **[Doc : TXD/32/25487]** IS 13501 : 1992 Textiles **—** Determination of Flammability by Oxygen Index
4. **[Doc : TXD/32/25852]** IS 16890 : 2018 Textiles **—** Protective Clothing for Firefighters **—** Specification (*first revision*)
5. **[Doc : TXD/32/25824]** Textiles **—** Fire resistant fabric made of Cotton Man-made fibres, filaments and their blends **—** General and Performance Requirements

The aforementioned draft Indian Standards as issued in wide circulation are given in **Annex 5 (P-27 to 89).** The comments received from Shri Manoj Jhaver, Dupont Speciality Products India Pvt Ltd., Mumbai on **Doc: TXD/32/25824** are given **Annex 6 (Page 90 to 91).**

**4.1.1** The committee may **DECIDE.**

**Item 5 DRAFT STANDARD FOR WIDE CIRCULATION**

**5.1** In the 19th meeting of TXD 32, the committee decided to constitute the working group under the convenorship of Dr M S Parmar, NITRAfor the revision of IS 15768. During the 1st meeting of the working group held on 08 August 2024, the working group finalized the draft revision of IS 15768. The minutes of the meeting along with draft revision of IS 15768 as finalized by the working group is given in **Annex 7 (Page 92 to 125).**

**5.1.1** The committee may **DECIDE**.

**Item 6 COMMENTS ON PUBLISHED STANDARD**

**6.1** A query pertaining to the ambiguity in the scope of the IS 15742 for Requirements for clothing made of limited flame spread materials and material assemblies affording protection against heat and flame was received from Central Marks Department, BIS as given in **Annex 8 (Page 126).** The scope of the standard is given below:

***‘1 SCOPE***

* 1. ***This standard specifies the performance requirements for the limited flame spread properties of textile materials and material assemblies used in protective clothing affording protection against heat and flame.***

***1.2 This standard is applicable to clothing where protection against heat and fire mainly due to accidental contact with small igniting flames is required in circumstances where there is no significant heat or fire hazard such as clothing used in kitchens of commercial organizations such as office canteens, guest houses, restaurants, hotels, motels, inns, hospitals, etc.’***

Clause 1.1 suggests that the standard is applicable for textile materials and material assemblies used in protective clothing while clause 1.2 implies that standard is applicable to entire protective clothing.

To address this issue and ensure the standard’s clarity and effectiveness, it was proposed that the standard is applicable to the entire protective clothing and not only in the textile materials and material assemblies used in protective clothing. The above-mentioned proposal was circulated to the members of TXD 32 sectional committee. The comments received on the above-mentioned proposal are given in **Annex 9 (P- 127 to 128)**.

Furthermore, it is important to note that this standard also falls under the Protective Textiles (Quality Control) Order, 2022.

* + 1. The committee may **DECIDE**.

**6.2** The comments received from M/s NITRA, Ghaziabad on IS 15809 : 2017 for High visibility warning clothes are given in **Annex 10 (P- 129 to 130).**

**6.2.2** The committee may **DECIDE**.

**Item 7 NEW WORK ITEM PROPOSAL**

**7.1** A New work item proposal on Jute based cloth for workers working in foundry and other fire accident prone workplaces is received from M/s NITRA, Ghaziabad. The P-draft on the above-mentioned subject is given in **Annex 11 (P- 131 to 136)**.

**7.1.1** The committee may **DECIDE.**

**Item 8 REVIEW OF R&D PROJECT**

**8.1** In the 18th meeting of TXD 32, thecommittee prepared the Terms of Reference (ToR) for the R&D project on fire hoods for firefighters. The above-mentioned R&D project was then approved by the review committee after Head (TXD) and Member Secretary (TXD 32) apprised the review committee about the project and explained the rationale behind the proposed R&D project. The approved ToR was then made available for public bidding. After receiving bids, the research evaluation committee decided to allocate the project to NITRA, Ghaziabad under the leadership of Smt Shweta Saxena. The mid-term progress report, Statement of Expenditure and Fund Utilization Report as submitted by Smt Shweta Saxena, NITRA, Ghaziabad is given in **Annex 12** **(P- 137 to 139)**. The ToR as approved by the review committee is given in **Annex 13** **(P- 140 to 143)**.

**8.1.1** The committee may **REVIEW**.

**Item 9 ANY OTHER BUSINESS**

**Annex 1**

**(Item 2.1)**

**COMPOSITION OF TEXTILE PROTECTIVE CLOTHING SECTIONAL COMMITTEE, TXD 32**

**SCOPE -** To formulate Indian Standards for testing and specification for textile protective clothing for protection from fire and other health/life hazards

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sl No.** | **NAME OF THE ORGANIZATION** | **REPRESENTED BY** | **MEETING ATTENDANCE** | | |
| **18th** | **19th** | **20th** |
|  | Northern India Textile Research Association, Ghaziabad | Dr. Arindam Basu (**CHAIRMAN)** | P | P | P |
|  | Aeronav Industrial Safety Appliances, Noida | Shri Sandeep Hora | P | P | P |
|  | Arvind Limited, Ahmedabad | Shri Narinder Thapa  Shri Pabitra Sahoo  Smt Palak Kakkar (Alternate) | A | P | P |
|  | Border Security Force, New Delhi | Shri Satish Chandra  Shri Tarun Ravi (Alternate) | A | A | A |
|  | Avient Protective Materials Limited, Pune | Shri Harsh Wardhan Sharma  Shri Rakesh Gaikwad (Alternate) | A | P | P |
|  | Central Industrial Security Force, New Delhi | Shri Anand Saxena  Shri Ravindra Kumar Meel (Alternate) | A | A | A |
|  | Central Reserve Police Force, New Delhi | Shri D.N Lal  Shri Sanjeev Kumar Singh (Alternate) | A | P | P |
|  | Centre for Fire and Explosive Environment Safety, Defence Institute of Fire Research, Delhi | Shri Mahipal Meena  Ms Anjlina Kerketta (Alternate) | P | P | P |
|  | Confederation of Indian Industry, New Delhi | Shri Saunak Banerjee | P | P | P |
|  | Defence Bio-Engineering and Electromedical Laboratory, Ministry of Defence, Bengaluru | Dr T M Kotresh  Shri Vinoth. P (Alternate) | A | A | A |
|  | Defence Institute of Physiology and Allied Science (DRDO), New Delhi | Dr. Madhusudan Pal  Shri Sunil Kumar Hota (Alternate) | A | A | P |
|  | Defence Materials and Stores Research and Development Establishment, Kanpur | Smt. Priyanka Katiyar  Smt. Shraddha Mishra (Alternate) | A | P | P |
|  | Defence Research and Development Organisation, Terminal Ballistics Research Laboratory, Chandigarh | Dr. Preeti Jain  Shri Sandeep Bagga (Alternate) | A | A | P |
|  | Department of Delhi Fire Services, Govt of NCT of Delhi, Delhi | Atul Garg  Shri Sanjay Tomar (Alternate) | A | A | A |
|  | Department of Jute and Fibre Technology, University of Kolkata, Kolkata | Dr Swapan Kumar Ghosh  Dr. Amiya Kumar Singha (Alternate) | A | P | A |
|  | Directorate General Fire Services, Civil Defence and Home Guards, Ministry of Home Affairs, New Delhi | Shri Prashant Longkar | A | P | A |
|  | Directorate General of Quality Assurance, Ministry of Defence, New Delhi | Shri Mahendra Singh  Shri P De (Alternate) | P | A | A |
|  | E.I. DuPont India Private Limited, Gurugram | Shri Manoj Jhaver  Smt. Mithali Chenggapa (Alternate) | P | P | P |
|  | Foremost Technico Private Limited, New Delhi | Shri Vinay Khanna  Shri Anoop Khanna (Alternate) | P | P | P |
|  | Indian Institute of Technology Delhi, New Delhi | Prof. Abhijit Majumdar  Dr Bipin Kumar (Alternate) | P | P | P |
|  | Indian Technical Textiles Association, Mumbai | Dr Anup Rakshit  Shri Sanjay Sathe (Alternate) | P | P | P |
|  | Indo Tibetan Border Police, New Delhi | Shri M Kumar  Shri Uttam Kumar (Alternate) | P | P | A |
|  | Kusumgar Corporates Private Limited, Vapi | Shri Sidhartha Kusumgar  Dr M K Talukdar (Alternate) | P | A | P |
|  | Mishra Dhatu Nigam Limited, Hyderabad | Col Ashwani Kumar | A | A | A |
|  | National Forensic Sciences University, Gandhinagar | Shri S K Khandelwal  Shri Saurabh Kumar (Alternate) | A | A | P |
|  | Northern India Textile Research Association, Ghaziabad | Dr M S Parmar  Smt Shweta Saxena (Alternate) | P | P | P |
|  | National Security Guard, New Delhi | Shri Manu Lochab | P | P | P |
|  | Office of the Textile Commissioner, Mumbai | Shri N. K. Singh  Shri Sanjay Charak (Alternate) | P | P | P |
|  | Oil Industry Safety Directorate, Noida | Shri Devendra M. Mahajan  Shri Harendra Yadav (Alternate) | P | A | A |
|  | Ordnance Clothing Factory, Shahjahanpur | Shri V Mathivanan  Shri Shanmugam B (Alternate) | P | P | P |
|  | SGS India Private Limited, Mumbai | Dr. Anitha Jeyaraj  Dr. Karthikeyan K (Alternate) | P | P | P |
|  | SMPP Private Limited, New Dehi | Shri Ashish Kansal  Dr. S. C. Kansal (Alternate) | P | A | P |
|  | Star Safety Hub, Faridabad | Shri Pawan Kumar Gupta  Shri Naveen Gupta (Alternate) | P | P | P |
|  | System 5S Private Limited, Chennai | Shri Sudhir Takkar  Smt. Bhavna Sr. Takkar (Alternate) | P | P | P |
|  | Teijin India Private Limited, Gurugram | Shri Ravi Kumar  Shri Sahil Aneja (Alternate) | P | A | P |
|  | Tex Corporation Limited, Gurugram | Shri Vijay Toley  Shri Sanjay Aggarwal (Alternate) | A | P | P |
|  | Textiles Committee, Mumbai | Shri Kartikay Dhanda  Smt Shilpi Chauhan (Alternate) | P | A | P |
|  | The Synthetic and Art Silk Mills Research Association, Mumbai | Dr. Manisha Mathur  Smt. Ashwini Sudam (Alternate) | A | A | P |

**Annex 2**

**(Item 2.2)**

**REQUEST FOR RECONSIDERATION OF TERMINATION FROM COMMITTEE**

1. **MKU LIMITED, KANPUR**

 Dear Sir,

Good Afternoon !!

We humbly mention that in previous meetings we were not able to participate as we got occupied in unavoidable commitments.

We have taken note of the policies and guidelines of BIS and going forward we will make sure of our participation.

We are looking forward again for participation in the meeting and humbly requesting once again for our Membership acceptance.

Thanking you in anticipation

Best Regards

Madhurendu Bajpai

Please find attached the filled Form to participate in the TXD 32 sectional committee.

|  |  |
| --- | --- |
| **Principal Member’s Name** |  |
| General Interest | Active participation in Defense Industry related subject matter. |
| Shri/~~Smt./Dr./Prof.~~ | VAIBHAV GUPTA |
| Designation | DIRECTOR |
| Name of Organization | MKU LIMITED |
| Address | 13, GANDHI GRAM, KANPUR-208007, U.P. |
| Mobile No. | 9717495750 |
| E-mail | [vaibhav.gupta@mku.com](mailto:vaibhav.gupta@mku.com) |
| Photograph | A person in a suit and tie  Description automatically generated |

1. **NBC Equipment Wing, Ministry of Defence (DGQA), Pune**

1. Reference :-

(a) BIS email dated Fri, Jun 07, 2024 01 :53 PM.

(b) DGQA(Veh & EE-2) letter No. B/87146-A/BIS CommitteeNeh-2 dated 02 Apr 2024.

2. This is to inform that Lt Col RS Jhinkwan is no longer the representative of NBC Eqpt Wing, Pune in Textile Protective Clothing Sectional Committee TXD-32 as he has been posted out.

3. As per DGQA(Veh & EE-2) letter referred at Para 1 (b) above the present members are:-

(a) Principal Member - Shri RN Aparajit, Jt Controller

(b) Alternate Member - Lt Col Devashish De, Dy Controller

4. It is requested to intimate about the meetings well in advance for informing the members to attend the same.

5. For information and necessary action please.

**TERMINATION OF MEMBERSHIP FROM TEXTILES PROTECTIVE CLOTHING SECTIONAL COMMITTEE, TXD 32**

1. Refer BIS email dated Wed, Jun 12, 2024 12:13 PM.

2. The contact details of the Principle and Alternate Members for the BIS Committees TXD-32 are as follows: -

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl No. | Name of the Committee  / | Principal Member | | | Alternate Member | | |
| Rank/name/  Designation | Address | Email/Fax  No./Phone | Rank/name/  Designation | Address | Email/Fax  No./Phone |
| 1. | Textile  Protective  Clothing  Section  Committee  TXD-32 | Shri RN  Aparajit,  JCQA (NBC) | NBC Eqpt  Wing,  CQA  (FFE)  Complex,  Aundh  Camp,  Pune-27. | [Nbcewaundh-dgga@nic.in](mailto:Nbcewaundh-dgga@nic.in)  [Reamesh-aparajit05@gov.in](mailto:Reamesh-aparajit05@gov.in)  Ph No. 020-272831933 | Lt Col  Devashish  De, DCQA  (NBC) | NBC Eqpt  Wing,  CQA  (FFE)  Complex,  Aundh  Camp,  Pune-27 | [Nbcewaundh-dgga@nic.in](mailto:Nbcewaundh-dgga@nic.in)  [Devashishde.361h@gov.in](mailto:Devashishde.361h@gov.in)  Ph No. 020-272586872 |

1. **TUV Rhineland (India) Private Limited, Mumbai**
2. Dear J.K. Gupta Sir,

I hope this message finds you well.

Please find the attached nomination form for your reference.

We are committed to regularly joining BIS meetings and actively participating. Additionally, we kindly request the possibility of receiving a reminder or notification on the same day as the meeting, preferably as a calendar reminder. This would greatly help us in ensuring we do not miss any meetings.

Thank you for your kind assistance.

Shivendra Parmar

AGM, Technical

1. Dear Sir

Thanks. Due to my regional and global assignments followed with continuous travel, I was unable to attend the two previous meetings. I will request my colleague to nominate themselves in this committee. They will revert back to you shortly.

Thank you once again for bringing me this to my notice.

Warm regards

Dr. Shanmuga Sundaram

Senior Vice President - Products, India, Middle East & Africa

**Annex 3**

**(Item 2.3)**

**REQUESTS FOR CO-OPTION**

1. **M/s Star Wire (India) Ltd.**

To

The Deputy Director General

Bureau of Indian Standard,

9, Bahadur Shah Zafar Marg,

New Delhi – 110002

Dear Sir/Madam,

1. In reference to the meeting between The Director General (BIS) and Major General Ashok Narula, & Ms. Kalpna Adhikari from Star Wire (India) Ltd. I am writing to formally submit our requests and follow up on the discussed matters.
2. We would like to request you to please add us into your mailing list so that in case of any meeting regarding the BP Products we too get the intimation. Our company contact details are as under.

• Company Name : M/s Star Wire (India) Ltd.

• Contact Person : Ms. Kalpna Adhikari, DGM (Mktg.)

• Mail : [kalpanaadhikari@starwire.in](mailto:kalpanaadhikari@starwire.in) and [info@starwire.in](mailto:info@starwire.in)

• Contact Number : 8376900340

1. We would request you if it is possible to designate the Terminal Ballistics Research Laboratory (TBRL), Chandigarh, as the authorized testing laboratory for ballistic trials of bullet-proof products such as BR Jackets, BR Vests, BR Patkas, BR Helmets, BP Morchas, etc. This designation is crucial for ensuring the compliance and quality of our products with established standards.
2. As discussed during the meeting, we urge you to consider developing specific BIS standards for the hinges used in BP Morchas. Currently, the standards referenced for hinges are intended for conventional doors and are not suitable for bulletproof products. Developing tailored standards for hinges used in bulletproof products will enhance safety and efficacy.

We appreciate your attention to these matters and look forward to your favourable response.

Thank you for your cooperation.

Yours Sincerely,

For Star Wire (I) Ltd

Kalpana Adhikari

DGM (Mktg.)

1. **Shahi Garg**

**SHAHI GARG**

shahigarg220@gmail.com , Kakadiya complex, ghod dod road,

7990483766 Surat-395007 ; GUJARAT.

**OBJECTIVE**

I seek challenging opportunities where I can fully use my skills for the success of the organization.

**EDUCATION**

**2017 St.Mark's High School**

SSC

77%

**2019 H.M.Bachkaniwala High School**

HSC

61%

**2023 The Maharaja Sayajirao University**

Bachelor of Engineering

82%

**PROJECTS**

Influence of different alkali on dyeing of cotton with homo-bifunctional reactive dyes

**SKILLS**

Communication skills, Computer knowledge, Time management, Leadership skill.

**ACHIEVEMENTS & AWARDS**

Gold medalist in B.E. Recevied 1st Rank certificate from MSU vision. Awarded by ACTI (Association of chemical Technologists-India) for 1st Rank. Got Miss Fresher Award. Proudly, I had represented my university (MSU) in National Integration Camp and State camp. I have served as National Service Scheme (NSS) Coordinator. Our project got published in IJSRD (International Journal for Scientific Rearch and Development).

**ACTIVITIES**

I have a strong background in community service, including visits to orphanages, old age homes, slum areas, and shelters for disabled individuals. Additionally, I have organized webinars, awareness camps, leadership camps, gaushala & many more. Industrial visits to companies like Hare Krishna Diamond Hub, Balaji Wafers, Aglon Inds. Pvt. Ltd., Donear Ind. Ltd., Ecotex, Nobletex. My active involvement with community has allowed me to organize, manage, and volunteer in various social activities. I have also attended exhibitions to broaden my understanding of diverse fields.

**LANGUAGES**

English

Hindi

Gujarati

**EXPERIENCE**

|  |  |
| --- | --- |
| 10/06/2022 - 18/06/2022 | **ALOK IND.LTD.**  Intern  Grey inspection  Scouring & Desizing & Bleaching  Dyeing & printing  Lab instruments & Testing |
| 1/11/2023 - Till date | **Ventara Hi-Tech fabric-MNC**  Quality control Manager/Lab Incharge /Lab Executive |

**HOBBIES**

Nature walk

Fashion

Music

Reading books

Spirituality

**DECLARATION**

I have ensured that the information provided by me in this resume is true to my knowledge.

**Member Details**

1. Invite ID 5361192879

2.Name Shahi

3. Email ID [shahigarg220@gmail.com](mailto:shahigarg220@gmail.com)

4. Alternate Email

5. Mobile Number 7990483766

6. Address Kakadiya Complex opp Kalyan Jewellers Ghod dod road surat 395007, Surat, GUJARAT, India

7. Organization Name Individual Capacity

8. Designation

9. Other Relevant Information Gold Medalist in Bachelor's of Textile Engineering Recognition from Association of Chemical Technologies NSS Coordinator

**Educational Qualification :**

Graduate MSU 2023

**Experience of R & D projects undertaken :**

|  |  |  |  |
| --- | --- | --- | --- |
| Sl No. | Project Name | Institute Name | Research File |
| 1 | Reactive dyeing on Cotton and Viscose  with different alkalis | Dyestuffs, auxiliaries, testing and analytical methods, effect of alkalis,  effect of concentration of various alkalis |  |

**Papers Published (Not more than 3 important ones) :**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl No.** | **Title** | **Publisher** | **Year** | **File** |
| 1 | Influence of different Alkali on Dyeing of Cotton with Homo-Bifunctional Reactive Dyes | IJSRD | 2023 |  |

**Influence of Different Alkali on Dyeing Of Cotton with Homo - Bifunctional Reactive Dyes**

**D.P. Panchal1 T.A. Pathak2 Deepur Kaushik3 Shahi Garg4 Karan Darji5**

1,2,3,4,5Department of Textile Chemistry

1,2,3,4,5Faculty of Technology and Engineering, Kalabhavan, The Maharaja Sayajirao University of Baroda, Vadodara, India

**Abstract** — The study's goals are to ascertain how various alkalis affect cellulosic material and the dyeing process that result. In the presence of different fixing agents, the material was colored using homo-bifunctional reactive dye (high exhaust reactive dye). Sodium carbonate is one of the

common alkalis; a comparison with potassium hydroxide and sodium silicate is being conducted. To optimize the dyeing parameters, the conventional recipe's alkali concentration was also adjusted and decreased. The color strength of the dyed cellulose samples was examined in order to ascertain

how the various alkalis affected the dyeing procedure. Bright and deep hues are produced by bi-functional reactive dyes because they tend to be highly soluble and have good leveling capabilities. Effluent load and expense were decreased by lowering the alkali concentration, which also produced outstanding shades, equal leveling, and fastness attributes comparable to the conventional recipe.

**Keywords:** Alkali, Dyeing of Cotton, Homo-Bifunctional Reactive Dyes

**I. INTRODUCTION**

Since the dawn of modern civilization, cotton has been used as a textile fabric, and a vast variety of garments are made from cotton fibers. Among all the textile fibers, it is the main type of cellulosic fiber. With the formula (C6H10O5)n, cellulose is an organic molecule that is a polysaccharide made up of a linear chain of several hundred to more than ten thousand β (1→4) connected D-glucose units. Cotton is noted for its comfort, good moisture absorption, and strong wicking qualities. It also has good tensile properties.[1-3]

Reactive dyes are typically used to dye cellulose because of its brightness, range of colors, strong wet fastness, and flexible application. The discovery of bi-functional reactive dyes in the 1970s was a significant breakthrough. Two reactive groups are carried by a dye that is bi-functional. It is possible for the groups to be hetero- or mixed-functional, or homo-bifunctional. The mid-1980s saw a renewed focus on homo-bifunctional types, with additional research being done on items based on bis-vinylsulphonyl and bis-monochlorotriazinyl.[4] Additional benefits of combined bi-functional dyes include enhanced fastness, faster washing-off, and application across a larger temperature range. It is currently offered for sale by over 50 dye makers and is distinguished by its superior economy, high fixation, and variety of application.[4,5] These H-E dyes were designed to considerably outperform comparable products with a single chlorotriazinyl group in terms of fixing and substantivity exhaustion values. A temperature above 80°C was used in conjunction with the thetriazinyl group's propensity for substantivity improvement to promote good fatigue and leveling qualities. This strategy reduced the amount of color in the effluent by improving color use.[6]

Specifically, a significant quantity of electrolyte is needed for the reactive dyes to exhaust. NaCl (common salt) and Na2SO4 (Glauber's salt) are the salts that are most frequently used. Additionally, the cellulose fiber surface ionizes in water to produce negative charges, which creates a charge barrier that prevents color molecules from entering. In order to counteract the negative charges on the fiber surface and facilitate the colors' easier diffusion into the fiber, salt is added to the dye bath [7]. Alkali is applied after the dye molecules have been fully exhausted onto the fiber, causing the dye molecules to become fixed on the fiber. The dye bath must remain alkali-free until the dye is fully exhausted in order to prevent the dye from fixing too soon and causing uneven dyeing. Once the dye has been absorbed into the cellulose phase, a reaction between the dye and cellulose may happen.[8,9]

Temperature and alkalinity conditions affect how the reactive site of the dyes interacts with the functional group on the fiber. When alkali is present, reactive dyes react with the cellulosic fiber to create a strong covalent connection between the oxygen atoms of the hydroxyl group in the cellulose and the carbon atoms of the dye molecule. Alkali addition speeds up the rate of neutralization by making the maximum number of -OH groups available in the dye bath. The type of alkali that should be used for fixation depends on type of reactive the dye..[10, 11]

The purpose of the current study was to dye cotton using homo-bifunctional dye, which has higher consistency than hot brand dyes. Additionally, an effort has been made to look at how various alkalies, such as potassium hydroxide, sodium carbonate, and sodium silicate, affect the dyeing of cotton using homo-bifunctional dye. Using accepted evaluation techniques, the findings were assessed for their dyeing performance.

**II. MATERIALS AND EXPERIMENTAL METHODS**

**A. Fibers**

There are a number of things to take into account when choosing a cloth for dyeing, such as the fiber composition, weave, and finish (Table 1). The cotton fabric used in this investigation was purchased from local market Vadodara, Gujarat.

**Table 1: Specifications of fabric**

|  |  |  |
| --- | --- | --- |
| **Name of fiber** | **Whiteness index**  **(ASTME313)** | **GSM (grams per**  **square meter)** |
| Cotton | 126.57 | 110 |

**B. Dyestuffs**

Reactive dye products belonging to various classes were acquired from a reputable chemical company called Colourtex Ind. Pvt. Ltd. In the current study, homo bifunctional reactive dye with high exhaust was employed (Table 2).

**Table 2: Specification of dyestuff**

|  |  |
| --- | --- |
| Dye Class | Homo Bi-Functional (High Exhaust)  (HE) |
| Chemical name | C.I. Reactive Blue 172 |
| Commercial name | CoracionNavy Blue HE2R |
| Reactive Group | Two Monochlorotriazine groups |

**C. Auxiliaries**

Chemical auxiliaries of the Laboratory Reagent (L.R.) grade were employed in this investigation. Table 3 has a report with all the chemical details.

**Table 3: Specifications of auxiliaries**

|  |  |  |
| --- | --- | --- |
| Name of Chemicals | Chemical  formula | Molecular  weight (g/mol) |
| Glauber’s salt | Na2SO4 \*10H2O | 322.22 |
| Sodium Carbonate | Na2CO3 | 105.98 |
| Sodium meta-Silicate | (Na2O)SiO2 | 122.6 |
| Potassium Hydroxide | KOH | 56.10 |

**D. Experimental Procedure**

Prior to dyeing, cotton samples were given a hot wash. The dye bath was prepared for 3% owf (On weight of fabric) shade. The dyeing was carried out in open bath using the exhaust dyeing technique. The cotton fabric sample was dyed at different pH levels using the following procedure, which took into account the varied alkalis employed as fixing agents.

**Table 4: Dye bath formulation for dyeing**

|  |  |
| --- | --- |
| M: L: R | 1:30 |
| % Shade | 3% |
| Glaubersalt (gpl) | 40 |
| Alkali (gpl) | 20, 40, 60 |
| Temperature (oC) | 90-95 |
| Time (mins) | 45-60 |

**Table 5: pH of dyebath based on alkali used**

|  |  |
| --- | --- |
| **Alkali** | **pH** |
| Sodium carbonate | 10.7 |
| Sodium meta-silicate | 11.5 |
| Potassium hydroxide | 12.7 |

All of the samples were dyed using the exhaust dyeing method in a water-heated dyebath in a laboratory. Utilizing HE dyes, a dye bath with a 3% owf shade was created for cotton fabric. After 10 minutes of room temperature dying, the bath's temperature was gradually increased to 95oC (Table 4). To help the color run out, electrolyte or salt was applied after 15 minutes and left for 30 minutes. The dye bath must remain alkali-free until the dye is fully exhausted in order to prevent the dye from fixing too soon and causing uneven dyeing. As a result, alkali was given to the dye bath after 30 minutes to maintain the pH based on the various alkalis employed (Table 5). After cooling the bath to room temperature and rinsing the samples under tap water, the dyeing process was extended for a further fifteen minutes. The samples were then subjected to a 10- to 15-minute treatment at 60–70 oC using 2 gpl non-ionic detergents to remove the hydrolyzed unfixed dye from the fiber surface. The samples were then dried after receiving a thorough washing in cold water. A similar process was used to dye cotton using various concentrations of the aforementioned alkalis. After that, the color and fastness characteristics of each sample were examined.

**E. Testing and analytical methods**

1) *Determination of color strength*

On various cotton fabric samples, the color parameters of distinct reactive dyed samples were assessed using a computer color matching (CCM) system called the "Premier Color Scan Spectrophotometer" (Model 5100). Different wavelengths of light are transmitted, scattered, and reflected differently by the colored textile materials. The current analysis made advantage of this principle.

K/S= (1-R)2/2R

Where,

K=Absorption Coefficient,

S=Scattering Coefficient

R=Reflectance.

2) *Determination of washing f astness (AATCC 61-1994 test method)*

AATCC 61-1994 test method was used for the determination of washing fastness of dyed fabrics. Launder-O-meter is used for this purpose. The fabric to be tested of 10 × 4 cm was placed between two adjacent undyed fabrics of same size. Then sewed it along four side to form a composite specimen. The composite specimen was placed in a glass jar containing 5 g/l soap solutionand 2 g/l soda ash solution, keeping material to liquor ratio 1:50. Jars were then closed and placed in Launder-O-meter. Machine was then run for 30 minutes at 60 ± 2 ºC temperature after completion of treatment, the samples were removed and washed with water, squeezed, and dried in air. By using Grey scale, the change in shade was assessed and graded from 1 to 5 (1 means poor and 5 means excellent fastness to washing).[12]

3) *Determination of rubbing fastness (AATCC-08)*

A device used for the rubbing test has a finger of 1-6 cm diameter moving to and fro in a straight line covers a 10 cm track on the specimen with a force of 6N, a suitable apparatus is the crock-meter. The rubbing cloth against which the specimens were tested consist of desized, bleached and unfinished cloth cut into 10 ×10 cm size. Piece of material to be tested were prepared in two pairs of pieces not less than 15× 15 cm2, one for the dry rubbing and the other for the wet rubbing test. In both the cases, it travels 10 times in 10 seconds along the track. The staining of the rubbing cloth was assessed with grey scale and graded from 1 to 5 (1 means poor and 5 means excellent fastness to rubbing).[12]

4) *Determination of light fastness (AATCC 16-B- 1977)*

Color fastness to light was evaluated by exposing the dyed samples to sunlight for 8 hours in a normal manner (according to AATCC test method 16-B- 1977) to see the effect of fading of colour due to sunlight. The light fastness properties were evaluated by comparison of exposed portion with the unexposed portion of the material. They were graded from 1 to 8 (1 means poor and 8 means excellent fastness to light) based on blue wool standard scale.[12]

**III RESULT AND DISCUSSION**

A. *Effect of different alkali on the color strength (K/S) values of cotton dyed with homo-bifunctional reactive dye*

The laboratory's Premier Color Scan 5100 CCM system was used to measure the dyed samples' color strength. Evaluation was conducted for each sample based on variations in pH and alkali dosage. The results in terms of K/S values are presented in Table 6.

**Table 6: Colour strength (K/S) values of cotton sample dyed with**

**homo-bifunctional reactive dye**

|  |  |  |
| --- | --- | --- |
| **Alkali** | **Concentration**  **of alkali (gpl)** | **Colour strength**  **(*K/S*)** |
| Sodium Carbonate (Na2CO3) | 20 | 1.663 |
| 40 | 1.671 |
| 60 | 2.072 |
| Sodiummeta- Silicate  [(Na2O)SiO2] | 20 | 1.101 |
| 40 | 1.466 |
| 60 | 2.43 |
| Potassium Hydroxide (KOH) | 20 | 1.293 |
| 40 | 1.46 |
| 60 | 1.624 |

1*) Effect of alkali*

Various alkalis were employed as fixing agents in cotton dyeing, as this study examines. It was for this reason that the pH varied according to the alkalis employed. While potassium hydroxide and sodium meta-silicate provide a greater alkaline environment for dyeing, HE dyes need a milder alkaline environment to create covalent bonds. Although these two alkalis can be employed as a buffer system, they provide duller colors when used alone since HE dyes cannot withstand extremely high alkaline dyeing conditions [13]. Because soda ash is a moderate alkali and is in the right pH range, it reacts with the fiber to create a long- lasting bond that keeps the dye attached to the fiber. In all three of the dyebath's alkali concentrations, it effectively activates the fiber molecules to allow them to chemically attack the dye and provide outstanding depth of shade (Figure 1).

2) *Effect of concentration of various alkalis*

The dyeing recipe took into account three distinct alkali concentrations. As needed, the normal concentration of 40 gpl produced the best outcomes. When the concentrations were changed, the findings demonstrated that the depth of shade was achieved at or nearly as well as that of samples dyed in the presence of 40 gpl of alkali when the concentration was reduced, i.e., 20 gpl. Additionally, as the alkali effluent load rises, greater alkali dosages, such as 60 gpl, are found to be environmentally hazardous.

A screenshot of a computer

Description automatically generated

A) Conc. of alkali (gpl)

A screenshot of a computer

Description automatically generated

B) Conc. Of alkali (gpl)

A screenshot of a computer

Description automatically generated

C) Conc. of alkali (gpl)

Fig. 1: Color strength obtained based on different alkalis

used i.e., (a) Sodium carbonate, (b)Sodium meta-silicate, (c)

Potassium hydroxide

B*. Effect of different alkali on the fastness properties of cotton dyed with homo-bifunctional reactive dye*

The fastness attributes are the most crucial requirements for any dyeing from the perspective of the consumer. Table 7 displays the results of the evaluation of the dyed samples'

**Table 7: Fastness ratings of cotton dyed with homo-bifunctional reactive dye**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Name of alkali | Concentration of alkali | Washing fastness ratings  (1 to 5) (colour stain) | | Rubbing fastness ratings  (1 to 5) | | Light fastness  ratings (1 to 8) |
| Dry rubbing | Wet rubbing | Colour stain | Colour change | Colour fading |
| Sodium Carbonate (Na2CO3) | 20 | 5 | 5 | 5 | 5 | 7 |
| 40 | 5 | 5 | 5 | 5 | 7 |
| 60 | 5 | 5 | 5 | 5 | 7 |
| Sodiummeta-Silicate [(Na2O)SiO2] | 20 | 5 | 5 | 4.5 | 4.5 | 5 |
| 40 | 3.5 | 4.5 | 3.5 | 4.5 | 7 |
| 60 | 4 | 3.5 | 4 | 4 | 7 |
| Potassium Hydroxide (KOH) | 20 | 3.5 | 3.5 | 4 | 4 | 5 |
| 40 | 4.5 | 3.5 | 4.5 | 3.5 | 5 |
| 60 | 4 | 4 | 3.5 | 4 | 7 |

**IV. CONCLUSION**

Brighter hues and better exhaustion are produced when homo-bifunctional dyes are applied to cotton fabric. According to the study's findings, sodium carbonate produced a superior fixation than other alkalis when utilized as a fixation agent. This was because sodium carbonate supplied the ideal pH level needed for HE dyes. When the amount of alkalis was varied, it was discovered that dropping the concentration below the recommended level might produce great results. Because potassium hydroxide and sodium meta- silicate are extremely alkaline by nature, they negatively affect the dye's pH and higher concentrations of these alkalis can result in higher effluent loads. As a result, it can be said that sodium carbonate, when employed under conditions of lower concentration, can produce equally good outcomes as regular alkali dosage while also reducing effluent burden.

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1. **Mr Gopal Suryavanshi**

**RESUME**

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|  |  |  |  |
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| 3 | Doctorate | Not Applicable | 2020 |

**Experience of R & D projects undertaken :**

|  |  |  |  |
| --- | --- | --- | --- |
| **S**  **No** | **Project Name** | **Institute Name** | **Research File** |
| **1** | **Gopal Suryawanshi** | **NA** | **No document uploaded** |

**Annex 4**

**(Item 3.1)**

**SUMMARY OF ACTIONS TAKEN ON THE MINUTES OF THE**

**LAST MEETING OF TXD 32**

|  |  |  |
| --- | --- | --- |
| **ITEM NO.** | **DESCRIPTION OF ACTION REQUIRED** | **ACTION TAKEN** |
| **2.1 & 2.2** | **SCOPE AND COMPOSITION OF TXD 32** | Updated composition is given in **Annex 1** |
| **4.1 &4.2** | The committee decided to finalize the amendment to IS 15768 | Under publication |

**Annex 5**

**(Item 4.1)**

**WIDE CIRCULATION DRAFTS**

1. **[Doc : TXD/32/25492]** IS 12722 : 1989 Textile **—** Floor Coverings Determination of Flame Resistance by Tablet Test

**भारतीय मानक ब्यूरो**

**BUREAU OF INDIAN STANDARDS**

*Draft for comments only* Doc: TXD 32 (25492)WC

*भारतीय मानक*  मसौदा

**फर्श पर बिछाए जाने बाले वस्त्रादि** — **गोली परीक्षण द्वारा ज्वाला प्रतिरोध निर्धारण बिधी**

(आई एस 12722 का *पहला पुनरीक्षण*)

Draft *Indian Standard*

**Textile Floor Coverings — Determination of Flame Resistance**

**by Tablet Test**

**(*First revision* of IS 12722)**

**ICS 13.220.40**

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BIS or used as Standard 01 July 2024

Textiles Protective Clothing Sectional Committee, TXD 32

**FOREWORD**

Besides the conventional textile floor coverings manufactured from wool, silk jute, etc., these are now increasingly being manufactured utilizing blends containing man-made fibres. Their flammability depends upon the constituent fibres, exposure conditions during actual use and the nature of flame retardant treatment imparted. The floor coverings are normally subjected to various treatments, such as shampooing, dry-cleaning, washing and hot water extraction cleaning during actual use. The flame retardant finish is required to withstand these treatments. Since the type of such treatments vary considerably depending upon the end use, it is recommended that the type and number of such treatments may be as agreed to between the buyer and the seller.

This standard was first published in the year 1989 and it is being revised again to update the reference in the standard.

While preparing this standard, considerable assistance has been derived from ISO 6925 ‘Textile floor coverings-Burning behaviour - Tablet test at ambient temperature’, issued by the International Organization for Standardization (ISO).

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 ‘Rules for rounding off numerical values (*second revision*)’.

**1 SCOPE**

**1.1** This standard prescribes a method for the determination of flame resistance of textile floor coverings in a horizontal position when exposed to a small source of ignition under controlled laboratory conditions.

**1.2** The method is applicable to all types of textile floor coverings irrespective of their construction or their fibre composition. The method may also be applicable to unfinished material.

**1.3** The results obtained on specimens in a horizontal position, as specified in this standard, do not apply to the behaviour of the textile floor covering when used in another position, particularly in a vertical position.

NOTE — The method should be used solely to assess the properties of materials or systems in response to heat and flame under controlled laboratory conditions and should not be used for the evaluation or regulation of the hazard of textile floor coverings under actual fire conditions. The method has been used extensively in the trade for acceptance testing and is considered satisfactory as a test for acceptance of merchandise, provided that an appropriate sampling plan such as given IS 7877 (Part I). Methods of sampling and tests for handmade carpets: Part 1 Sampling and selection of areas of physical tests, is used.

**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 subjected to revision, and parties to agreements based on this standard are encourage to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

**3 PRINCIPLE**

**3.1** A specimen of textile floor covering is exposed in a horizontal position to the action of a small ignition source (methenamine tablet) under specified conditions and the resulting damaged length is measured.

**4 APPARATUS**

**4.1 Test Box**

A test box with inside dimensions of 300 × 300 × 300 mm and made from hard, fire resistant insulation board with similar thermal properties to asbestos cement board, not less than 6 mm thick. The chamber is open at the top and has a flat removable base made of the same material as above. The joints shall be air tight.

NOTE — Any other test chamber giving identical results may be used.

**4.2 Square Metal Plate**

The square metal plate shall be of size 230 × 230 mm, 6.5 ± 0.5 mm thick, with a 206 mm diameter hole cut in the centre of the plate.

**4.3 Desiccator(s)**

The desiccator shall be required for storing the methenamine tablets (set 5.1) and the bone dry specimens (*see* **6.4.2**). It is recommended that self-indicating silica gel is used as desiccant.

**4.4 Circulating Air Oven**

The oven shall be ventilated, forced draught and thermostatically controlled at 105 ± 2 ºC throughout the enclosure.

**4.5** **Glove**, disposable, of polyethylene, polypropylene or rubber.

**4.6** **Rule**, graduated in mm.

**4.7 Vacuum cleaner**

A vacuum cleaner of which all surfaces in contact with the specimen are flat and smooth, shall be required.

**4.8 Laboratory Fume Hood**

Laboratory fume hood of about 2m3 capacity, capable of being closed and having its draught turned off during the test shall be required. The front or one of the sides of the hood shall be of glass in order to permit observation of the specimen during the test.

**4.9 Timing Device**

Requirement of timing device will be optional.

**5 REAGENTS**

**5.1** **Methenamine Tablet**

**5.1.1** Tablets of hexamethylenetetramine, flat, having a mass of 150 ± 5 mg and a diameter of

6 mm.

NOTE — Storage of the tablets in a desiccator reduces the tendency to crack upon ignition.

**6 PREPARATION OF TEST SPECIMENS**

**6.1 Sampling**

**6.1.1** Sampling of specimens shall be carried out in accordance with IS 7877 (Part 1).

**6.2 Dimensions and Number**

**6.2.1** Cut at least eight specimens, each 230 ± 3 mm square, from each sample.

**6.3 Underlays**

**6.3.1** The use of an underlay is not specified. However, subject to agreement between the interested parties, this method can be used to assess the effect of an underlay in combination with a textile floor covering.

**6.4 Conditioning of Test Specimens**

**6.4.1** Clean each specimen with the vacuum cleaner (**4.7**) until the pile is free from fluff or loose ends of yarn, fibres, etc.

**6.4.2** Condition the test specimens in a manner that will permit free air circulation so that they are not resting upon one another, in one of the following ways, or as agreed between the interested parties:

1. In the standard atmosphere of 27 ± 2 °C and 65 ± 2 percent relative humidity in accordance with IS 6359, or
2. By drying the specimens in the oven (**4.4**) at 105 ± 2 °C for 2 hours, removing the specimens from the oven with a gloved hand (*see* **4.5**) and placing the specimens immediately in the desiccator (**4.3**) for at least 1 hour, until they reach ambient temperature.

NOTE — The use of bone dry specimens may be more stringent than the use of specimens conditioned at 65 percent relative humidity. However, it may be that use of specimens conditioned at 65 percent relative humidity is more realistic. Performance requirements should be set accordingly.

**7 DURABILITY OF FLAME RETARDANT TREATMENT**

**7.1** For checking the durability of flame retardant treatment applied to the textile floor-coverings, the type and number of treatments for shampooing, dry-cleaning, washing and/or hot water extraction cleaning, etc shall be as per the agreement between the buyer and the seller (*see* also IS 11471and IS 11969).

**8 PROCEDURE**

**8.1** Carry out the test in an atmosphere having a temperature between 15 and 35°C and a relative: humidity between 20 and 70 percent.

**8.2** Place the test chamber (**4.1**) in the laboratory fume hood (4.8) with the ventilation turned off.

**8.3** Remove a specimen from the conditioning atmosphere or desiccator according to the method of conditioning chosen in (**6.4**) with a gloved hand and, if there is a pile, brush it in a direction opposite to the lay to bring the pile to an upright position.

**8.4** Place the specimen flat on the floor of the test box with the use surface uppermost, ensuring the specimen is horizontal. Place the metal plate (**4.2**) on top of the specimen, and line up the outside edges of the plate with those of the specimen.

**8.5** Place a methenamine tablet (**5.1**) flat and in the centre of the specimen and ignite the tablet with a lighted match which shall only lightly touch the upper face of the tablet. If ‘used, start the timing device (**4.9**). Do not touch the specimen with the lighted match.

**8.5.1** If more than 2 minutes elapses between removal of the specimen from the conditioning atmosphere or the desiccator and ignition of the tablet, repeat the procedure specified in **8.1** to **8.5** with a new conditioned specimen. Close the fume cupboard.

**8.5.2** If the tablet cracks upon ignition, consider the test result void.

**8.6** Allow the ignition flame or any propagated flame to burn until extinction or until the flame or glowing reaches the edges of the hole in the metal plate. Terminate the test when either of the above conditions is reached. Stop the timing device, if used. Start the ventilation in the fume hood to eliminate any volatile products of combustion.

**8.7** After each specimen has been tested, lift the removable base from the test chamber and fret it of any residue which would prevent the next specimen from lying in a horizontal plane. Allow sufficient time between each test for the test chamber to cool to ambient temperature ±5˚C.

**8.8** Repeat the procedure specified in **8.3** to **8.7** on each specimen.

**8.9** On each specimen measure, to the nearest mm, the maximum distance between the centre of the specimen and the edge of the damaged zone using the rule (**4.6**).

**8.10** If required, measure the time in seconds from the ignition of the tablet to the moment when the flame or glowing reaches the edge of the hole in the metal plate, using the timing device (**4.9**).

**9 EXPRESSION OF RESULTS**

**9.1** The results of the test shall be the value obtained for each specimen (*see* **8.9**).

**10 TEST REPORT**

**10.1** The test report shall include the following information:

1. A statement of the sampling plan used.
2. Whether a separate underlay was incorporated in the test (*see* **6.3**).
3. The conditioning atmosphere used for the test specimens (*see* **6.4**).
4. For each specimen, the damaged length as determined in **8.9**.
5. If required, the flame spread time measured according to (**8.10**).
6. Any operating detail not stated in this standard or any incident likely to have an effect on the test results.

**ANNEX A**

(*Clause* 2)

**LIST OF REFERRED STANDARDS**

|  |  |
| --- | --- |
| *Is No.* | *Title* |
| IS 6359 : 2023 | Method for conditioning of textiles (*first revision*) |
| IS 11471 : 2020  ISO 2551 : 2020 | Textile Floor Coverings and Textile Floor Coverings in Tile Form — Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions and Distortion out of Plane (*First Revision*) |
| IS 11969 : 2020  ISO 18168 : 2020 | Textile floor coverings — Colour fastness to shampooing (*first revision*) |
| IS 7877 (Part 15) : 1976 | Methods of sampling and tests for hand-made carpets |

1. **[Doc : TXD/32/25486]** IS 10054 : 1996 Textiles **—** High Density Polyethylene (HDPE) Monofilament Mosquito Netting Round Mesh **—** Specification (*first revision*)

**भारतीय मानक ब्यूरो**

**BUREAU OF INDIAN STANDARDS**

*Draft for comments only* Doc: TXD 32 (25486) WC

*भारतीय मानक*  मसौदा

**वस्त्रादि – उच्च घनत्व पॉलीइथलीन मोनोफिलामेंट का गोल जाली का मच्छरदानी का कपड़ा** – **विशिष्टी**

(आई एस 10054 का *दूसरा पुनरीक्षण*)

Draft *Indian Standard*

**Textiles — High Density Polyethylene (HDPE) Monofilament Mosquito Netting, Round Mesh —Specification**

( *Second Revision* of IS 10054 )

**ICS 59.080.30**

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BIS or used as Standard 01 July 2024

Textiles Protective Clothing Sectional Committee, TXD 32

FOREWORD

(*Formal clauses will be added* *later*)

This standard was originally published in 1981 and was subsequently revised 1996. The present revision has been made in the light of experience gained since last revision and to incorporate the following major changes:

1. Method for identification of polyethylene has been incorporated in the standard.
2. Packaging clause has been modified.
3. Marking clause has been updated.
4. Method of test for count of yarn has been incorporated.
5. References to Indian Standard given in Annex A has been updated.

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 ‘Rules for rounding off numerical values (revised)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

**1 SCOPE**

**1.1** This standard prescribes constructional details and other requirements of HDPE monofilament mosquito netting, round mesh.

**1.2** This standard does not specify the general appearance, feel, shade, etc, of the netting.

**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 the standards indicated in Annex A.

**3 MANUFACTURE**

**3.1 Yarn**

The monofilament yarn used for the manufacture of the netting shall be made out of HDPE of designation HDPE LAN A50 T012, or HDPE LAN A57 T012, or HDPE LAN A50 T022 or HDPE LAN A57 T022 according to IS 7328. However, the density of the material used shall not be more than 955 kg/ m3 at 27°C and the melt flow rate (MFR) - 190/50 of the material shall be between 1.3 to 2.4 g/10 min. The filament shall be uniform and reasonably free from defects.

**3.2 Netting**

The shade of the netting shall be as agreed to between the buyer and the seller and the netting shall be free from knitting and other defects.

**4 REQUIREMENTS**

**4.1 Construction**

The netting shall comply with the requirements specified in Table 1. The linear density of filament is given for guidance only.

**Table 1 Particulars of HDPE Monofilament Mosquito Netting, Round Mesh**

(*Clause* 4.1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sl No.** | **Linear Density of Filament** | **Number of Holes per cm2** | **Mass,**  **g/m2** | **Bursting Strength,**  ***Min***  **N (or kgf/m2)** | **Width,**  **cm** | **Length,**  **m** |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| i) | 18 to 19 tex  (or 160 to 170 denier) | 16 to 20 | 80 ± 5% | 83 (or 8.5) | 122 or as agreed ±1 | As agreed |
| Method of test | IS 3442 | Annex B | IS 1964 | IS 1966 | IS 1954 | |

**4.2 Colour Fastness**

The colour fastness rating of netting shall comply with the requirements specified in Table 2.

**Table 2 Colour Fastness**

(*Clause* 4.2)

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No.** | **Colour Fastness Rating** | **Requirement** | **Method of Test** |
| (1) | (2) | (3) | (4) |
| i) | Light (change in colour), *Min* | 5 | IS/ISO 105-B01 or IS/ISO105-B02 |
| ii) | Washing, Test 2 (change in colour and staining), *Min* | 4 | IS/ISO 105-C10 |

* 1. The Polyethylene in the monofilament Mosquito Netting shall be identified by the method prescribed in IS 667.

**5 MARKING**

**5.1** The netting shall be marked with the following:

a) Name of the material;

b) Width and length of the piece;

c) Source of manufacture; and

d) Year of manufacture

**5.2 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 thereunder, and the products may be marked with the Standard Mark.

**6 PACKING**

Each roll or bundle of mosquito netting shall be packed in low density polyethylene film of 60 gm thickness (150 gauge) or any other suitable material as agreed to between the buyer and the seller. The rolls or bundles shall again be packed in bales or cases. The packaging shall be roadworthy, airworthy and seaworthy.

**7 SAMPLING**

**7.1 Lot**

The number of pieces of mosquito netting delivered to a buyer against one despatch note shall constitute a lot.

**7.2** For assessing the conformity of the lot to the requirements of the standard, the samples as given in Table 3 shall be drawn at random from the lot for inspection. To ensure the randomness of selection, methods given in IS 4905 shall be followed.

**Table 3 Sample Size**

(*Clause* 7.2)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl No.** | **Number of Pieces in the Lot** | **Number of Pieces to be Inspected for** | | |
| **Length, Width and Number of Holes** | **Mass and Bursting Strength** | **Colour Fastness** |
| (1) | (2) | (3) | (4) | (5) |
| i) | Up to 100 | 8 | 3 | 2 |
| ii) | 101 to 150 | 13 | 5 | 2 |
| iii) | 151 to 300 | 20 | 5 | 2 |
| iv) | 301 and above | 32 | 8 | 3 |

**7.3** The lot shall be considered as conforming to the requirements of this standard if all the samples meet the requirements specified in the standard.

**ANNEX A**

(*Clause* 2)

**LIST OF REFERRED STANDARDS**

|  |  |
| --- | --- |
| *IS No.* | *Title* |
| IS 667 : 1981 | Methods for identification of textile fibres (*first revision*) |
| IS 1954 : 1990 | Determination of length and width of woven fabrics — Methods (*second revision*) |
| IS 1964 : 2001 | Textiles — Methods for determination of mass per unit length and mass per unit area of fabrics (*second revision*) |
| IS 1966 (Part 1) : 2022 | Textiles — Bursting properties of fabrics Part 1: Hydraulic method for determination of bursting strength and bursting distension (*third revision*) |
| IS 3442 : 2023 | Textiles — Method for determination of crimp and linear density of yarn removed from fabric (*second revision*) |
| IS 4905 : 2015 | Random sampling and randomization procedures (*first revision*) |
| IS 7328 : 2020 | Specification for Polyethylene Material for Moulding and Extrusion (*third revision*) |
| IS/ISO 105-B01 : 2014 | Textiles — Tests for colour fastness — Part B01 Colour fastness to light: Daylight |
| IS/ISO 105-B02 : 2014 | Textiles — Tests for colour fastness — Part B02 Colour fastness to artificial light: Xenon arc fading lamp test |
| IS/ISO 105-C10 : 2006 | Textiles — Tests for colour fastness — Part C10 Colour fastness to washing with soap or soap and soda |

**ANNEX B**

(*Table* 1)

**MEASUREMENT OF NUMBER OF HOLES**

**B-1 APPARATUS**

**B-1.1 Template**

a) A metal plate of about 0.5 mm thickness with a square hole of 2 cm × 2 cm cut accurately in the centre.

OR

b) A rigid transparent plastic sheet with a square of 2 cm × 2 cm marked in the centre.

**B-2 METHOD**

Lay the netting flat without stretching on a flat surface of contrast colour. Count the number of holes in the square marked on/cut in the template in such a way that holes of more than half in size are counted as full hole and holes which are less than half in size are ignored. Divide the number of holes thus counted by 4. Count the number of holes at 5 different places and calculate the average.

1. **[Doc : TXD/32/25487]** IS 13501 : 1992 Textiles **—** Determination of Flammability by Oxygen Index

**भारतीय मानक ब्यूरो**

**BUREAU OF INDIAN STANDARDS**

*Draft for comments only* Doc: TXD 32 (25487) WC

*भारतीय मानक*  मसौदा

**वस्त्रादि — ऑक्सीजन सूचकांक द्वारा ज्वलनशीलता ज्ञात करना**

( आई एस 13501 का *पहला पुनरीक्षण* )

Draft *Indian Standard*

**Textiles — Determination of Flammability by Oxygen Index**

( *First Revision* of IS 13501 )

**ICS 13.220.40**

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BIS or used as Standard 01 July 2024

Textiles Protective Clothing Sectional Committee, TXD 32

FOREWORD

(*Formal clauses will be added* *later*)

Oxygen index results obtained using the method prescribed in this standard can provide a sensitive measure of the burning characteristics of a textile material intended for clothings under certain con- trolled laboratory conditions, and hence may be useful for quality control purposes. The results obtained are dependent upon the shape, orientation and isolation of the test specimen and conditions of ignition. For particular materials or applications, it may be necessary or appropriate to specify different test conditions. Such requirements should be referred to in other standards.

This standard was originally published in 1992. It has been revised to incorporate following changes:

1. References of Indian standards have been updated
2. Amendment has been incorporated.

Results obtained from test specimens of differing thickness or by using different ignition procedures may not be comparable and no correlation with flammability behaviour under other fire conditions is implied. Results obtained in accordance with this standard must not be used to describe or appraise the fire hazard presented by a particular textile material or shape under actual fire conditions, unless used as one element of a fire risk assessment that takes into account all the factors pertinent to the assessment of the fire hazard of a particular application for the textile material.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’.

**1 SCOPE**

**1.1** This standard specifies method for deter­mining the minimum concentration of oxygen, is admixture with nitrogen that will support combustion of small vertical test specimens under specified test conditions. The results are defined as oxygen index values.

**1.2** The method prescribed in this standard provides a sensitive measure of the burning characteristics of textile materials intended for clothings.

**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 subjected to revision, and parties to agreements based on this standard are encourage to investigate the possibility of applying the most recent editions of the standards indicated in Annex **A**.

**3 PRINCIPLE**

**3.1** A small test specimen is supported vertically in a mixture of oxygen and nitrogen flowing up­wards through a transparent chimney. The upper end of the specimen is ignited. The mini­mum concentration of oxygen in a mixture of oxygen and nitrogen flowing upward in a test chimney that will just support combustion is measured under equilibrium conditions of candle-like burning. The equilibrium is established by the relation between the heat generated from the combustion of the specimen and the heat lost to the surroundings as measured by one or the other of two arbitrary criteria, namely, the period for which burning continues, or the length of specimen burnt. This point is approa­ched from both sides of the critical oxygen con­centration in order to establish the oxygen index.

**4 DEFINITION**

**4.0** For the purpose of this standard, the definitions given in IS 11871 and the follow­ing definition shall apply.

**4.1 Oxygen Index**

The minimum concentration of oxygen by percentage volume in a mixture of oxygen and nitrogen that will just support combustion of a material under specified test conditions.

**5 APPARATUS**

The following apparatus shall be arranged as indicated in Fig. 1 and 2.

**5.1 Test** **Chimney**

A heat resistant glass tube supported vertically on a base through which oxygen-containing gas mixture can be introduced. The preferred dimensions of the chimney are 450 mm mini­mum height and 75 mm minimum diameter cylindrical bore. The upper outlet shall be rest­ricted as necessary by an overhead cap having an outlet small enough to produce an exhaust velocity of at least 90 mm/s from a flow rate within the chimney of 30 mm/s (*see* Note). Chimneys of other dimensions, with or without restricted outlets, may be used, if shown to give equivalent results. The bottom of the chimney, or the base upon which the chimney is supported, shall incorporate a means for distributing evenly the gas mixture entering the chimney. The pre­ferred means comprises solid glass beads of bet­ween 3 and 5 mm diameter, in a layer between 80 and 100 mm deep. Other means, such as radial manifolds, may be used, if shown to give equi­valent results. A porous screen may be mounted below the level of the specimen holder, to prevent falling combustion debris from fouling the gas entry and distribution paths. The chimney support may incorporate a levelling device and indicator, to facilitate vertical align­ment of the chimney and a test specimen supported therein. A dark background may be provided to facilitate observation of flames within the chimney.

NOTE— For tubes of 75 to 100 mm diameter, a cap converging to an outlet of 40 mm diameter at a level at least 10 mm above the top of the cylindrical chimney has been found satisfactory.

**5.2 Test Specimen Holder**

Suitable for supporting a specimen vertically in the centre of the chimney. The specimen shall be supported by both vertical edges in a frame equivalent to that illustrated in Fig. 2, with reference marks at 20 mm and 100 mm below the top of the frame. The profile of the holder and its support should be smooth to minimize induction of turbulence in the rising flow of gas.

**5.3 Gas Supply**

Comprising commercial grade oxygen and nitrogen. If an air supply is used with oxygen or nitrogen, it shall be clean and dry. The gas supply system shall incorporate a drying device. The constituent gas supply lines shall be linked in a manner which thoroughly mixes the gases, before they enter the gas distribution device at the base of the chimney, so that the variation in oxygen concentration in the gas mixture rising in the chimney, below the level of the test specimen, is less than 0.2 percent (v/v).

**5.4 Gas Measurement and Control Devices**

Suitable for establishing the concentration of oxygen and nitrogen in the gas mixture entering the chimneywith an accuracy of ± 1.0 percent (*v/v)*.

NOTE — System of measurement and control that have proved satisfactory include the following:

1. Needle valves on individual and mixed gas supply lines, a paramagnetic oxygen analyzer that conti­nuously samples the mixed gas, and a flowmeter to indicate when the gas flow through the chimney is within the required limits;
2. Calibrated orifices, gas pressure regulators and pressure gauges on the individual gas supply lines; Or
3. Needle valves and calibrated flowmeters on the individual gas supply lines.

Systems (b) and (c) may require calibration after assembly to ensure that the compounded errors of the component parts do not exceed the requirements of **5.4**.

**5.5 Flame Igniter**

Comprising a tube that can be inserted into the chimney **to** apply to the test specimen a flame issuing from an outlet of 2 ± 1 mm diameter at the end of the tube. The flame fuel shall be commercially available liquefied petroleum gas (LPG). The fuel supply shall be adjusted so that the flame will project 6 to 25 mm vertically downwards from the outlet when the tube is vertical within the chimney and the flame is burning within the chimney atmosphere.

**5.6 Timing Device**

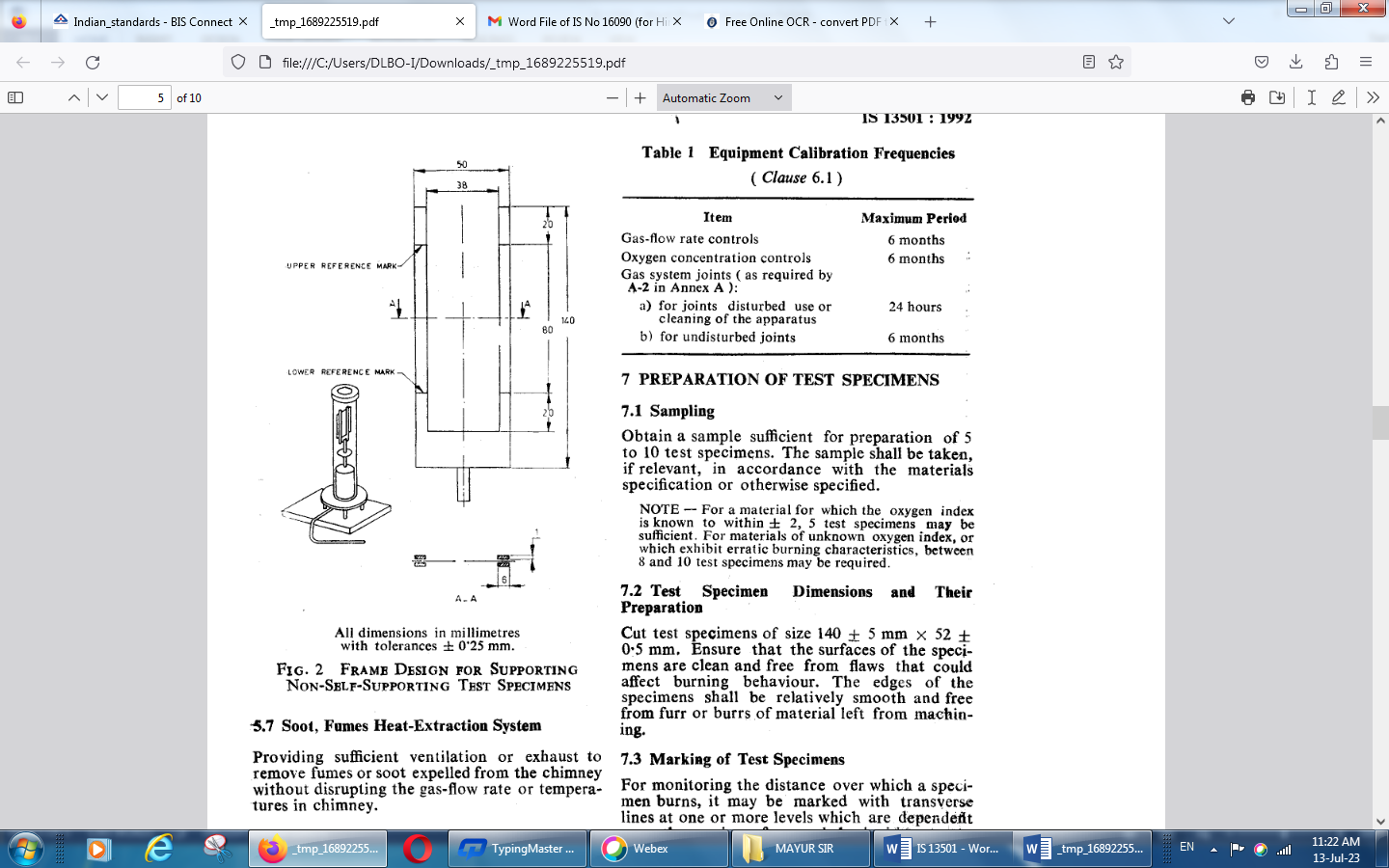
Capable of measuring periods up to 10 min with an accuracy of 5 seconds.

A computer screen shot of a computer screen

Description automatically generated

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 Burning test specimen | 7 | Base plate | 12 | Precision pressure regulator |
| 2 Specimen holder | 8 | Gas premixing point | 13 | Filter |
| 3 Igniter | 9 | Cut-off valve | 14 | Needle valve |
| 4 Debris screen of wire mesh | 10 | Orifice in holder | 15 | Gas flow meter |
| 5 Chimney support | 11 | Pressure gauge | 16 | Temperature sensor |
| 6 Bead bed |  |  |  |  |

FIG 1 DIAGRAM OF TYPICAL APPARATUS FOR DETERMINATION OF OXYGEN INDEX



All dimensions in millimetres with tolerances of ± 0.25 mm.

FIG 2 FRAME DESIGN FOR SUPPORTING NON-SELF-SUPPORTING TEST SPECIMENS

**5.7 Soot, Fumes Heat-Extraction System**

Providing sufficient ventilation or exhaust to remove fumes or soot expelled from the chimney without disrupting the gas-flow rate or tempera­tures in chimney.

NOTES

**1** If soot-generating materials are being tested, the glass chimney may require cleaning to maintain good visibility, and the gas inlets, or inlet screen, and temperature sensor (if fitted) may also require cleaning to function properly. Suitable precautions should be taken to protect personnel from noxious materials or burns during testing or cleaning operations.

**2** Any other suitable oxygen analyzer equipment based on the principle specified in this standard and capable of giving reliable and reproducible results directly, may also be used.

**6 CALIBRATION OF EQUIPMENT**

**6.1** For compliance with this method, calibrate the equipment periodically in accordance with the instructions given in Annex B so that the maximum interval between recalibration and use complies with the periods stated in Table 1.

**Table 1 Equipment Calibration Frequencies**

(*Clause* 6.1)

|  |  |  |
| --- | --- | --- |
| **Sl No.** | **Item** | **Maximum Period** |
| (1) | (2) | (3) |
| i) | Gas-flow rate controls | 6 months |
| ii) | Oxygen concentration controls | 6 months |
| iii) | Gas system joints ( as required by **B-2** in Annex **B** ): | |
| a) for joints disturbed use or cleaning of the apparatus | 24 hours |
| b) for undisturbed joints | 6 months |

**7 PREPARATION OF TEST SPECIMENS**

**7.1 Sampling**

Obtain a sample sufficient for preparation of 5 to 10 test specimens. The sample shall be taken, if relevant, in accordance with the materials specification or otherwise specified.

NOTE — For a material for which the oxygen index is known to within f 2, 5 test specimens may be sufficient. For materials of unknown oxygen index, or which exhibit erratic burning characteristics, between 8 and 10 test specimens may be required.

**7.2 Test Specimen Dimensions and Their Preparation**

Cut test specimens of size 140 ± 5 mm × 52 ± 0.5 mm. Ensure that the surfaces of the speci­mens are clean and free from flaws that could affect burning behaviour. The edges of the specimens shall be relatively smooth and free from furr or burrs of material left from machin­ing.

**7.3 Marking of Test Specimens**

For monitoring the distance over which a speci­men burns, it may be marked with transverse lines at one or more levels which are dependent upon the specimen form and the ignition proce­dure to be used. If wet inks are used, the marks shall be dry before the specimen is ignited.

**7.3.1** The reference marks for testing specimens are carried by the supporting frame (*see* Fig. 2).

**7.4 Conditioning and Testing Atmospheres**

**7.4.1** *Conditioning*

Before testing, condition the specimens for 24 hours in a standard atmosphere of 65 ± 2percent relative humidity and 27 ± 2 °C tempe­rature (*see* IS 6359). If the test is not carried out immediately after conditioning, place the specimens in a tightly closed container until the commencement of the test. Each speci­men shall be tested within two minutes of removing it from either the conditioning atmos­phere or the container.

**7.4.2** *Testing Atmosphere*

Carry out the test in a substantially draught-free room or enclosure in an atmosphere of relative humidity between 20 to 80 percent and temperature between 20 to 35 °C.

**8 PROCEDURE**

**8.1 Setting up the Apparatus and Test Specimen**

**8.1.1** Re calibrate equipment components, if necessary (*see* **6.1** and Annex B).

**8.1.2** The test shall be conducted in the testing atmosphere specified in **7.4.2**

**8.1.3** Select an initial concentration of oxygen to be used. When possible, this may be based on experience of results for similar materials. Alternatively, try to ignite a test specimen in air, and note the burning behaviour. If the specimen burns rapidly, select an initial concen­tration of about 18 percent (*v/v*) of oxygen; if the test specimen burns gently or unsteadily select an initial oxygen concentration of about 21 percent WO; if the specimen does not continue to burn in air, select an initial concen­tration of at least 25 percent (v/v), depending upon the difficulty of ignition or the period of burning before extinguishment in air.

**8.1.4** Ensure that the test chimney is vertical (*see* Fig. 1). Mount a specimen vertically in the centre of the chimney so that the top of the specimen is at least 100 mm below the open top of the chimney and the lowest exposed part of the specimen is at least 100 mm above the top the gas distribution device at the base of the chimney (*see* Fig. 1 or Fig. 2 as appropriate).

**8.1.5** Set the gas mixing and flow controls so that an oxygen/nitrogen mixture containing the desired concentration of oxygen is flowing through the chimney at a rate of 40 ± 10 mm/s. Allow the gas to flow for at least 30 seconds to purge the system prior to ignition, of each specimen, and maintain the flow without change dur­ing ignition and combustion of each specimen. Ignite the test specimen as described in **8.2**.

**8.1.6** Record the oxygen concentration used as the volume percent calculated according to the equations given in Annex C.

**8.2 Igniting the Test Specimen**

**8.2.1** Apply the lowest visible part of the flame to the top of the specimen using a sweeping motion, if necessary, to cover the whole surface, but taking care not to maintain the flame against the vertical faces or edges of the specimen. Apply the flame for up to 30 seconds, removing it every 5 seconds for just sufficient time to observe whether or not the entire top surface of the specimen is burning.

**8.2.2** Consider the specimen to be ignited, and commence measurement of the period and dis­tance of burning, as soon as removal of the igniter, after a contact period increment of 5-seconds, reveals, burning supported by the whole of the top end surface of the specimen.

**8.3 Assessing Burning Behaviour**

**8.3.1** For the purpose of **8.3.2** to **8.3.6** inclusive, observe and terminate the burning of individual test specimens as follows:

**8.3.2** Commence measurement of the period of burning as soon as the specimen has beenignited in accordance with **8.2,** as applicable, and ob­serve its burning behavior. If burning ceases but spontaneous re-ignition occurs in less than 1 second, continue the observation and measure­ments.

**8.3.3** Theconcentration of oxygen is too high and must be reduced if the specimen burns and either the period or the extent of burning exceeds the relevant limits specified in Table 2. The concentration of oxygen must be raised if the flaming of the specimen extinguishes before meeting the criteria specified in Table 2. Do not adjust the oxygen concentration after igniting the specimen.

**Table 2 Criteria for Oxygen Index Measurements**

(*Clauses* 8.3.3 *and* 8.3.5)

|  |  |  |
| --- | --- | --- |
| **Sl No.** | **Period of Burning After Ignition ( seconds )** | **Extent of Burning** |
| (1) | (2) | (3) |
| i) | 180 | 58 mm below the top  of the specimens |

NOTE —These criteria do not necessarily produce equivalent oxygen index results for specimens of differing shape or tested using different conditions or procedures.

**8.3.4** Adjust the oxygen concentration, insert a new specimen, or if the previous specimen is long enough, turn it end for end or cut off the burnt end, then purge and re-ignite.

**8.3.5** Continue repeating **8.1.5** to **8.3.4** until the critical concentration of oxygen is determined. This is the lowest oxygen concentration that will meet the criteria specified in Table 2. At the next lower concentration that will give a difference in oxygen index of 0.2 percent or less, the specimen should not meet the criteria speci­fied in Table 2.

NOTES

**1** The critical oxygen concentration has been found to be dependent on the temperature of the specimen at ignition and the temperature of the gas mixture.

**2** For a material having consistent burning characte­ristics, the difference in oxygen concentration bet­ween and extinguishing as specified in **8.3.2** will be reproducible within **0.1** percent to 0'3 percent depend­ing on the sensitivity of the flow measuring equipment and upon the particular oxygen concentration invol­ved. Some materials, however, exhibit erratic burning characteristics because of inhomogeneity, char formation, dripping, bending, etc, which cause less reproducible results. In such cases, the critical con­centration may be determined by a statistical testing method as given in *American Statistical Association Journal,* pp-967-970 (1965).

**8.3.6** Perform the test at least three times by starting at a slightly different flow rate still within 30 to 50 mm/second limits and again per­forming the procedure from **8.1.5** to **8.3.5**.

**9 CALCULATIONS**

**9.1** Calculate the oxygen index, n, of the mate­rial for each replicate in **8.3.6** by the formula:

n =

where

*O*2 = the volumetric flow of oxygen in cm3/s, at the concentration deter­mined in **8.3.5**; and

*N*2 = the corresponding volumetric flow rate of nitrogen in cm3/s.

NOTE — If an oxygen analyzer is used, the oxygen index should be determined using the readout from the particular instrument used.

**9.1.1** If air is used and either oxygen or nitrogen is added as required, calculate *n* assuming that air contains 20.9 percent oxygen as follows:

n=

where

*A =* the volumetric flow rate of air in cm3/s.

**10 TEST REPORT**

**10.1** The test report shall include the following:

1. Identification of the material tested, including, where relevant, the type of material, density, previous history, and the specimen orientation with respect to any anisotropy in the material or sample;
2. The test specimen dimensions;
3. The igniter used;
4. The individual oxygen index values found for each of the tests, and average index value;
5. A description of any relevant ancillary characteristics or behaviour, such as charring, dripping, severe shrinkage, erratic burning, after-glow;
6. Any variations from the requirements of this standard;
7. Any other information required by the law in force

**ANNEX A**

(*Clause* 2)

**LIST OF REFERRED STANDARDS**

*IS No. Title*

IS 6359: 2023 Method for conditioning of textiles

IS 11871: 1986 Methods for determination of flammability and flame resistance of textile fabrics

**ANNEX B**

(*Clauses* 6.1 and 8.1.1 and *Table* 1)

**CALIBRATION OF EQUIPMENT**

**B-1 CALIBRATION OF GAS FLOW RATE CONTROLS**

**B-1.1** Check the system for indicating the gas-flow rate through the chimney using a water-sealed rotating drum meter (wet test meter), or an equivalent device, with an accuracy equi­valent to ± 2 mm/s flow rate through the chimney.

**B-1.2** Estimate the flow rate by dividing the total gas-flow rate through the chimney by the cross-sectional area of the bore of the chimney, for example by using the equation.

*F* = 1.27 ×

Where

*F =* the flow rate through the chimney, in mm per second:

qv = the total gas-flow through the chimney, in litres per second

*D =* the diameter of the bore of the chimney, in millimeters.

**B-2 CALIBRATION OF OXYGEN CONCENTRATION CONTROLS**

**B-2.1** Check the the concentration of oxygen in the mixture of gases flowing into the chimney to an accuracy of 0.1 percent (*v/v*) of mixture, either by sampling the chimney atmosphere for analysis or by using an independently calibrated oxygen analyzer *in situ.* Integral oxygen analy­zers may be calibrated using standard oxygen/ nitrogen mixtures. The checks should be carried out for at least three different nominal concen­trations, representing respectively maximum, minimum and intermediate levels for the oxygen concentration range for which the equipment is to be used.

**B-2.2** Carry out leak-tests on all joints where leaks could change the oxygen concentration levels in the chimney from the concentration levels set or indicated.

**B-3 CALIBRATION OF COMPLETE EQUIPMENT**

**B-3.1** Check the performance of the equipment for a specific test procedure, by testing a cali­brated material and comparing the measured results with the expected result for the calibrated material. For information on the availability and use of calibrated materials, *see* Annex C.

**ANNEX C**

(*Clause* 8.1)

**CALCULATION OF OXYGEN CONCENTRATION**

**B-1** Calculate the oxygen concentrations accord­ing to the following equation:

C0 =

Where

*Co* = the oxygen concentration, in per­cent by volume;

Vo = the volume of oxygen per volume of mixture; and

VN = the volume of nitrogen per volume of mixture.

NOTES

**1** If an oxygen analyzer is used, the oxygen con­centration should be determined using the readout from the particular instrument used.

**2** If the result is calculated from flow or pressure data for individual gas streams contributing to the mixture, it is necessary to allow for the proportion of oxygen present in streams other than a pure oxygen supply. For example, for mixtures made using air mixed with oxygen of 98.5 percent (*v/v*  purity or with nitrogen containing 0.5 percent ( *v/v* ) of oxygen, the oxygen concentration, in percent by volume, should be calculated using the relationship:

C0 =

Where

*Vto* = the volume of oxygen stream used, per volume of mixture;

*VtA* = the volume of air stream used, per volume of mixture; and

*V tN* = the volume of nitrogen stream used, per volume of mixture.

assuming that the streams are at the same pressure and temperature.

For mixture based on two gas streams, becomes zero, as appropriate

1. **[Doc : TXD/32/25852]** IS 16890 : 2018 Textiles **—** Protective Clothing for Firefighters **—** Specification (*first revision*)

*DRAFT* FOR COMMENTS ONLY Doc: No: TXD 32 (25852) WC

भारतीय मानक ब्युरो

*भारतीय मानक मसौदा*

**वस्त्रादि – अग्निशामकों के लिए सुरक्षात्मक कपड़े – विशिष्ट**

**(आई एस 16890 का पहला पुनरीक्षण)**

**BUREAU OF INDIAN STANDARDS**

Draft *Indian Standard*

**‘Textiles — Protective Clothing for Firefighters — Specification’**

(*First revision of* IS 16890)

**ICS 13.340.10**

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BIS or used as Standard 13 July, 2024

FOREWORD

(*Formal clause will be added later*)

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:

1. *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.
2. *Inner shell* – The inner shell is generally composed of moisture barrier and a thermal barrier.
3. *Moisture barrier* – Moisture barriers may totally prevent the passage of moisture, whether liquid or vapour.
4. *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 the year 2018. It is being 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:

*IS Title*

ISO 811 : 1981 Textile fabrics — Determination of resistance to water penetration —

Hydrostatic pressure test

ISO 3175-1 : 2010 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)

ISO 17493 : 2016 Clothing and equipment for protection against heat — Test method for

convective heat resistance using a hot air circulating oven

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 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

**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 proximity fire approach applications and support activities. While category 2 of protective clothing is recommended to be worn during intense structural firefighting, close proximity 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 23616:2022 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 subjected to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

**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 i.e. 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:

1. *Multilayer clothing assemblies for Category 1*

a) *Outer layer* – Mass shall not be more than 270 g/m2

b) *Moisture barrier* – Mass shall not be more than 150 g/m2

c) *Thermal layer* – Thermal layer may be a single layer or two layers and the mass (including lining) shall not be more than 380 g/m2

1. *Multilayer clothing assembly for Category 2*

a) *Outer layer- Mass* shall not be more than 240 g/m2

b) *Moisture barrier-* Mass shall not be more than 140 g/m2

c) *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 ± 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 ± 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.

**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 | 80-88 | 152-158 |
| ii) | M | 88-96 | 158-164 |
| iii) | L | 96-104 | 164-176 |
| iv) | XL | 104-112 | 176-182 |
| v) | XXL | 112-120 | 182-188 |
| vi) | XXXL | 120-124 | 188-194 |

**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 clause **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 verticallyin 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.

**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 HTI24 ≥ 13 seconds and a mean HTI24 – HTI12 ≥ 4 seconds.

**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 HTI24 ≥ 17 seconds and a mean HTI24 – HTI12 ≥ 6 seconds.

**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/m2, shall give a mean RHTI24 ≥ 18 seconds, a mean RHTI24 – RHTI12 ≥ 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/m2 shall give a mean RHTI24 ≥ 26 seconds, a mean RHTI24 – RHTI12 ≥ 8 seconds, 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/m2. Each specimen shall have a tensile strength ≥ 450 N. This requirement is applicable for both category 1 and category 2 of protective clothing.

**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 ± 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% (for woven fabric ) and ≤ 5% (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;

b) 36 percent hydrochloric acid (HCI) at 20 °C;

c) 30 percent sulfuric acid (H2SO4) at 20 °C; and

d) O-xylene, 100 percent

NOTE – 1. 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 m2 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.

|  |
| --- |
| **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

**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;

A black and white sign with a person putting out a fire

Description automatically generated

FIG. 2 PICTOGRAM ISO 7000-2418

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.

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

**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 protective clothing may also be marked with the Standard Mark.

**8.4.1** The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of the conditions under which a license for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

**ANNEX A**

(*Clause* 2)

**LIST OF REFERRED INDIAN STANDARDS**

|  |  |
| --- | --- |
| *IS No.* | *Title* |
| 1969  (Part 1) : 2009 | Textiles —Tensile properties of fabrics — Determination of maximum force and elongation at maximum force: Part 1 Strip method (*third revision*) |
| 6489  (Part 2) : 2011 | Textiles — Tear properties of fabrics: Part 2 Determination of tear force of trouser shaped test specimens (single tear method) (*second revision*) |
| 14452 : 2014 | Textiles — Care labelling code using symbols |
| 15370 : 2005 | Textiles — Domestic washing and drying procedures for textile testing |
| 15758 | Textiles — Protective clothing: |
| (Part 1) : 2020 | Method of determining of heat transmission on exposure to flame |
| (Part 2) : 2007 | Assessment of material assemblies when exposed to source of radiant heat |
| (Part 3) : 2007 | Test method for resistance of material to penetration by liquids |
| (Part 4) : 2007 | Test method for limited flame spread |
| 15809 : 2008 | High visibility warning clothes — Specification |
| IS/ISO 13935-2 : 1999 | Textiles — Seam tensile properties of fabrics and made-up textile articles: Part 2 Determination of maximum force to seam rupture using the grab method |
| IS/ISO 17462  (Part 1) : 2020 | 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 |
| IS/ISO 13360  (Part6/sec10) : 2013 | Plastics – Methods of testing: 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 (First Revision) |
| ISO 5077 : 2007 | Textiles – Determination of dimensional change in washing and drying |

**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:

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

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

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:

The adequacy of the range of adjustments available;

The ease and security of closures and adjusters; and

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?

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

Raising both hands above the head; and

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

The following points should be considered:

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

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

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

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:

Coverage of specific protection zones of the intended body area by protective material or special constructions; and

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:

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

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.

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 m2 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 m2.

**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 ± 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 clothingof 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 clothingof 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.

**Table 2 Sample Size**

(*Clause* D-2)

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

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**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.

1. **[Doc : TXD/32/25824]** Textiles **—** Fire resistant fabric made of Cotton Man-made fibres, filaments and their blends **—** General and Performance Requirements

*DRAFT* FOR COMMENTS ONLY Doc: No: TXD 32 (25824) WC

भारतीय मानक ब्युरो

*भारतीय मानक मसौदा*

**वस्त्रादि – कपास, मानव निर्मित फाइबर/तंतुओं और उनके मिश्रणों से बने अग्निरोधी कपड़े - सामान्य और प्रदर्शन आवश्यकताए**

**BUREAU OF INDIAN STANDARDS**

Draft *Indian Standard*

**Textiles — Fire resistant fabric made of Cotton, Man-made fibres/filaments and their blends — General and Performance Requirements**

**ICS 13.340.10**

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BIS or used as Standard 7 July, 2024

Foreword

(*Formal foreword to be added later*)

Within industries such as oil and gas, welding, aviation, automotives etc. the threat of fire is a constant concern. In such environments, ensuring the safety of workers and infrastructure against fire hazards is of utmost importance. Flame retardant fabrics play a crucial role in reducing the threat posed by fire hazards in various industries. Although, there are several technologies and methods employed to impart fire resistance in textile fabrics, but these methods can broadly be divided into two categories:

1. **By chemical treatments,**

Chemical treatments like Proban coating, Pyrovatex treatment, and FR chemical finishes are employed to impart flame retardant properties to fabrics. Proban forms a polymer network on the fabric surface, Pyrovatex chemically bonds with cellulose fibers, and FR chemical finishes utilize compounds like brominated, phosphorus, and nitrogen compounds. These treatments enhance fabric safety in fire-prone environments.

1. **By selection of inherently fire-resistant fibres,**

Fibres such as Meta-aramid, Para-aramid, and Modacrylic are inherently flame resistant due to their chemical structure. Fabrics made from these fibres exhibit high resistance to ignition and do not require additional chemical treatments.

**1 SCOPE**

* 1. This standard specifies the general and performance requirements for fire resistant fabric made of cotton, man-made fibres/filaments and their blends.
  2. This standard covers the following 3 categories of fire resistant fabric:

1. Fire-resistant fabric utilized in the manufacture of clothing for use in the oil and gas sector, foundries, automotive industries, aviation sectors, and allied industries.
2. Fire-resistant fabric used in the manufacture of clothing for use during welding, and allied activities.
3. Fire-resistant fabric utilized in the manufacture of clothing for use in the construction sites, and allied activities.

**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 editions of the standards indicated in Annex A.

**3 REQUIREMENTS**

**3.1 Category 1: Requirements for fire-resistant fabric utilized in the manufacture of clothing for use in the oil and gas sector, foundries, automotive industries, aviation sectors, and allied industries.**

**3.1.1** *Pre-treatment by cleaning*

Before each test specified in Clauses **3.1.4** the fabric shall pre-treated by cleaning. If the manufacturer’s instructions indicate that cleaning is not allowed, i.e. single-use fabric, then testing shall be carried out on new fabric. In addition, **3.1.4.3** requires that the limited flame spread tests shall be carried out both before the pre-treatment and after the pre-treatment, if cleaning is allowed.

The cleaning shall be in line with the manufacturer’s instructions, on the basis of standardized processes. If the number of cleaning cycles is not specified, the tests shall be carried out after five cleaning cycles (a cleaning cycle is one wash and one dry cycle). This shall be reflected in the information supplied by the manufacturer. If the fabric can be washed and dry-cleaned, it shall only be washed. If only dry-cleaning is allowed, the fabric shall be dry-cleaned in accordance with the manufacturer’s instructions.

NOTE — Manufacturer’s instructions typically indicate one or several of the various methods and processes of ISO 6330,[2] ISO 15797,[3] ISO 3175-2,[5] or equivalent as standardized processes for cleaning.

**3.1.2** *Ageing*

In the case that the fabric should be submitted to some treatment to maintain its limited flame spread property as specified in **3.1.4.3**, the manufacturer shall indicate the maximum number of cleaning cycles that can be carried out before applying the treatment indicated to maintain the fabric protective performance. Limited flame spread test according to **3.1.4.3** shall be carried out after the last cleaning cycles before any treatment as indicated by the manufacturer; in both cases the fabric shall comply with the requirement.

**3.1.3** *Conditioning*

Fabric shall be conditioned for at least 24 h in an atmosphere having a temperature of (27 ± 2) °C and a relative humidity of (65 ± 4) %. Testing shall be carried out within 5 min of removal from this atmosphere.

**3.1.4** *Performance requirement*

**3.1.4.1** *General*

The fabric shall meet the requirements of Clause **3.1.4.2**, **3.1.4.3** and shall meet at least one of the heat transmission requirements for letter codes B, C, D, E or F of **3.1.4.4** based on their intended use. The fabric shall also meet the requirements of clause **3.1.4.5** to **3.1.4.8.**

**3.1.4.2** *Heat resistance*

**3.1.4.2.1** *Heat resistance at a temperature of (180 ± 5) °C*

The fabric shall be tested according to ISO 17493 at a temperature of (180 ± 5) °C for an exposure time of 5 min. Test samples shall not ignite, melt or drip, and fabrics shall also not shrink by more than 5 %.

**3.1.4.2.2** *Optional requirement — Heat resistance at a temperature of (260 ± 5) °C*

The fabric can be optionally tested according to ISO 17493 at a temperature of (260 ± 5) °C for an exposure time of 5 min. The fabric shall not ignite, melt, or drip and shall not shrink by more than 10 % in addition to meeting the requirements of **3.1.4.2.1**.

NOTE — Heat shrinkage has the potential to reduce the thermal protection level of the fabric as it reduces the insulating air pocket between the fabric and the body. Therefore, heat shrinkage in heat and flame protective fabric has to be limited, especially in cases where a heat or flame hazard exists that could hit a large percentage area of the fabric.

**3.1.4.3** *Limited flame spread*

Testing of fabric shall take place in accordance with ISO 15025, to Procedure A (code letter A1). This test shall be carried out both before and after the pre-treatment specified in **3.1.1**.

**3.1.4.3.1** *Testing in accordance with ISO 15025, Procedure A (code letter A1)*

When tested in accordance with ISO 15025, Procedure A, specimens from fabric shall meet the following requirements (*see* Table 1):

**Table 1 — Limited flame spread performance requirements, ISO 15025, Procedure A**

**(code letter A1)**

(*Clause* 3.1.4.3.1)

|  |  |
| --- | --- |
| **Properties** | **Requirement** |
| Flame spread | No specimen shall permit any part of the lowest boundary of any flame to reach the upper or either vertical edge. |
| Flaming debris | No specimen shall give flaming or molten debris. |
| Hole formation | No specimen shall give hole formation of 5 mm or greater in any direction, except for an interlining that is used for specific protection other than heat and flame protection. |
| Afterglow | Afterglow time shall be ≤ 2 s.  A glowing inside the charred area is defined in ISO 15025 as afterglow without combustion and for the purpose of this clause is not regarded as afterglow |
| After flame | After flame time shall be ≤ 2 s. |

**3.1.4.4** *Heat transmission performance requirements*

**3.1.4.4.1** *Convective heat (code letter B)*

When tested in accordance with IS 15758 (Part 1), fabrics that are claimed to offer protection against convective heat shall meet at least performance level B1 in Table 2.

**Table 2 Performance levels: Convective Heat Test**

(*Clause* 3.1.4.4.1)

|  |  |  |
| --- | --- | --- |
| **Performance levels** | **Heat transfer factor HTI24 values**  S | |
| Min | Max |
| B1 | 4.0 | <10.0 |
| B2 | 10.0 | <20.0 |
| B3 | 20.0 |  |
| NOTE —Heat transfer index, as defined in ISO 9151. | | |

**3.1.4.4.2** *Radiant heat (code letter C)*

When tested in accordance with IS 15758 (Part 2), Method B, at a heat flux density of 20 kW/m2, fabrics that are claimed to offer protection against radiant heat shall meet at least performance level C1 in Table 3.

**Table 3 Performance levels: Radiant Heat Test**

(*Clause* 3.1.4.4.2)

|  |  |  |
| --- | --- | --- |
| **Performance levels** | **Heat transfer factor RHTI24**  S | |
| Min | Max |
| C1 | 7.0 | <20.0 |
| C2 | 20.0 | <50.0 |
| C3 | 50.0 | <95.0 |
| C4 | 95.0 |  |
| NOTE — Radiant heat transfer index, as defined in ISO 6942. | | |

**3.1.4.4.3** *Molten aluminium splash (code letter D)*

When tested in accordance with IS 15758 (Part 5)using molten aluminium, fabrics that are claimed to offer protection against molten aluminium splash shall meet at least performance level D1 in Table 4. Fabrics which ignite during the test do not meet this requirement.

**Table 4 Performance levels: Molten Aluminium Splash**

(*Clause* 3.1.4.4.3)

|  |  |  |
| --- | --- | --- |
| **Performance levels** | **Molten aluminium splash**  G | |
| Min | Max |
| D1 | 100 | <200 |
| D2 | 200 | <350 |
| D3 | 350 |  |

**3.1.4.4.4** *Molten iron splash (code letter E)*

When tested in accordance with IS 15758 (Part 5)using molten iron, fabrics that are claimed to offer protection against molten iron splash shall meet at least performance level E1 in Table 5. Fabrics which ignite during the test do not meet this test.

**Table 5 Performance levels: Molten Iron Splash**

(*Clause* 3.1.4.4.4)

|  |  |  |
| --- | --- | --- |
| **Performance levels** | **Molten iron splash**  G | |
| Min | Max |
| E1 | 60 | <120 |
| E2 | 120 | <200 |
| E3 | 200 |  |

**3.1.4.4.5** *Contact heat (code letter F)*

When tested in accordance with IS 17462 (Part 1) at a temperature of 250 °C, fabrics that are claimed to offer protection against contact heat shall meet at least performance level F1 in Table 6.

**Table 6 Performance levels: Contact Heat**

(*Clause* 3.1.4.4.5)

|  |  |  |
| --- | --- | --- |
| **Performance levels** | **Threshold time**  S | |
| Min | Max |
| F1 | 5.0 | <10.0 |
| F2 | 10.0 | <15.0 |
| F3 | 15.0 |  |

**3.1.4.5***Tensile strength*

When tested in accordance with ISO 13934-1, woven fabric shall have a minimum tensile strength of 300 N in both the machine and cross directions.

**3.1.4.6** *Tear strength*

When tested in accordance with ISO 13937-2, woven fabric shall have a minimum tear strength of 10 N in both the machine and cross directions.

**3.1.4.7** *Burst strength for knitted materials*

When tested in accordance with ISO 13938-1 or ISO 13938-2, knitted fabric shall have a minimum burst strength of 100 kPa, when using 50 cm2 test area, or of 200 kPa, when using a 7.3 cm2 test area.

**3.1.4.8** *Dimensional Change*

Dimensional change shall be measured after the samples have undergone five cleaning cycles according to 3.1.1. The change in dimensions of woven fabric shall not exceed ± 3 % in either length or width direction when measured in accordance with ISO 5077. The change of dimensions of knitted materials shall not exceed ± 5 % when measured in accordance with ISO 5077. Dimensional change shall be measured after the fabric has been uncreased and flattened on a plane surface. Dimensional change does not apply to single use fabric.

**3.2 Category 2: Requirements for fire-resistant fabric used in the manufacture of clothing for use during welding, and allied activities.**

**3.2.1** *Pre-treatment of material*

Before each test specified in **3.2.5 to 3.2.12**, the test materials and test specimens shall be pre-treated by cleaning. If the manufacturer’s instructions indicate that cleaning is not allowed, i.e. single use fabric, then testing will be carried out on new material. In addition, **3.2.9** requires that the limited flame spread tests shall be carried out both before the pre-treatment and after the pre-treatment. The cleaning shall be in line with the manufacturer’s instructions, on the basis of standardized processes. If the number of cleaning cycles is not specified, the tests shall be carried out after five cleaning cycles (a cleaning cycle is one wash and one dry cycle). This shall be reflected in the information supplied by the manufacturer. If the fabric can be washed and dry-cleaned, it shall only be washed. If only dry-cleaning is allowed, the fabric shall be dry-cleaned in accordance with the manufacturer’s instructions.

NOTE — The manufacturer’s instructions typically indicate one or several of the various methods and processes of ISO 6330, ISO 15797, ISO 3175-2 or equivalent as standardized processes for cleaning.

**3.2.2** *Ageing*

In the case that the fabric should be submitted to some treatment to maintain its limited flame spread property as specified in **3.2.9**, the manufacturer shall indicate the maximum number of cleaning cycles that can be carried out before applying the treatment indicated to maintain the fabric protective performance. Limited flame spread test according to **3.2.9** shall be carried out after the last cleaning cycles before any treatment as indicated by the manufacturer, in both cases, the fabric shall comply with the requirement.

**3.2.3** *Conditioning*

Fabric shall be conditioned for at least 24 h in an atmosphere having a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %. Leather specimens shall be conditioned for at least 48 h in an atmosphere having a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %. Testing shall be carried out within 5 min of removal from this atmosphere. Samples for electrical resistance testing specified in **3.2.12** shall be conditioned and tested in an atmosphere having a relative humidity of (85 ± 5 %) and a temperature of (20 ± 2) °C.

**3.2.4** *Classification*

This Indian Standard specifies the performance requirements of two types of fabrics used in the manufacture of clothing for use during welding, and allied activities as given below:

1. Class 1 is protection against less hazardous welding techniques and situations, causing lower levels of spatter and radiant heat. (*see* Annex B).
2. Class 2 is protection against more hazardous welding techniques and situations, causing higher levels of spatter and radiant heat. (*see* Annex B).

**3.2.5** *Tensile strength*

When tested in accordance with ISO 13934-1, woven outer fabric shall have a minimum tensile strength of 400 N in both the machine and cross directions.

**3.2.6** *Tear strength*

When tested in accordance with ISO 13937-2, woven outer fabric shall have a minimum tear strength of 15 N in both the machine and cross directions for Class 1 welders clothing and 20 N in both the machine and cross directions for Class 2 welders clothing.

**3.2.7** *Burst strength of knitted materials*

When tested in accordance with ISO 13938-1 or ISO 13938-2, knitted outer fabric shall have a minimum burst strength of 100 kPa, when using 50 cm2 test area, or 200 kPa, when using a 7.3 cm2 test area.

**3.2.8** *Dimensional change of textile materials*

Dimensional change shall be measured after the samples have undergone five cleaning cycles according to **3.2.1**. The change in dimensions of woven fabric shall not exceed ± 3 % in either length or width direction when measured in accordance with ISO 5077. The change of dimensions of knitted materials shall not exceed ± 5 % when measured in accordance with ISO 5077. Dimensional change shall be measured after the fabric has been uncreased and flattened on a plane surface. Dimensional change does not apply to single use fabric.

**3.2.9** *Limited flame spread*

When tested in accordance with ISO 15025, Procedure A (code letter A1)., fabric shall meet the following requirements (*see* Table 7). This test shall be carried out both before and after the pre-treatment specified in **3.2.1**.

**Table 7 — Limited flame spread performance requirements ISO 15025, Procedure A**

**(code letter A1)**

(*Clause* 3.2.9)

|  |  |
| --- | --- |
| **Properties** | **Requirement** |
| Flame spread | No specimen shall permit any part of the lowest boundary of any flame to reach the upper or either vertical edge. |
| Flaming debris | No specimen shall give flaming or molten debris. |
| Hole formation | No specimen shall give hole formation of 5 mm or greater in any direction, except for an interlining that is used for specific protection other than heat and flame protection. |
| Afterglow | Afterglow time shall be ≤ 2 s.  A glowing inside the charred area is defined in ISO 15025 as afterglow without combustion and for the purpose of this clause is not regarded as afterglow |
| After flame | After flame time shall be ≤ 2 s. |

**3.2.10** *Impact of spatter (small splashes of molten metal)*

When tested according to ISO 9150, the fabric shall require:

— at least 15 drops of molten metal to raise the temperature behind the test specimen by 40 K for Class 1, and

— at least 25 drops of molten metal to raise the temperature behind the test specimen by 40 K for Class 2.

Fabric samples which ignite during the test do not meet this requirement.

**3.2.11** *Heat transfer (radiation)*

When tested in accordance with ISO 6942, Method B, at a heat flux density of 20 kW/m2, fabrics shall meet a radiant heat transfer index (RHTI for 24 °C) of

— for Class 1: RHTI 24 ≥ 7.0, and

— for Class 2: RHTI 24 ≥ 16.0.

**3.2.12** *Electrical resistance*

Conditioning and testing of the samples shall be carried out at a temperature of (27 ± 2) °C and relative humidity of (65 ± 4) %. When the fabric is tested in accordance with the test method specified in EN 1149-2 and under an applied potential of (100 ± 5) V, the electrical resistance shall be greater than 105 Ω (corresponds to less than 1 mA leakage current).

**3.3 Category 3: Requirements for fire-resistant fabric utilized in the manufacture of clothing for use in the construction sites, and allied activities.**

**3.3.1** *Pre-treatment by cleaning*

Before each test specified in Clauses **3.3.4,** the fabric shall pre-treated by cleaning. If the manufacturer’s instructions indicate that cleaning is not allowed, i.e. single-use fabric, then testing shall be carried out on new fabric. In addition, **3.3.4.3** requires that the limited flame spread tests shall be carried out both before the pre-treatment and after the pre-treatment, if cleaning is allowed.

The cleaning shall be in line with the manufacturer’s instructions, on the basis of standardized processes. If the number of cleaning cycles is not specified, the tests shall be carried out after five cleaning cycles (a cleaning cycle is one wash and one dry cycle). This shall be reflected in the information supplied by the manufacturer. If the fabric can be washed and dry-cleaned, it shall only be washed. If only dry-cleaning is allowed, the fabric shall be dry-cleaned in accordance with the manufacturer’s instructions.

NOTE — Manufacturer’s instructions typically indicate one or several of the various methods and processes of ISO 6330,[2] ISO 15797,[3] ISO 3175-2,[5] or equivalent as standardized processes for cleaning.

**3.3.2** *Ageing*

In the case that the fabric should be submitted to some treatment to maintain its limited flame spread property as specified in **3.3.4.3**, the manufacturer shall indicate the maximum number of cleaning cycles that can be carried out before applying the treatment indicated to maintain the fabric protective performance. Limited flame spread test according to **3.3.4.3** shall be carried out after the last cleaning cycles before any treatment as indicated by the manufacturer; in both cases the fabric shall comply with the requirement.

**3.3.3** *Conditioning*

Fabric shall be conditioned for at least 24 h in an atmosphere having a temperature of (27 ± 2) °C and a relative humidity of (65 ± 4) %. Testing shall be carried out within 5 min of removal from this atmosphere.

**3.3.4** *Performance requirement*

**3.3.4.1** *General*

The fabric shall meet the requirements as given in clause **3.3.4.2** to **3.3.4.6**.

**3.3.4.2** *Heat resistance*

**3.3.4.2.1** *Heat resistance at a temperature of (180 ± 5) °C*

The fabric shall be tested according to ISO 17493 at a temperature of (180 ± 5) °C for an exposure time of 5 min. Test samples shall not ignite or melt, drip and fabrics shall also not shrink by more than 5 %.

**3.3.4.2.2** *Optional requirement — Heat resistance at a temperature of (260 ± 5) °C*

The fabric can be optionally tested according to ISO 17493 at a temperature of (260 ± 5) °C for an exposure time of 5 min. The fabric shall not ignite or melt and shall not shrink by more than 10 % in addition to meeting the requirements of **3.3.4.2.1**.

NOTE — Heat shrinkage has the potential to reduce the thermal protection level of the fabric as it reduces the insulating air pocket between the fabric and the body. Therefore, heat shrinkage in heat and flame protective fabric has to be limited, especially in cases where a heat or flame hazard exists that could hit a large percentage area of the fabric.

**3.3.4.3** *Limited flame spread*

Testing of fabric shall take place in accordance with ISO 15025, to Procedure A (code letter A1). This test shall be carried out both before and after the pre-treatment specified in **3.3.1**.

**3.3.4.3.1** *Testing in accordance with ISO 15025, Procedure A (code letter A1)*

When tested in accordance with ISO 15025, Procedure A, specimens from single layer fabric shall meet the following requirements (*see* Table 8):

**Table 8 — Limited flame spread performance requirements, ISO 15025, Procedure A**

**(code letter A1)**

(*Clause* 3.3.4.3.1)

|  |  |
| --- | --- |
| **Properties** | **Requirement** |
| Flame spread | No specimen shall permit any part of the lowest boundary of any flame to reach the upper or either vertical edge. |
| Flaming debris | No specimen shall give flaming or molten debris. |
| Hole formation | No specimen shall give hole formation of 5 mm or greater in any direction, except for an interlining that is used for specific protection other than heat and flame protection. |
| Afterglow | Afterglow time shall be ≤ 2 s.  A glowing inside the charred area is defined in ISO 15025 as afterglow without combustion and for the purpose of this clause is not regarded as afterglow |
| After flame | After flame time shall be ≤ 2 s. |

**3.3.4.4** *Tensile strength*

When tested in accordance with ISO 13934-1, woven fabric shall have a minimum tensile strength of 300 N in both the machine and cross directions.

Note — The requirement of tensile strength is not applicable for knitted fabric.

**3.3.4.5** *Tear strength*

When tested in accordance with ISO 13937-2, woven fabric shall have a minimum tear strength of 10 N in both the machine and cross directions.

**3.3.4.6** *Burst strength for knitted materials*

When tested in accordance with ISO 13938-1 or ISO 13938-2, knitted fabric shall have a minimum burst strength of 100 kPa, when using 50 cm2 test area, or of 200 kPa, when using a 7.3 cm2 test area.

Note — The requirement of bursting strength is not applicable for woven fabric.

**4 MARKING**

**4.1** Each fabric shall be marked with the following information:

a) Name of the material, for example, FR treated/FR proban treated fabric or in case of blended/mixed FR treated/FR proban treated fabric, the full name of fibres in the mixture and their composition;

b) Length and width;

c) Mass in g/m2;

d) Batch/ Lot No.;

e) Manufacturer's name, initials or trade-mark;

f) Month and year of manufacture; and

g) Any other information required by the law in force.

**4.2 BIS Certification Marking**

The product 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 thereunder, and the product may be marked with the Standard Mark.

**5 PACKING**

The fabrics shall be packed in bales or cases in accordance with the procedure laid down either in IS 2194 or in IS 2195 or as agreed upon between the buyer and the seller.

**6 SAMPLING**

**6.1 Lot**

The rolls of fabrics for same type of application, produced in one facility, using the same production processes and materials and being offered for delivery at one time to buyer against a dispatch noteshall constitute a lot.

**6.2** Unless otherwise agreed between the buyer and the seller, the number of rolls selected at random for inspection shall be as per col (3) of Table 9.

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

**Table 9 Sample size**

(*Clause* 6.2)

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

**ANNEX A**

(Clause 2)

**LIST OF REFERRED STANDARDS**

|  |  |
| --- | --- |
| IS No. | Title |
| IS 667: 1981 | Methods for identification of textile fibres (first revision) |
| IS 1954: 1990 | Determination of length and width of woven fabrics — Methods (second revision) |
| IS 1964 : 2001 | Textiles — Methods for determination of mass per unit length and mass per unit area of fabrics (second revision) |
| IS 1966 (Part 1) : 2022 | Textiles — Bursting properties of fabrics Part 1: Hydraulic method for determination of bursting strength and bursting distension (third revision) |
| IS 1966 (Part 2) : 2022 | Textiles — Bursting properties of fabrics Part 2: Pneumatic method for determination of bursting strength and bursting distension (third revision) |
| IS 1969 (Part 1) : 2018 | Textiles — Tensile properties of fabrics — Part 1: Determination of maximum force and elongation at maximum force using the strip method (fourth revision) |
| IS 2194 : 1963 | Code for seaworthy packaging of man-made fibre fabrics |
| IS 2195 : 1964 | Code for inland packaging of man-made fibre fabrics and man-made fibre yarns |
| IS 6489 (Part 2) : 2011 | Textiles — Tear properties of fabrics Part 2: Determination of tear force of trouser shaped test specimens (Single tear method) (second revision) |
| IS 15370 : 2020 | Textiles — Domestic washing and drying procedures for textiles testing (first revision) |
| IS 15758 (Part 1) : 2020 | Textiles — Protective clothing Part 1: Determination of heat transmission on exposure to flame (first revision) |
| IS 15758 (Part 2) : 2007 | Textiles — Protective clothing Part 2: Assessment of material assemblies when exposed to source of radiant heat |
| IS 15758 (Part 4) : 2020 | Textiles — Protective clothing Part 4: Method of test for limited flame spread (first revision) |
| IS 15758 (Part 5) : 2020 | Textiles — Protective clothing Part 5: Assessment of resistance of materials to molten metal splash (first revision) |
| IS 17468 : 2020 | Clothing and Equipment for Protection against Heat — Test Method for Convective Heat Resistance using a Hot Air Circulating Oven |
| IS 17462 (Part 1): 2020 | 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 |
| 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 5077 : 2007 | Textiles — Determination of dimensional change in washing and drying |
|  |  |
| ISO 9150 : 1988 | Protective clothing — Determination of behaviour of materials on impact of small splashes of molten metal |

**Annex B**

(*Clause* 3.3.4)

**GUIDANCE FOR THE SELECTION OF THE TYPE OF FABRIC FOR WELDERS’ CLOTHING (CLASS 1/ CLASS 2)**

**Table C.1 — Selection criteria for fabric for clothing for use in welding or allied processes (reference points)**

|  |  |  |
| --- | --- | --- |
| **Type of welders’**  **clothing** | **Selection criteria relating to the process:** | **Selection criteria relating to the environmental conditions:** |
| Class 1 | Manual welding techniques with light formation of spatters and drops, e.g.:  — gas welding;  — TIG welding;  — MIG welding (with low current);  — micro plasma welding;  — brazing;  — spot welding;  — MMA welding (with rutile-covered electrode). | Operation of machines, e.g.:  — oxygen cutting machines;  — plasma cutting machines;  — resistance welding machines;  — machines for thermal spraying;  — bench welding. |
| Class 2 | Manual welding techniques with heavy formation of spatters and drops, e.g.:  — MMA welding (with basic or cellulose-covered electrode);  — MAG welding (with CO2 or mixed gases);  — MIG welding (with high current);  — self-shielded flux cored arc welding;  — plasma cutting;  — gouging;  — oxygen cutting;  — thermal spraying. | Operation of machines, e.g.:  — in confined spaces;  — at overhead welding/cutting or in comparable constrained positions. |

**Annex 6**

**(Item 4.1)**

**comments received from M/S Dupont Speciality Products India Pvt Ltd., Mumbai on Doc: TXD/32/25824**

Dear Mayur,

As discussed, I had difficulty in providing the feedback on the portal as it was going in a circular error, hence sharing comments in the email.

Received a draft standard with the title as **"Textiles — Fire resistant fabric made of Cotton, Man-made fibres/filaments and their blends — General and Performance Requirements"**. On reviewing the content, it seems to be similar in scope like the IS 15748 – the forward of the IS 15748 specifies the protective clothing against flame and heat. Similar is the content for the shared document Doc: No: TXD 32 (25824).

I would suggest to upgrade the standard IS 15748 to reflect some of the changes

|  |  |  |
| --- | --- | --- |
|  | **Doc: No: TXD 32 (25824)**  **(include welding performance)** | **IS 15748 (excluding fire**  **fighters & welders)** |
| Scope | Fabric  All the test for heat & flame are for fabric and not for a garment. Hence the test methods in this doc are identical to IS 15748. There is guidance for garment which is extra in IS 15748 | Clothing  2 different TM for fabric & clothing will create confusion among users regarding the test needed to be referred. Rather we can update the IS 15748 to have 2 sections for fabric & clothing respectively. This will avoid confusion in the market among the users of such articles. |
| Type of Fire-Resistant fabric  (Material of Construction –  MoC) | No need to include brand names like Proban and Pyrovatex in the treated cotton.  In fact the standard should only talk about the performance without going into MoC as in IS 15748. | MoC not defined as is a practice in all international standards |
| Heat Resistance ISO 17493 | Covered | Covered |
| Limited Flame spread (code  letter A) | Covered as per ISO 15025 | Covered as per IS 15758 (part 4) (IS 15758-4 is adopted from ISO 15025) |
| Convective heat (code  letter B) IS 15758 (Part 1), | Covered | Covered |
| Radiant heat (code letter C)  IS 15758 (Part 2) | Covered | Covered |
| Molten aluminium splash (code letter D) IS 15758 (Part 5) | Covered | Covered |
| Molten iron splash (code  letter E) IS 15758 (Part 5) | Covered | Covered |
| Contact heat (code letter F) | Covered - IS 17462 (Part 1) | Covered - ISO 12127 (Part 1) |
| Impact of spatter (small  splashes of molten metal) | ISO 9150 | Not-covered |
| Tensile / Tear / Burst | Covered | Covered |
| Durability of fire retardant  property | Not defined  A critical aspect to ensure that  the protection is durable | Defined in Annex. B of  standard |

Also there is a change in the legal entity of my firm as follows:

|  |  |
| --- | --- |
| Old legal entity | New legal entity |
| E. I. DuPont India Pvt. Ltd. | DuPont Specialty Products India Pvt. Ltd. |

Requesting your help to update the same in your records.

Regards,

Manoj Jhaver

**Annex 7**

**(Item 5.1)**

**MINUTES OF THE MEETING OF TXD 32 WG 02**

*For BIS Use Only*

**BUREAU OF INDIAN STANDARDS**

**(New Delhi)**

**MINUTES**

**1st meeting of Working group TXD32/WG02 for discussion on IS 15741 and revision of IS 15768**

|  |  |  |
| --- | --- | --- |
| **Date** | **Time** | **Venue** |
| 08 August, 2024 | 1100 h | Through Video Conferencing |

**ATTENDEES:**

The present composition of the panel is given as follows:

|  |  |  |
| --- | --- | --- |
|  | **Dr. M S Parmar** | **NITRA, Ghaziabad (Chairman)** |
|  | Shri Mahipal Meena | CFEES, Delhi |
|  | Shri Nirav Shah | Godrej & Boyce Mfg., Mumbai |
|  | Shri Prashant Phapale | Godrej & Boyce Mfg., Mumbai |
|  | Shri Shanmugam. B | Ordnance Clothing Factory, Avadi |
|  | Shri Sudhir Thakkar | System 5s, Chennai |
| **BIS DIRECTORATE GENERAL** | | |
| 1 | Shri Mayur Katiyar | Member Secretary, Bureau of Indian Standards, New Delhi |
| 2 | Dr. Shanu Prabhakar | Young Professional, Bureau of Indian Standards, New Delhi |
| 3 | Shri Anshul Saxena | Consultant, Bureau of Indian Standards, New Delhi |

**Item 0 WELCOME & INTRODUCTORY REMARKS**

**0.1** Dr. M S Parmar, Convener, welcomed all the members. He further elaborated that we are having this meeting to discuss the standard on Upholstery Fabric & Curtains and Drapes. He expressed gratitude to all attendees for promptly joining this meeting.

**0.2** The member secretary also welcomed the convener and the members present in the meeting.

**Item 1 COMPOSITION OF THE WORKING GROUP**

**1.1** The working group noted the present composition.

**Item 2 REVISION OF IS 15768 FOR RESISTANCE TO IGNITION OF UPHOLSTERY FABRIC**

**2.1** The working group scrutinized the comments received from M/s Godrej & Boyce Mfg. Co. Ltd as given in **Annex 2** to the agenda. The working group also scrutinized the draft of IS 15768 as mentioned in **Annex 1** to the agenda. After detailed deliberation, the working group finalized the draft revision of IS 15768 as given in **Annex A** to the minutes. The draft revision as prepared by the working group shall be placed before the TXD 32 Sectional Committee for discussion and decision.

**Item 3 DISCUSSION ON IS 15741 FOR CURTAINS AND DRAPES**

**3.1** The working group scrutinized the scope and content of the standard IS 15741on curtains and drapes. After detailed deliberation the working group noted/decided as follows:

1. The working group noted that the Blinds can not only be made from textiles material but also be made of non-textile materials like bamboo, metal, plastics, etc
2. The working group also noted that the testing procedure (like size of sample, type of material, etc) for testing of Blinds shall be different from curtains and drapes.
3. In view of the above, the working group decided that the blinds do not fall under the scope of IS 15741.
4. Consider the role of Blinds in fire safety of both residential and public occupancies, the working group also decided that a separate new standard shall be formulated for Blinds.

**3.2** The meeting ended with a vote of thanks to and from the convenor.

**Annex A**

**(Item 2.1)**

**DRAFT FOR IS 15768 FOR UPHOLSTERY FABRIC**

*DRAFT* FOR COMMENTS ONLY Doc: No: TXD 32 (XXXX) WC

भारतीय मानक ब्युरो

*भारतीय मानक मसौदा*

**वस्त्रादि – अग्निरोधक सोफ़ासाजी के कपडे की अग्नि अवरोधकता *–* विशिष्ट**

**(आई एस 15768 का प्रथम पुनरीक्षण)**

**BUREAU OF INDIAN STANDARDS**

Draft *Indian Standard*

**TEXTILES - RESISTANCE TO IGNITION OF FIRE-RESISTANT UPHOLSTERY FABRICS *–* SPECIFICATION**

(*First revision of* IS 15768)

**ICS 59.080.97.140**

Not to be reproduced without permission of Last date for receipt of comment is

BIS or used as Standard XXXX, 2024

**FOREWORD**

*(Formal clause to be added later)*

There have been many fire incidents in recent years in residential and public buildings/places, the origin of which could be many, such as, electric short circuiting, ignition. etc. The origin of fire may not be that much dangerous and hazardous as the ease of ignition and spreading of fire due to combustible materials such as, textiles, plastics, upholstery fabric etc. Depending upon the type of materials encountered in burning, its ease of ignition and its fire spread properties, the extent of damage to the life and property could be enormous. In order to prevent or minimize the damage to life and property due to such fire risks, formulation of this standard needs no emphasis.

Specification for resistance to ignition of textile materials and assemblies for use in the public buildings/places exist in various developed countries as a fallout of various legislation, Rules or Acts, etc, or directions of local bodies. The trend is increasing in other countries also and India should be no exception to this. This standard lays emphasis on matching the magnitude of threat posed in various places/buildings with commensurate performance levels of fire resistant textile materials so as to ensure safety of the life and property.

This standard is based on BS 7176 : 1995 'Resistance to ignition of upholstered furniture for non –domestic seating by testing composites'. The list of buildings/places under different fire hazard categories have been included taking assistance from SP 7 : 2016 'National Building Code of India 2016'.

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 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

**1 SCOPE**

**1.1** This standard covers the requirements for the resistance to ignition of fire-resistant upholstery fabrics in all forms such as roll form or piece form etc.

NOTE — The levels of ignition resistance have been set after careful consideration of the fire risk of the particular end-use environment involved. These levels do not necessarily reflect the behaviour of the upholstered seating in a fully developed fire.

**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 publications, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

**3 TERMINOLOGY**

For the purposes of this standard the definitions given in SP 45 together with the following shall apply:

**3.1 Fire Hazard** — Potential for loss of life (or injury) and/or damage to property, by fire.

**3.2 Fire Risk** — Probability of fire causing loss of life (or injury) and/or damage to property.

**3.3 Ignition Risk** — The probability that ignition will result if a source of heat is allowed into close proximity or contact with a combustible material.

**3.4 Upholstery Fabric** — Upholstery fabric is defined as the textile fabric used for covering furniture such as sofas, chairs, ottomans, beds, tables, and other furniture items, including seats and beds used in railways, ships, automobiles, airplanes etc.

**3.5 Composite** — A composite refers to the combination of different elements of furniture like frame, upholstery fabric (covering fabric), filling materials (foam, feathers, foam crumbs etc.), webbing and other components.

**4 PERFORMANCE REQUIREMENTS FOR RESISTANCE TO IGNITION**

**4.1 Ignitability**

The upholstery fabric shall meet the levels of ignition resistance given in Table 1 when tested in accordance with the test methods specified in Table 1 for the various categories of hazardous places/buildings as specified in Annex B.

**4.1.1** The testing shall be done as per standards mentioned in Table 1 by making the composite specimens as described in respective Indian Standards specified in Table 1.

**4.2 Durability of Flame Retardant Property**

The upholstery fabric shall pass the relevant ignition tests as specified in Table 1 before and after 50 *Min* cycles of washing as per the standard or the reduced washing procedure depending upon the type of textile material under test, as specified in Annex D. The upholstery fabric shall be conditioned in the standard atmosphere as per the method specified in IS 6359 before each washing cycle and shall be dried by any method suitable for the fabric type after each washing cycle. The upholstery fabric, which is claimed to be dry cleanable, shall be subjected to 50 dry cleaning cycles as per the method prescribed in Annex C of IS 15612 (Part 2) and shall pass the tests as specified in Table 1 before and after 50 dry cleaning cycles.

**4.3 Toxicity Index**

The toxicity Index of gases evolved during burning of 100 g of upholstery fabric shall be 1.0 *Max* when tested by the method prescribed in Annex E.

NOTE — This requirement is to be tested on the upholstery fabric as delivered by the supplier before any washing.

**4.4 Visibility Due to Smoke Released on Combustion**

The visibility due to smoke released on combustion of upholstery fabric shall conform to either Class A or Class B when tested by the method specified in IS 15782.

NOTE — This requirement is to be tested on the upholstery fabric as delivered by the supplier before any washing.

**Table 1 Performance Requirements and Notes on Application of Hazard Categories**

(*Clause* 4.1, 4.1.1 *and* 4.2)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl No.** | **Hazard Category** | **Requiremeats1)** | **Typical Examples of**  **Places/Buildings**  **(For guidance only)** | **Methods of Test** |
| (1) | (2) | (3) | (4) | (5) |
| i) | Low Hazard Category | To pass the:  a) Smouldering cigarette test  b) Match flame equivalent test | Annex B | IS 12467 (Part 1)  IS 12467 (Part 2) |
| ii) | Moderate Hazard Category | To pass the:  a) Smouldering cigarette test  b) Match flame equivalent test  c) Crib test, source I | Annex B | IS 12467 (Part I)  IS 12467 (Part 2)  Annex C |
| iii) | High Hazard Category | To pass the:  a) Smouldering cigarette test  b) Match flame equivalent test  c) Crib test, source 2 | Annex B | IS 12467 (Part I)  IS 12467 (Part 2)  Annex C |
| NOTES    **1** It is important to realize that the listing of types of premises under different hazard categories in Table 1 is given for guidance only and that the classification of a particular premises into one of the hazard categories is a decision for staff responsible for fire safety.    **2** The examples cited in Table 1 for each hazard category cannot be exhaustive and do not cover all types of possible premises in a hazard category. It will be noted that some of the examples appear in more than one hazard category. This reflects the range of hazards possible under different circumstances for particular types of premises. Other examples, whether or not listed in Table 1, could also fall into more than one hazard category. However, when all the relevant factors have been considered, a particular premise can then be assigned to one hazard category.    **3** The classification of a particular premises into one of the hazard categories in Table 1 is a decision for staff responsible for fire safety, for example, building control, fire brigade, licensing authorities, or environmental health authorities. Government departments and other organizations often have their own classifications for upholstered furniture where all the hazards have been assessed and a general policy has been adopted. Such classifications may be different from the examples given in Annex B. Attention is drawn to the following factors when classifying a hazard area:    a) Statutory requirements and other recommendations;  b) The Building Regulations and Local Authority Bye-Laws;  c) Consumer Protection Acts and Safety Regulations:  d) The National Building Code of India, 2016;  e) Fire precautions in existing places of work that require clearance from fire authorities;  f) Fire precautions in existing residential care premises;  g) Fire precautions in existing places of entertainment and like premises;  h) Fire precautions in premises used as hotels and boarding houses which require a fire certificate;  j) Fire safety management in hotels and boarding houses;  k) Whether or not people sleep at premises;  m) The level of occupancy;  n) Whether. in the case of fire, occupants could be expected on their own or whether they would need assistance. for example, Babies, children. old and infirm, the invalid. the sick, and those retained by locked doors;  p) The presence or absence of an automatic fire detection and alarm system, or an automatic fire extinguishing system;  q) Any special hazards, such as cooking, heating, live flame effects, smoke effects, low lighting levels. strobe lighting. Loud music. drinking, use after dark;  r) Whether or not the premises are, during times of use. under the control of staff trained in appropriate evacuation procedures; and  s) The location of the hazard area, namely of floors. whether or not high rise and/or below ground and/or windowless.    **4** If a particular premise in the low hazard area is also used for sleeping purposes, then that premises shall be assigned the next higher hazard | | | | |

**5 SAMPLING AND CRITERIA FOR CONFORMITY**

**5.1 Lot**

All upholstery fabric pieces/rolls of identical type and composition delivered to a buyer against one dispatch note shall constitute a lot.

**5.2** The number of upholstery fabric rolls to be selected at random shall be according to col 2 and 3 of Table 2.

**5.3** The number of upholstery fabric pieces to be selected at random shall be according to col 2 and 3 of Table 3.

**5.4** **Number of Tests and Criteria for Conformity**

**5.4.1** The samples of upholstery fabric rolls selected shall be in accordance with col 3 of Table 2. The lot shall be declared conforming to the requirements of this standard if all the samples meet the requirements as specified in this standard.

**5.4.2** The samples of upholstery fabric pieces selected shall be in accordance with col 3 of Table 3. The lot shall be declared conforming to the requirements of this standard if all the samples meet the requirements as specified in this standard.

**Table 2 Sample Size**

(*Clauses* 5.2 *and* 5.4.1)

|  |  |  |
| --- | --- | --- |
| **Sl No.** | **Lot Size** | **Sample**  **Size** |
| (1) | (2) | (3) |
| i) | Up to 50 | 2 |
| ii) | 51-150 | 3 |
| iii) | 151-300 | 3 |
| iv) | 301-500 | 5 |
| v) | 501-1 000 | 7 |
| vi) | 1001 and above | 7 |

**Table 3 Sample Size**

(*Clauses* 5.3 *and* 5.4.2)

|  |  |  |
| --- | --- | --- |
| **Sl No.** | **Lot Size** | **Sample**  **Size** |
| (1) | (2) | (3) |
| iii) | Upto 300 | 3 |
| iv) | 301-500 | 5 |
| v) | 501-1 000 | 5 |
| vi) | 1 001 and above | 8 |

**6 MARKING**

**6.1** Each piece of upholstery fabric material shall carry a permanently stitched and clearly readable label with the following information:

1. Nature and composition of the upholstery material, for example, polyester/cotton blended (50 : 50 percent);
2. Length and width, in mm and mass, in g/m2:
3. Name and address of the manufacturer or his trade-mark(s);
4. The words 'FIRE RESISTANT'; and
5. Any other information as required by the law in force.

**6.2** The minimum size of the graphic part of the label shall be 50 mm × 50 mm. The colour of the label shall be white with a green border and the words 'FIRE RESISTANT' shall be of a distinct colour and of minimum height 5 mm.

Note — In case the fabric is in piece form, the label shall be present on each piece of upholstery fabric.

**6.3** The following wording shall also appear on the label:

1. Complies with this standard; direct test/ predictive test for low hazard (not recommended for use in higher hazard areas); or

1. Complies with this standard for medium hazard (not recommended for use in higher hazard areas)' or

1. Complies with this standard for high hazard.

**6.3.1** The letters of the wording shall be easily legible and of minimum height 2 mm.

**6.4 BIS Certification Marking**

The upholstery fabric may also be marked with the Standard Mark.

**6.4.1** The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations made thereunder. The details of conditions under which the license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from Bureau of India Standards.

**7 PACKING**

The upholstery fabric shall be packed as per the relevant Indian Standard or as agreed to between the buyer and the seller.

**ANNEX A**

(*Clause* 2)

**(LIST OF REFFERED STANDARDS)**

|  |  |
| --- | --- |
| ***IS No.*** | ***Title*** |
| 6359 : 2023 | Method for conditioning of textiles |
| 12467 (Part 1) : 2006 | Textiles – Assessment of the ignitability of upholstered furniture Part 1 Ignition source: smouldering cigarette (*first revision*) |
| 12467 (Part 2) : 2006 | Textiles – Assessment of the ignitability of upholstered furniture Part 2 Ignition source: match flame equivalent (*first revision*) |
| 15612 (Part 2): 2006 | Textiles – Burning behaviour of curtains and drapes Part 2 Measurement of flame spread of vertically oriented specimens with large ignition source |
| IS 15782 : 2008 | Textiles – Method for determining deterioration of visibility due to smoke released on combustion of materials |
| SP 45 : 1988 | Handbook on glossary of textile terms |

**ANNEX B**

(*Clause* 4.1 and *Table* 1)

**BROAD CLASSIFICATION OF VARIOUS OCCUPANCIES INTO DIFFERENT DEGREES OF HAZARD**

**B-1 Low Hazard Occupancies**

1. Analytical, Inspection and/or Q.C. Laboratories;
2. Assembly buildings (small) – Institutional / Office Seminar or Meeting halls;
3. Clubs;
4. Day Centres;
5. Dwellings, lodges, dormitories, etc;
6. Educational and Research Institutions;
7. Office premises;
8. Places of worship; and
9. Residential buildings (except hotels);
10. Museums, archives and record rooms

**B-2 Moderate Hazard Occupancies**

1. Airport and other transportation terminal buildings;
2. Assembly buildings (large): Places of Public Entertainment or Gatherings
3. Casinos;
4. Computer Installations (like data centres, server rooms, etc);
5. Hospitals including ‘X’ ray and other diagnostic clinics;
6. Mercantile occupancies (departmental stores, shopping complex, shopping malls, etc);
7. Museums, archives, record rooms;
8. Places of public entertainment (exhibitions, marriage pandals, theatres, cinema halls, etc.);
9. Public Halls;
10. Public houses and bars; and
11. Residential apartments, hotels, cafes, restaurants

**B-3 High Hazard Occupancies**

1. Hazardous occupancy buildings;
2. Offshore installations;
3. Prison cells;
4. Sleeping accommodation in certain hospital wards; and
5. Underground shopping complexes and underground shopping malls.

**ANNEX C**

(*Table* 1)

**CRIB TEST**

**C-1 PRINCIPLE**

Materials forming a composite are assembled together on the test rig appropriate to the ignition source being used.

**C-2 APPARATUS**

**C-2.1 Test Rig**, as specified in Fig. 1 and 2 of IS 12467 (Part 1), consisting of two rectangular frames hinged together and capable of being locked at right angles to each other. The frames shall securely hold the expanded steel platforms and a standard edging section may be used around the expanded steel to give protection and greater rigidity. The hinge rod shall be continuous across the back of the rig. The frame shall be lockable at right angles to each of the pairs of the members forming the back legs.

**C-2.2** **Test Enclosure,** either a room with a volume greater than 20 m3 (which contains adequate oxygen for testing). or a smaller enclosure with a thorough flow of air (between 0.02 m/s to 0.2 m/s) equipped with inlet and extraction systems.

**C-2.2.1** The atmosphere within the enclosure during the test shall have a temperature of 25 ± 5°C and a relative humidity of 50 ± 20 percent. A means of extracting smoke and toxic gases shall be provided for all such enclosures.

**C-2.3 Propane-2-ol**

**C-2.4** **Graduated Glass Syringe**, or other suitable measuring instrument, capable of measuring 1.4 ± 0.1 ml of propane-2-ol.

**C-2.5 Stop Clock**, accurate to 1 s and capable of measuring at least 1h.

**C-2.6 Crib Ignition Sources**

**C-2.6.1** *Materials and Construction*

The cribs shall be constructed from the following:

1. Dry planks of the softwood Pinus Kesiya (Khasi Pine) which have been stored in warm

dry conditions for a minimum of one week;

b) Absorbent surgical lint; approximately 200 g/m2 which is cut into nominal squares 40 mm × 40 mm (each square having a mass of approximately 0.3 g); and

c) Polyvinyl acetate or other suitable wood adhesive for gluing together the sticks and lint.

**C-2.6.2** *Assembly of the Cribs*

**C-2.6.2.1** The crib assembly shall have the parameters as specified in Tables 4 and 5. The arrangements of cribs are illustrated in Fig. 1 and 2. The suggested methods of construction are given in **C-2.7**.

**C-2.6.2.2** Select the required number and sizes of sticks conditioned in accordance with **C-3** to provide the required total mass and assemble into cribs with the square of lint incorporated, fluffy side uppermost when the crib is standing on its base. The sticks in each layer shall be parallel to one another and at right angles to the sticks in the adjacent layer. The sticks in each layer shall be placed as far away from each other as possible, but without undue overhang at their ends glued together and the lint secured with small amounts of the adhesive.

**Table 4 Parameters of Crib 1 (Ignition Source 1)**

(*Clause* C-2.6.2.1)

|  |  |  |
| --- | --- | --- |
| **Sl No.** | **Parameter** | **Requirement** |
| (1) | (2) | (3) |
| i) | Stick length, mm | 40 ± 2 |
| ii) | Stick square section, mm | 6.5 ± 0.5 |
| iii) | Number of sticks | 20 |
| iv) | Total mass of sticks, g | 17 ± 1 |
| v) | Number of layers each of two sticks | 10 |
| vi) | Approximate lint dimensions, mm | 40 × 40 |

**Table 5 Parameters of Crib 2 (Ignition Source 2)**

(*Clause* C-2.6.2.1)

|  |  |  |
| --- | --- | --- |
| **Sl No.** | **Parameter** | **Requirement** |
| (1) | (2) | (3) |
| i) | Main crib stick length, mm | 80 ± 2 |
| ii) | Main crib stick square section, mm | 12.5 ± 0.5 |
| iii) | Number of sticks, main crib | 18 |
| iv) | Number of layers each of two sticks in main crib | 9 |
| v) | Ignition crib base stick length, mm | 80 ± 2 |
| vi) | Ignition crib stick length, mm | 40 ± 2 |
| vii) | Square section of all sticks in the ignition crib, mm | 6.5 ± 0.5 |
| viii) | Number of ignition crib base sticks | 4 |
| ix) | Number of ignition crib sticks | 6 |
| x) | Number of layers each of two sticks in ignition crib | 5 |
| xi) | Total mass of main and ignition crib sticks, g | 126 ± 4 |
| xii) | Approximate lint dimensions, mm | 40 × 40 |

**C-2.7 Suggested Methods of Construction**

**C-2.7.1** *Crib* 1

Glue together 18 sticks to form the main crib body. Stick one square of lint across the main crib body. Stick one square of lint across the crib square section and then glue on the remaining two sticks to form the base (*see* Fig. 1).

**C-2.7.2** *Crib 2*

Glue together 16 of the main crib sticks to form the main crib body to make construction A (*see* Fig. 2B). Glue together the six ignition crib sticks plus two of the ignition crib base sticks to form the ignition crib body; stick one square of lint across the ignition crib square Section and then glue on the remaining two ignition crib base sticks to form the ignition crib; glue on the remaining two main crib sticks to make construction B (*see* Fig. 2A). When the adhesive is set, invert construction B and glue it to construction A (*see* Fig. 2B).

NOTE — A simple way to ensure that the core of the crib is correct is to build the crib around a former. A smooth hardwood block nominally 27 mm × 27 mm ×100 mm is suitable for crib 1 and inner side of crib 2. A hardwood block nominally 55 mm x 55 mm × 155 mm is suitable for crib 2. The sticks are glued around the block and block removed before the glue sets. For example, crib 1 is made by gluing 18 sticks together, removing the block. fixing lint in place on top and then gluing on the remaining two sticks.

**C-3 CONDITIONING**

The sticks and the cribs shall be conditioned immediately before the test for 72 h in indoor ambient conditions and then for at least 16 h at 25 ± 5°C and 50 ± 20 percent relative humidity.

**C-4 TEST SPECIMENS**

**C-4.1 General**

The test specimen shall comprise a structure with vertical and horizontal parts of the composite of upholstery materials under test. These materials shall be representative of the cover, filling and other components to be used in the composites.

A drawing of a cube

Description automatically generated

FIG. 1 CRIB 1

**C-4.2 Cover Material and Fabric Inter-Liner**

**C-4.2.1** *Test specimens used shall be as shown in Fig. 3.*

**C-4.2.2** The long dimension shall be cut parallel to the machine direction. The cover may be constructed from smaller pieces of test materials provided that the resulting seams do not occur within 100m, of the area likely to be affected by the test or they are located behind the pivot bar. If lack of test materials requires the use of additional alternative material, for example, side extension, their use shall be stated in the test report.

**C-4.2.3** The cut-outs shall be positioned such that when assembled on the test rig, the lie of the pile is down the vertical assembly and from the hinge to the front of the horizontal assembly. Where a fabric inter-liner is used, it is cut to the same dimensions. and in the same orientation as the cover, for fitting to the rest rig under the cover.

**C-4.3 Upholstery Filling**

**C-4.3.1** It shall consist of two pieces of filling, one (450 mm ± 5 mm) × (450 mm ± 5 mm) × (75 mm ± 2 mm) thick and the other (450 mm ± 5 mm) × (300 mm ± 5 mm) × (75 mm ± 2 mm) thick for each test. Some cushioning assemblies may consist of several layers that may be typically felt, wadding or various foams. Where the total thickness exceeds 75 mm, the upper 75 mm of the cushioning assembly is reproduced, except that the upper layer(s) are not continued over and round the edges of the assembly.

A diagram of a structure

Description automatically generated

FIG. 2A CRIB 2 - CONSTRUCTION B

A diagram of a structure

Description automatically generated

2B COMPLETE CRIB 2

FIG. 2 CONSTRUCTION OF THE CRIBS

A diagram of a rectangular object with arrows and a point

Description automatically generated

Approximate cut-out dimensions

Key

1 Lie of pile A : 110

2 Vertical B : 50

3 Horizontal C : 20

4 Cut-outs

FIG. 3 DETAILS OF TEST SPECIMENS FOR FABRIC COVERS AND INTER-LINERS

**C-4.3.2** Where this filling is less than 75 mm thick the test piece shall be built up to the required thickness by adding to the underside a further layer of the bottom material.

**C-4.3.3** If lack of test materials requires the use of additional alternative materials such as side extensions, the additional materials shall not be positioned within 100 mm of the ignition source, or above the top of the ignition source if used in the vertical part of the test specimen. The use of additional materials shall be noted in the test report.

**C-4.3.4** In case of the loose filling material, for example, foam crumb or feathers, the filling shall be built up beneath the covering materials to reproduce the 75 mm thickness of the assembly at a realistic filling density. Where necessary, a finer grid material or air porous fabric may be laid over the expanded metal of the test rig to retain the filling.

**C-4.3.5** If, in use, the loose infill is enclosed in an interlining (or ticking), two bags of the inter-lining suitably filled and to the overall dimensions given above for use as the upholstery filling beneath the cover(s) shall be used.

Note — The tests described in this section are unsuitable when used with composites where the loose filling materials flows out of the assembly during the test and either extinguishes, moves or adversely affects the burning of the ignition sources. A more positive result may be obtained with such materials are tested as a complete item of furniture.

**C-5 CRITERIA OF IGNITION**

**C-5.1 General**

The ignition criteria shall include both the progressive smouldering and flaming ignition and shall be assessed separately.

**C-5.2 Progressive Smouldering Ignition**

The following types of behaviour shall be considered as progressive smouldering ignition:

1. any test specimen that displays escalating smouldering combustion behaviour so that it is unsafe to continue the test and forcible extinction is required;

1. any test specimen that smoulders until it is essentially consumed or that smoulders to the extremities of the specimen, that is to either side or to the full thickness of the specimen, within the duration of the test;

1. any test specimen that produces externally detectable amounts of smoke, heat or glowing 60 min after ignition of the crib; and

1. any test specimen that, on final examination shows evidence of charring within the filling (other than discoloration) more than 100 mm in any direction apart from upwards from the nearest part of the original position of the source.

Note — In practice it has been found that there is usually a clear distinction between materials that char under the influence of the ignition source but that do not propagate further (non-progressive) and those where smouldering develops in extent and spreads (progressive)

**C-5.3 Flaming Ignition**

The following types of specimens shall be considered as flaming ignition.

a) any test specimen that displays escalating flaming combustion behaviour so that it is unsafe to continue the test and forcible extinction is required;

b) any test specimen that burns until it is essentially concerned within the test duration;

c) any test specimen on which any flame front reaches the extremities of the specimen other than the top of the vertical part of the test specimen or passes through the full thickness of the specimen within the duration of the test;

d) for flaming ignition source 1 any test specimen that continues to flame for more than 10 min after ignition of the crib;

e) for flaming ignition source 2 any test specimen that continues to flame for more than 13 min after ignition of the crib; and

f) for all sources; any test specimen from which debris causes an isolated floor fire not meeting the requirements of items (d) or (e).

NOTE — It is recommended that composites which fail criterion (c), for example because the full thickness is penetrated by molten material rather than by flames. are tested as a complete item of furniture.

**C-6 PROCEDURE**

Note — For safety. all tests should be carried out in a suitably constructed enclosure.

**C-6.1 Preparation**

**C-6.1.1** Ensure that the means of fire extinguishing are close to hand.

**C-6.1.2** Open out the test rig and thread the covering fabric and, if used, the fabric inter-liner, behind the hinge bar so that the cut outs are aligned with the hinge bar.

**C-6.1.3** Place the filling pieces under the covering fabric(s) and locate the filling pieces in the frame recesses.

**C-6.1.4** Lock the frames at right angles by the bolts or pins ensuring that the filling components are not displaced. Fasten the fabric(s) over the top, bottom and sides of the frame using clips and secure the fabric(s) under even tension by allowing approximately 20 mm of fabric to wrap around the frame so that the edge of the fabric just contacts the expanded metal.

**C-6.2 Wood Crib Tests (Ignition Sources 1 and 2)**

**C-6.2.1** Use a new specimen for each test. After the assembly of a crib (*see* **C-2.6.2**) and after conditioning (*see* **C-3**) it add slowly 1.4 ± 0.1 ml of propane-2-ol to the centre of the lint. Place the crib on the horizontal part in contact with the vertical part of the test specimen, centrally between the sides of the rig. The base sticks of the crib shall be parallel to the vertical surface of the test specimen.

**C-6.2.2** Within 2 min of adding the propane-2-ol to the lint, ignite the alcohol from the front and above the lint, using a match, small gas flame or hot wire ignition, and simultaneously start the clock.

**C-6.2.3** If the crib collapses causing embers to be scattered over a distance greater than 100 mm measured from the edge of the crib, repeat the test with a new crib placed in position on a new test specimen.

**C-6.2.4** Observe for evidence of ignition (*see* **C-5**) in the interior and/or cover.

**C-6.2.5** If flaming or progressive smouldering of the composites is observed (*see* **C-5**) extinguish the test specimen and record ignition for the ignition source used.

**C-6.2.6** If flaming or progressive smouldering of the composites is observed (*see* **C-5**) repeat the test. If flaming or progressive smouldering is not observed in this retest, record non-ignition for the ignition source used, unless the test specimen fails the final examination specified in **C-6.2.3**. In this case, extinguish the test specimen and record ignition.

**C-7 FINAL EXAMINATION**

As cases of progressive smouldering undetected from the outside have been reported, immediately after completion of the test programme on the test specimen, dismantle and examine the filling for progressive smouldering. If this is present, extinguish the test specimen and record ignition for the relevant ignition source. For safety reasons ensure that all smouldering has ceased before the rig is left unattended.

**ANNEX D**

(*Clause* 4.3)

**METHOD FOR DETERMINATION OF DURABILITY OF FIRE RETARDANT PROPERTY OF UPHOLSTERY FABRIC**

**D-1 General**

The method shall be used for assessing the possible effect of repeated commercial laundering on the fire-retardant property of upholstery fabrics. The effect of laundering is simulated using an automatic horizontal drum washing machine.

**D-2 APPARATUS AND REAGENTS**

**D-2.1 Washing machine**

**D-2.1.1** **Automatic Washing Machine**, equipped with a horizontal rotating drum with reversing action. The drum shall have a diameter of 480 mm to 610 mm and shall be fitted with three or four lifters. It shall rotate at 30 rev/min to 52 rev/min and reverse its direction every 10 revolutions to 20 revolutions. The liquor level shall be capable of being controlled to both low and high levels, giving liquor volumes of 0.3V, and 0.54V, where V is the volume of the rotating drum. Means shall be provided for heating and controlling the water temperature. This automatic washing machine shall be used in accordance with the procedures specified in **D-5.**

**D-2.2** **Soft Water**, with a maximum hardness, expressed as calcium carbonate, of 20 mg/l.

**D-2.3** **Ballast**, consisting of rectangular pieces in single layers of woven 100 percent bleached cotton or 100 percent polyester. Each piece shall measure at least 350 mm × 500 mm and shall be hemmed along the cut edges to prevent unravelling.

**D-2.4 Low-Foaming Detergent**, with perborates specified in **D-2.4.1,** may be used. Other similar detergents may also be used. Sodium perborate is added to the detergent immediately before use in the ratio of one part per borate to four parts of detergent. All detergent quantities quoted in **D-5** are for the detergent plus perborate.

**D-2.4.1** *Composition of the Reference Detergent (Informative)*

As the names and compositions of reference detergents are constantly changing, it is not possible to specify the use of a fixed detergent. A recommended detergent is the ECE or IEC TAED reference detergent. This is a zeolite built detergent. Alternative detergents may be agreed upon between the interested parties.

The TAED reference detergent is supplied as three separate components which are mixed in the following mass fractions immediately before use:

|  |  |
| --- | --- |
| *Parameters* | *Nominal Composition*  *(as Percent mass)* |
| Spray-dried powder with enzyme prills | 77.0 |
| Sodium perboratetetrahydrate | 20.0 |
| Bleach activator, tetraacetylethylenediamine | 3.0 |

Due to the variability of the manufacturing process and to ageing, the composition of the spray-dried powder may vary.

A typical composition of the ECE spray-dried powder is:

|  |  |
| --- | --- |
| *Component* | *Nominal Composition*  *(as mass fraction)* |
| Alkylbenzenesulfonate | 7.5 |
| C12-18 alcohol + 7 ethylene oxide | 4.0 |
| Soap (65 % C12-18, 35 % C20-22) | 2.8 |
| Sodium aluminium silicate (zeolite 4A) | 25.0 |
| Sodium carbonate | 10.0 |
| Sodium salt of acrylic/maleic acid copolymer | 4.0 |
| Sodium silicate (Si02 : Na20 = 3, 3 : 1) | 3.0 |
| Carboxymethylcellulose | 1.0 |
| Sodium ethylenediaminetetraacetate | 0.2 |
| Sodium sulfate | 9.4 |
| Water | 9.6 |
| Protease enzyme prills | 0.5 |

NOTE — The IEC TAED detergent contains 0. 2 % of stilbene-type optical whitener with the quantity of sodium sulfate reduced to 9.2 %.

**D-2.5 Iron, or Press**, capable of being used at a temperature appropriate for the material being tested.

**D-3 COMPOSITION OF LOAD**

The test specimens shall be of sufficient size for the subsequent ignitability testing. The total dry mass of the load shall be as calculated in **D-4.2** and at least half the load shall consist of material under test or material of similar fibre type, the remainder consisting of polyester ballast (*see***D-2.3**).

**D-4 PRELIMINARY CALCULATIONS**

**D-4.1 Drum Volume**

If it is not specified, calculate the volume *V1*, expressed in litres, of the rotating drum to the nearest litre, ignoring any space occupied by lifters, using the equation:

where

*l* = length of drum, in mm; and

*r* = radius of drum, in mm.

**D-4.2 Test Load**

Calculate the total dry mass m1 expressed in kilogram, of the test load to the nearest 0.1 kg using the equation

*m*1 = (0.060 ± 0.004)*V*1

**D-4.3 Detergent Quantity**

Calculate the mass *m*2, expressed in gram, of detergent to be added, to the nearest 0.5 g using the equation

*m*2 = (0.30 ± 0.02)*V*1

**D-4.4 Low Dip Level (*L*)**

Determine the volume of water *V*2, expressed in litre, required to fill the machine to the low dip level (*L*) to the nearest 0.5 litre with no load present and with a stationary drum, using the equation

*V*2 = (0.30 ± 0.02) *V*1

**D-4.5 High Dip Level (*H*)**

Determine the volume of water V3 expressed in litre, required to fill the machine to the high dip level (*H*) to the nearest 0.5 litre with no load present and with a stationary drum, using the equation

*V*3 = (0.54 ± 0.04) *V*1

**D-4.6 Parameters for Typical Automatic Washing Machines (Informative)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No** | **Type** | **A1** | **A2** |
| **(1)** | **(2)** | **(3)** | **(4)** |
| **i** | Volume, *V*1, (litre) | 70 | 45 |
| **ii** | Load, *m*1, (kg) | 4.2 ± 0.3 | 2.7 ± 0.2 |
| **iii** | Low dip volume, *V*2 (litre) | 21.0 ± 1.5 | 13.5 ± 1.0 |
| **iv** | High dip volume, *V*3 (litres) | 38.0 ± 3.0 | 24.5 ± 2.0 |
| **v** | Detergent, *m*2(g) | 21.0 ± l.5 | 13.5 ± l.0 |

NOTE — For some machines the dip levels are preset. Other machines require the dip levels to be adjusted to give the specified volumes.

**D-5 STANDARD WASHING PROCEDURE**

**D-5.1** Load the machine with a load of m1 as calculated in **D-4.2** and of the specified composition (*see* **D-3**). Start the machine with reduced agitation and fill with soft water (*see* **D-2.2**) at a temperature of 15 oC to 40 oC to the low dip level (*L*), at the same time adding the mass m2 of detergent (*se*e **D-2.4**) as calculated in **D-4.3**.

**D-5.2** If the inlet water temperature is below 37oC, heat to 40 ± 3oC with no agitation. Heat to 75 ± 3oC in 15 ± 3 min with reduced agitation. Switch to normal agitation and run at 75±3 oC for 15±0.5 min and then drain.

**D-5.3** Fill with cold soft water to the high dip level (*H*). Run for 3 min and then drain. Repeat three times to give a total of four rinses in all. Centrifuge for 6 min.

**D-5.4** Repeat the washing, rinsing and centrifuging cycles 49 times, giving a total of 50 cycles.

NOTE — If the number of wash cycles specified cannot be completed without interruption, the load may be left wet after centrifuging for a maximum of 18 h.

**D-5.5** Dry the specimens in air for the material. Press them (*see* **D-2.5**) at an appropriate temperature to remove creases (if the material is suitable for pressing).

**D-6 REDUCED WASHING PROCEDURE**

**D-6.1** Load the machine with a load of mass *m*1, as calculated in **D-4.2** and of the specified composition (*see* **D-3**). Start the machine with reduced agitation and fill with soft water (*see* **D** **2.2**) at a temperature of 15 oC to 40 oC to the low dip level (*L*), at the same time adding the mass m2 of detergent (*see* **D-2.4**) as calculated in **D-4.3**.

**D-6.2** If the inlet water temperature is below 37 °C, heat to 40 ± 3 °C with no agitation. Run at 40±3 °C with reduced agitation for 15 ± 0.5 min and then drain.

**D-6.3** Fill with cold soft water to the high dip level (*H*). Run for 3 min then drain. Repeat three times to give a total of four rinses in all. Centrifuge for 3 min.

**D-6.4** Repeat the washing, rinsing and centrifuging cycle 49 times, giving a total of 50 cycles.

NOTE — If the number of wash cycles specified cannot be completed without interruption, the load may be left wet after centrifuging for a maximum of 18 h.

**D-6.5** Dry the specimens in air. Press them (*see* **D-2.5**) at an appropriate temperature to remove creases (if the material is suitable for pressing).

**D-7 REPORT**

The test report on the fire retardant property of upholstery fabric tested after washing by these procedures shall contain the following:

1. Type of washing machine used that is automatic washing machine and its drum volume;
2. Type of detergent used;
3. Washing procedure employed (standard or reduced);
4. Any deviation from the procedure specified.

**ANNEX E**

(*Clause* 4.4)

**METHOD FOR DETERMINATION OF TOXICITY INDEX**

**E-1 GENERAL**

This method explores the toxicity of the products of combustion in terms of small molecular species arising when a small sample of a material is completely burnt in excess air under specified conditions. The method does not necessarily determine the total toxicity of all the constituents of the products of combustion.

**E-2 DEFINITION**

**E-2.1 Toxicity Index**

The numerical summation of the toxicity factors of selected gases produced by complete combustion of the material in air under specified conditions. The toxicity factors are derived from the calculated quantity of each gas that would be produced when 100 g of the material is burnt in air in a volume of 1 m3 and the resulting concentration expressed as a factor of the concentration fatal to man in a 30 min exposure time. A toxicity index of 1.0 for a given volume will, on average bring about death in 30 min.

**E-3 PRINCIPLE**

Analytical data of certain small molecular gaseous species arising from the complete combustion under flaming conditions of the material under test are mathematically computed using the exposure level (in ppm) of each gas to produce fatality in 30 min as a base to derive a combined toxicity index.

**E-4 APPARATUS**

**E-4.1 Toxicity Chamber** – A toxicity chamber (*see* Fig. 1) consisting of the following:

**a)** An airtight enclosure of at least 1 m3 (approximately 100 × 100 × 100 cm3) volume lined with opaque plastic sheeting having a hinged or sliding door, fitted with a transparent plastic panel.

NOTE — As far as possible, all items of the equipment within the test chamber shall be constructed of, or coated with, an inert non-metallic material. Some gaseous products of combustion may react with or be absorbed on the walls of the chamber. The materials of construction must be chosen to minimize this. Lining of polypropylene has been found satisfactory with poly carbonate where transparency is required.

**b)** The chamber shall be fitted with a forced air extraction system which can be closed at the exit from the chamber when required.

**c)** The chamber shall be fitted with sampling positions, such that the air tightness of the chamber is not impaired.

**d)** The chamber shall contain a mixing fan capable of being switched on and off externally. A six-bladed axial fan of at least 200 mm diameter shall be mounted horizontally and centrally inside the chamber at roof level to ensure rapid mixing of combustion products.

**E-4.2 Burner**

**E-4.2.1** The burner shall be capable of achieving a flame approximately 100 mm in height and having a temperature of 1 150 ± 50°C at its hottest point. The bunsen burner operating on natural gas (Methane) having a gross calorific value of approximately 40 MJ / m3 and modified to provide an external supply of air connected to the burner collar shall be used.

**E-4.2.2** In order to achieve the flame characteristics stated in **E- 4.2.1**, a bunsen burner of 125 mm overall height, 11 mm bore burner tube and 5 mm bore gas and air inlet tubes shall be used.

NOTE — Gas and air flow rates of 10 litre and 15litre/min respectively satisfy the requirements but some adjustments of the flow rates must be necessary to suit particular situation.

**E-4.2.3** Provision shall be made for igniting and extinguishing the burner from outside the chamber using a small pin flame on a separate gas supply.

NOTE — Unsatisfactory results will be obtained using a conventional bunsen burner drawing air from within the chamber. The effect is oxygen depletion and a consequential reduction of burner flame temperature, or even extinguishment during the combustion period of a test causing loss of standard conditions.

**E-4.3 Specimen Support**

**E-4.3.1** A device capable of supporting the test specimen over the bunsen burner without significantly moving it from the flame, shall be provided.

**E-4.3.2** The support shall be an annulus cut from a non-combustible material such as sheet steel of nominal thickness 2 mm to 4 mm, of approximately 100 mm overall diameter with a 75 mm diameter hole carrying temperature resistant wires approximately 100 mm apart to form a lattice. The complete assembly shall be equipped with a non-combustible side support arm to give a “tennis racket” appearance.

**E-4.4 Timing Device**

The timing device shall be capable of measuring time periods up to 5 min to an accuracy ±1 s.

**E-4.5 Analytical Equipment**

Any analytical system that will allow rapid detection and estimation of the gases in the products of combustion as detailed below:

1. Carbon dioxide (CO2)
2. Carbon monoxide (CO)
3. Formaldehyde (HCHO)
4. Nitrogen oxides (NO, NO2)
5. Hydrogen Cyanide (HCN)
6. Acrylonitrile (CH2CHCN)
7. Phosgene (COCl2)
8. Sulphur dioxide (SO2)

j) Hydrogen Sulphide (H2S)

k) Hydrogen Chloride (HCl)

m) Ammonia (NH3)

n) Hydrogen Fluoride (HF)

p) Hydrogen Bromide (HBr)

q) Phenol (C6H5OH)

NOTES

**1** This is not a complete list of all possible gases that can be products of combustion but it does represent those most commonly perceived upon which toxicity data can be based.

**2** The use of colorimetric gases reaction tube is acceptable.

**3** It is obvious that there is no need to determine the quantity of, say, hydrogen chloride in the products of combustion if the material being tested does not contain chloride. Therefore, as an aid to analysis it is desirable to determine the element present in the material before an assessment of the toxicity index is carried out. If nitrogen is not found, then there is no need to analyse nitrogen containing gases i.e. nitrogen oxides, hydrogen cyanides, acrylonitrile and ammonia.

**4** For the purpose of calculating toxicity indices, the following values of concentration of gases in ppm are used:

Carbon-di oxide 100000

Carbon monoxide 4000

Hydrogen sulphide 750

Ammonia 750

Formaldehyde 500

Hydrogen chloride 500

Acrylonitrile 400

Sulphur dioxide 400

Nitrogen oxides 250

Phenol 250

Hydrogen cyanide 150

Hydrogen bromide 150

Hydrogen fluoride 100

Phosgene 25

**E-4.6 Gas Sampling**

In order to minimize losses of certain toxic products through absorption or condensation prior to measurement, all sampling lines shall be as short as possible. This may be conveniently achieved, where use is made of colorimetric gas reaction tubes for analysis, by siting the tubes within the chamber itself.

**E-5 TEST SPECIMEN**

**E-5.1 Number and Size**

A sufficient number of specimens (normally 3) shall be cut from the material under test. The mass of the test specimen shall be chosen to provide optimum analytical precision depending upon the nature of the combustion products and sensitivity of the analytical procedure. The size and shape of the specimen shall be such that it is entirely engulfed in the flame.

NOTE — In some instances, for example, highly fluorinated polymers, it shall be necessary to reduce the mass of the specimen to less than 0.1 g in order to achieve a concentration within the range of the currently available colorimetric gas reaction tubes for hydrogen fluoride.

**E-6 CONDITIONING**

Unless otherwise specified, the test specimens shall be conditioned at 27oC ± 2oC and 65 ± 4 percent relative humidity before testing (*see* IS 6359).

**E-7 DETERMINATION OF BACKGROUND CORRECTION FACTOR**

**E-7.1** Position the burner in the centre of the test chamber floor and ignite it. Adjust the flow rates of gas and air to achieve the flame condition described in **E-4.2.1** and **E-4.2.2**. Record or otherwise control the flow rates in order that the conditions may be re-established when required. Extinguish the burner and ventilate the chamber.

**E-7.2** Place carbon monoxide, carbon dioxide and oxides of nitrogen tubes in position, if this method of analysis has been adopted ensuring that all other sampling positions are sealed.

**E-7.3** Seal the chamber, ignite the burner simultaneously starting the timing device. Maintain these conditions for 1 min, extinguish the flame and start mixing fan and allow this to continue for 30 s.

**E-7.4** Using their respective sampling points, extract portion of the atmosphere from the test chamber to determine the concentrations of carbon monoxide, carbon dioxide and oxides of nitrogen.

**E-7.5** Operate the extraction system of the test chamber, open the test chamber to free air and evacuate for 3 min. Repeat the procedure from **E-7.1** to **E-7.4**, but maintain the burning conditions stated in **E-7.3** for 2 min and 3 min in separate determinations.

**E-7.6** The results obtained are graphically displayed to show the rate of build-up of carbon monoxide, carbon dioxide and oxides of nitrogen with time of burning due to the burner alone. Zero time can be shown as 0.03 percent carbon dioxide and nil for carbon monoxide and oxides of nitrogen.

**E-8 SAFETY OF OPERATORS**

When the toxicity index test is being carried out, there is a risk that flammable and/or toxic fumes will be given off from the specimen under test. Operators are required to take appropriate precautions to avoid exposure to the evolved fumes.

**E-9 TEST PROCEDURE**

**E-9.1** Ensure that air temperature is 27 ± 2oC.

**E-9.2** Select a test specimen and determine its mass to the nearest mg.

**E-9.3** Position the burner in the centre of the test chamber floor and establish the flame conditions described in **E-4.2.1**.Extinguish the burner.

**E-9.4** Place the test specimen on the support approximately in the centre of the test chamber floor and adjust the support height so that the specimen will be sited within the flame boundary and subjected to the temperature given in **E-4.2.1** that is 1 150 ± 50oC.

**E-9.5** For materials which are liable to melt and drip, test specimens may be supported on a thin bed of glass wool placed on the wire mesh sample support to prevent sample losses during the combustion.

NOTE — The glass wool found suitable for this purpose is that commonly employed as a filter membrane by analytical laboratories.

**E-9.6** Ensure that the forced extraction ventilation system is off and sealed from the chamber.

**E-9.7** Insert series of colorimetric gas reaction tubes in to the chamber.

**E-9.8** Close the test chamber access door, turn on the fuel supply to the burner and ignite simultaneously and start the timing device.

**E-9.9** The burn period shall be continued for the duration considered sufficient to ensure complete combustion of the whole specimen and record the same and extinguish the burner.

**E-9.10** Start the mixing fan and continue mixing for 30 s and then switch off the fan.

**E-9.11** Immediately commence sampling the atmosphere from the chamber by drawing the gas mixture through each respective detection tube in turn. It is imperative that if the presence of halogen acids is suspected, then these must be tested before other gases in order to reduce losses through absorption or condensation which may be experienced through a delayed estimation.

**E-9.12** On completion of the analysis, the remaining products of combustion are removed from the chamber using the forced extraction exhaust system, initially opening the access door. Continue the forced ventilation for at least 3 min.

**E-9.13** Examine the residue of the test specimen to ensure that all of the combustion material has been consumed. If any portion remains unburnt or appears to be, the whole test must be repeated using a fresh sample.

**E-9.14** Repeat the procedure specified in **E-9.1** to **E-9.13** with a fresh specimen to obtain a duplicate determination, for as many times as necessary (*see* **E-5.1**).

**E-10 CALCULATION**

**E-10.1** Using the graph prepared as described in **E-7**, determine the quantity of carbon monoxide, carbon dioxide and oxides of nitrogen formed by the burner in the time recorded in **E-9.9**. Subtract these values from the total carbon monoxide, carbon dioxide and oxides of nitrogen contents determined by analysis (*see* **E-9.11**) to give the amounts actually produced by combustion of the test specimen.

**E-10.2** Using the formula given below, calculate the concentration of each gas in ppm (Cg) produced when 100 g of material is burnt and the combustion products diffused in air in a volume of 1 m3:

*Cg* = *C* × 100 × *V*

*m*

where

*C* = concentration of gas in test chamber, in ppm;

*V* = volume of test chamber in m3; and

*m* = fire test mass, in g.

**E-10.3** Calculate Cg for each gas in the duplicate determination. Calculate average of the values of Cg for each gas.

**E-10.4** Calculate the Toxicity Index as follows:

Toxicity Index = + + +…..+

where

1, 2, 3..........*n* represent each of the gas detected; and

*C*f = Concentration of the gas in ppm considered fatal to masses for a 30 min exposure time.

NOTE — Values of Cf for various gases are given in Note 4 under **E-4.5.**

**E-11 REPORT**

The test report shall include the following:

1. Full description of the material tested, including type, grade, reference number, etc.
2. The toxicity index per 100 g of material.
3. The following statement:

‘This test result alone does not assess the fire hazard of the material, or a product made from this material, under actual fire conditions. Consequently, the results of this test alone shall not be quoted in support of claims with respect to the fire hazard of the material or the product in actual fire conditions. The results when used shall only be for research and development of quality control and material specifications.’

**Annex 8**

**(Item 6.1)**

**COMMENTS FROM CENTRAL MARKS DEPARTMENT**

Sir,

This has reference to the IS 15742: 2007. As per clause 1.1 of the ibid ISS, the standard specifies the performance requirements for the limited flame spread properties of textile materials and material assemblies used in protective clothing affording protection against heat and flame.

However, contradicting to the above, clause 1.2 of the ISS states that the standard is applicable to clothing where protection against heat and fire mainly due to accidental contact with small igniting flames is required in circumstances where there is no significant heat or fire hazard such as clothing used in kitchens of commercial organizations such as office canteens, guest houses, restaurants, hotels, motels, inns, hospitals, etc.’

Further, all the requirements specified in the ISS pertains to the raw material. None of the requirement is specified for the clothing.

In view of above, TXD is requested to kindly clarify regarding the scope of IS 15742: 2007.

**Annex 9**

**(Item 6.1)**

**COMMENTS RECEIVED ON THE SCOPE OF IS 15742**

1. **Comments received from M/s** **DuPont Specialty Products India Pvt. Ltd.**

Dear Mayur,

Thanks for your message.

The protective clothing also has very wide scope. Clothing used to protect against chemicals / biohazard / cut / bullets etc. are also protective clothing and depending on application may or may not have heat & flame exposure risk. So, forcing the standard IS 15742 over all the protective clothing is not a good idea.

The basic assumption for the scope of standard IS 15742 as captured in the clause 1.2  is referring to "circumstances where there is no significant heat or fire hazard" whereas the protective clothing meant to be used against heat & flame have high risk of exposure to these hazards.

May be the language can be re-written for defining the scope of IS 15742 to bring clarity and indicate that protective clothing aiming for protection against heat & flame should also meet the requirement of IS 15748.

Thanks.

With Regards,

Manoj

+91 9987078813

1. **Comments received from M/s SASMIRA**

Dear Mr. Mayur,

I agree with the interpretation that "the standard is applicable to the entire protective clothing and not only in the textile materials and material assemblies used in protective clothing".

Thanks and regards

Dr. Manisha Mathur

Joint Director and Editor, MMTI

1. **Comments received from M/s Foremost Technico Pvt Ltd.**

Dear Sir

Refer trailing email reg IS 15742

Truly speaking …Scope 1.1 and Scope 1.2 can be mis-interpreted

Since the said Standard specifies manufacturer’s information on applicability of 2 types of materials   (**refer clause 8.1 and 8.2**) ,

we propose the following wordings be considered

**The Standard is applicable for the protecting clothing made from single layer textile material or Textile Material assemblies used in the fabrication.**

Thanks and Regards

Vinay Khanna

Director

**Annex 10**

**(Item 6.2)**

**COMMENTS RECEIVED FROM M/SNITRA, GHAZIABAD ON IS 15809**

Basic Details

|  |  |
| --- | --- |
| 1. Name: M S Parmar | 5. Doc No. / IS : IS 15809 : 2017 |
| 2. Email ID: drmsparmar@nitratextile.org | 6. Technical Commitee : TXD 32 |
| 3. Contact No. : 9810253731 | 7. Member Secretary : Mayur Katiyar |
| 4. Organisation Details : N/A | 8. Mode of receiving comment : |
| 9. Date of receipt : | 10. Upload Comment received : |

Comment details and Action Logs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sl No.** | **Clause /**  **Subclause No.** | **Paragraph No./**  **Figure No./Table**  **No.** | | **Type of Comment** | **Attachment** |
| 1 | 5.4, 5.5 and 8 | Annexure C | | Technical | N/A |
| Comments/Suggestions along with  Justification for the Proposed Change | | | 5.4: Photometric and physical performance requirements for Retroreflective and combined performance materials:  1. in subclause 5.4.1 as per C-3, the Number of readings to be taken is not mentioned in the standard.  2. It is not mentioned that the results of the average of all readings shall be given or a minimum value shall be reported. Clarity is required.  3. If only retroreflective tape is to be tested then there is no provision for any backing material to make the specimen uniform during testing, especially in the case of lighter material. | | |
| Proposed Change/Modified Wordings | | | In our opinion, at least 5 readings shall be taken and results shall be reported on the basis of the average value of 5 readings. There shall not be a 15% difference between all the readings. This point can be discussed in the meeting.  A black plate may be used as backing material as per the C-2.2 subclause | | |

**Annex 11**

**(Item 7.1)**

**NWIP RECEIVED FROM M/S NITRA, GHAZIABAD**

*Preliminary Draft on*

TEXTILES — JUTE-BASED CLOTH FOR WORKERS WORKING IN FOUNDRY AND OTHER FIRE ACCIDENT-PRONE WORKPLACES— SPECIFICATION

**1 SCOPE**

* 1. This standard prescribes the requirement of cloth for workers working in foundry and other fire accident-prone workplaces

**1.2** This standard does not specify the design/ pattern and stitching of workwear from the cloth.

**1.3** This standard does not specify the general appearance, colour, feel, etc. of the cloth.

**2 REFERENCES**

The standards listed in Annex A contain provisions that, 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 editions of the standards.

**3 MANUFACTURE AND FINISH**

The material is produced from the Jute-Cotton-based flame retardant fabric.

**3.1** For the development of Jute-cotton union fabrics, a jute yarn of 4.8 lbs (3.6 Ne approximately), single-ply in weft, and cotton yarn of approximately 4.55 (2 ply) in warp may be used. The weave should be 2/2 twill. For guidance ends/inch and picks/inch may be 32 and 28 respectively when measured as per IS 1963.

**3.2** The cloth may be dyed or printed as per the customer’s requirements. The dyed and printed cloth shall meet the colour fastness properties as given in Table 1. Dyes used for dyeing and printing shall be free from banned amine (*see* IS 15570).

**3.3** The undyed/dyed/printed cloth shall be finished with durable FR finishing agents as per the instruction of FR finish suppliers/manufacturers.

**3.3** The cloth should be supplied in the width of 135 to 140 cm or as per the agreement between buyer and seller. The length of each piece shall be as agreed between the buyer and seller.

**3.4 Freedom from Defects**

The cloth shall be free from major flaws (defects) which shall not exceed 10 per 100 meters in length (*see* Note). A list of major flaws (defects) is given in Appendix A of IS 14466: 1997/ISO 8498: 1990. The allowance for providing the extra length of cloth in lieu of the flaws (defects) not exceeding the permissible limit may be agreed between the buyer and the seller. It shall also be free from dyeing defects, such as streaks, stains uneven dyeing, and improper printing in case of printed design, etc. The cloth shall be free from any other defect which may significantly mark the appearance or serviceability.

NOTE — The number of defects shall be determined on all pieces under test and converted into the number of defects per 100-metre length.

**4.0 PRE-TREATMENT**

Samples shall be pretreated by cleaning before testing from Sl.No iv) to xi) as mentioned in Table 1. In addition, Sl.No iv) and v) shall be tested before and after cleaning. The cleaning shall be carried out as per the manufacturer’s instructions as per standard procedure. If the number of cleaning cycles is not specified, the test shall be carried out after five cleaning cycles. ISO 6330 procedure 2A followed by tumble dry delicate shall be used for cleaning purposes. A wash cycle is one wash and one drying.

**5.0 REQUIREMENTS**

**5.1** The workwear cloth shall conform to the requirements given in Table 1.

**5.2** If in order to illustrate or specify the indeterminable characteristics, such as general appearance, lustre, feel and shade of the cloth, a sample has been agreed upon and sealed, the supply shall be in conformity with the sample in such respect.

**5.3** The custody of the sealed sample shall be a matter of prior agreement between the buyer and the seller.

**6 MARKING**

Each piece of cloth shall be marked with the following:

a) Name of the material

b) Length and width;

c) Manufacturer’s name, initials, or trade-mark; and

d) Any other information required by the law in force and/or by the buyers.

**Table 1- Requirements of Cloth used for workers working in foundry and other fire accident-prone workplaces**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl No.** | **Characteristic** | **Requirement** | **Test Method** |
| (1) | (2) | (3) | (4) |
|  | Identification of fibre   * Warpwise * Weftwise | Cotton  Jute | IS 667 |
|  | Weave | 2/2 Twill | Visual |
|  | Mass, g/m2, *Max* | 650 | IS 1964 |
|  | Limited flame spread test,  Procedure A | The flame shall not reach the upper or vertical edge, no flaming debris, No hole formation, after flame & afterglow ≤ 2 s | IS 15758 Part 4 |
|  | Limited flame spread test,  Procedure B | Flame shall not reach the upper or vertical edge, no flaming debris, after flame & afterglow ≤ 2 s |
|  | Heat transfer Index (HTI244) due to Convective heat, s, *Min* | 4 | IS 15758 Part 1 |
|  | Heat transfer Index (RHTI244)  due to Radiant heat, s, *Min* | 7 | IS 15758 Part 2 |
|  | Molten metal splash  (Aluminium), g, *Min* | 100 | IS 15758 Part 5 |
|  | Molten Metal Splash (Iron), g, *Min* | 200 |
|  | Impact of spatter (Small splashes of molten metal), drops, *Min* | 15 | ISO 9150 |
|  | Threshold time due to Contact heat at 250oC, s, *Min* | 5 | IS 17462 Part 1 |
|  | Colour fastness to washing, *Min* |  | IS/ISO 105 C-10 C(3) |
| a) Change in colour | 4 or better |
| b) Staining on adjacent cotton fabric | 4 or better |
|  | Colour fastness to perspiration, *Min* |  | IS/ISO 105 E04 |
| a) Change in colour | 4 or better |
| b) Staining on adjacent cotton fabric | 4 or better |
|  | Colour fastness to rubbing, *Min* |  | IS/ISO 105 X12 |
| a) Dry | 4 or better |
| b) Wet | 4 or better |
|  | Colour fastness to light, *Min* | 4 or better | IS/ISO 105 B02 |
|  | Dimensional change due to relaxation,  both directions, percentage, *Max* | 2.0 | ISO 5077 |
|  | Tearing strength, N, *Min* |  | ISO 13937-2 |
| a) Warp-wise | 30 |
| b) Weft-wise | 30 |
|  | Tensile strength, N, *Min* |  | IS 1969 Part 1 |
| a) Warp-wise | 450 |
| b) Weft-wise | 450 |
|  | Air permeability, cc/sec/cm2, *Min* | 16 | IS 11056 |
|  | Water vapour permeability, g/m2/day, *Min* | 3000 | ASTM E 96/E96M |

**7 PACKAGING AND PACKING**

The workwear cloth shall be packed in polyethylene or polypropylene bags and/or in the box, as required by the buyer (*see* IS 2194 and IS 2195).

**8 SAMPLING AND CRITERIA FOR CONFORMITY**

**8.1 Lot**

The number of multilayer cloth pieces of the same type and composition and constructional particulars delivered to a buyer against one dispatch note shall constitute a lot.

**8.2** The number of woven pieces to be selected at random shall be according to columns 2 and 3 of Table 2. To ensure the randomness of the selection, IS 4905 : 2015/ISO 24153: 2009 may be followed.

**8.3 Number of Tests and Criteria for Conformity**

**8.3.1** The number of pieces to be selected for major flaws shall be in accordance with column 3 of Table 2. For constructional details, such as count of yarn, threads per decimetre, mass in g/m2, length, width manufacture and finish, the number of pieces selected shall be in accordance with column 5 of Table 2. For all other tests, the number of pieces selected shall be as given in column 6 of Table 2.

**8.3.2** All the pieces selected from the lot shall be visually examined for major flaws and tested for all other requirements as specified in **3.1** to **3.4** and Table 1. A piece shall be declared defective if it contains one or more major flaws or it does not meet any of the requirements specified in Table 1. The lot shall be declared conforming to the requirements of this standard if the total number of defective pieces does not exceed the value given in column 4 of Table 2.

**Table 2- Sample Size**

(*Clauses* 7.2, 7.3.1, *and* 7.3.2)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sl No. | Lot Size | Sample Size | Permissible Number of Non-conforming Pieces | Sub-sample Size | Sub-sample Size |
| (1) | (2) | (3) | (4) | (5) | (6) |
| i) | Upto 50 | 5 | 0 | 3 | 2 |
| ii) | 51 to 150 | 8 | 0 | 5 | 3 |
| iii) | 151 to 300 | 13 | 1 | 5 | 3 |
| iv) | 301 to 500 | 20 | 1 | 8 | 5 |
| v) | 501 to 1 000 | 32 | 3 | 10 | 7 |
| vi) | 1 001 and above | 50 | 3 | 10 | 7 |

**ANNEX - A**

(*Clause* 2)

**LIST OF REFERRED INDIAN STANDARDS**

*IS No. Title*

1390: 1983 Method for determination of pH value of aqueous extract of textile Materials (*first revision*)

1954: 1990 Determination of length and width of woven fabrics (second revision)

1963: 2004 Methods for determination of threads per unit length in woven fabric (*second revision*)

1964: 2001 Textiles — Methods for determination of mass per unit length and mass per area of fabrics (*second revision*)

IS 667: 1981 Methods for Identification of Textile Fibres

IS/ISO 105 B02 Methods for determination of colour fastness of textile materials to artificial light (xenon lamp)

ISO 5077: 2007 Determination of dimensional changes in washing and drying

4905: 2015/ Random sampling and randomization procedures (*first revision*)

ISO 24153: 2009

10971 (Part 1): 2011/ Textiles — Determination of fabric propensity to surface fuzzing

ISO 12945-1: 2000 and pilling: Part 1 Pilling box method (*first revision*)

14466: 1997/ Fabrics — Description of defects — Vocabulary

ISO 8498: 1990

IS/ISO 105-C10 Textiles — Tests for colour fastness: Part C10 Colour fastness to

: 2006 washing with soap or soap and soda

IS/ISO 105-E04 Textiles — Tests for colour fastness: Part E04 Colour fastness to

: 2008 perspiration

IS/ISO 105-X12 Textiles — Tests for colour fastness: Part X12 Colour fastness to

: 2001 rubbing

IS 15758 : Part 4 Protective Clothing Part 4 Method of Test for Limited Flame : 2020   Spread ( First Revision)

IS 15758 : Part 1 Protective clothing Part 1 Determination of heat transmission on 2020 exposure to flame (first revision)

IS 15758 : Part 5 Protective clothing, Part 5: Assessment of resistance of materials to 2020 molten metal splash

IS 15758 : Part 2 Protective clothing, Part 2: Assessment of material assemblies when 2020 exposed to source of radiant heat

ASTM E 96/E96M Standard Test Methods for Water Vapor Transmission of Materials

**Annex 12**

**(Item 8.1)**

**MID TERM PROGRESS REPORT, STATEMENT OF EXPENDITURE AND FUND UTILIZATION REPORT**

**1st Progress report (11th June 2024 to 20th August 2024)**

|  |  |
| --- | --- |
| **Project Title** | **:** Study of safety and performance requirements of fire hoods for firefighter |
| **R&D Project code** | **: TXD 0170.** |
| **Project work order** | **:** NJB/Tech./JPDS/1st EMC/2021-22/6178 dated 26th October 2021 |
| **Total project cost** | **:** Rs 10 Lakh |
| **Project Start Date** | **:** 11th June 2024 |
| **Project Team** | : Dr. Shweta Saxena, Dr. M.S. Parmar, Mr. Swami Sharan |
| **Project duration** | **:** 4 months |
| **Date and amount of 1st installment release** | **:** 10/6/2024, Rs. 2,70000/- |

**Work done during the period:** The following work was carried out in 2 months (11th June to 20 August 2024):

1. A comprehensive literature review has done to collect information on different materials that are used to make fire hoods in India and the world.
2. A suitable questionnaire is prepared and used to get first-hand information regarding an individual’s experiences, feelings, quality and manufacturer’s feedback.
3. Procurement of samples and duly filled questionnaire. The details of this is given below:

**Procurement of samples and information from the manufacturers:**

The Project Team visited the following three manufacturers of fire hoods for collection of samples and information regarding quality parameters and the manufacturing process.

1. M/s Sparakarm Pvt. Ltd., Chennai
2. M/s System 5s, Chennai
3. M/s Starsafety hub, Faridabad

Out of these three manufacturers, M/s System 5 S is medium and M/s. Sparakarm Pvt. Ltd. and M/s Star Safety HUB are small units.

Five more manufacturers are approached. These are

* M/s Arvind Ltd, Ahmedabad
* M/s Loyal Textiles, Chennai
* M/s 4S Industries, Chhattisgarh
* M/s Shree Deepak Exports, Mumbai
* M/s Vasa Industries (Safety) LLP, Mumbai

A visit to two fire stations is also lined up (Meerut and NCR) for user feedback.

**Progress of the work as per objectives:**

Objectives-wise progress is given in table 2

Table -2 Objectives-wise progress is given below:

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Objectives** | **Status of work** |
|  | Review of literature | **Completed** |
|  | Procurement of various samples currently used in the industry | **In progress** |
|  | Evaluation of collected samples on required parameters | **In progress** |
|  | Determined the performance and design requirements of fire hoods and report submission | **To be done** |

**Plan of work in the remaining period:**

1. Visit to manufactures and users of fire hoods.
2. Evaluation of collected samples on required parameters.
3. Determined the performance and design requirements of fire hoods and
4. Final report preparation

**Statement of expenditure and fund utilization**

* Manpower (June & July 2024) = Rs. 1,34,253
* Travelling = Rs. 46,795
* O.H. @ 10% = Rs. 18,106
* Testing = Rs. 33,000

**TOTAL = Rs. 2,32,154**

**Annex 13**

**(Item 8.1)**

**TERMS OF REFERENCE FOR THE R&D PROJECTS**

**1. Title of the Project:** Study of safety and performance requirements of fire hoods for firefighter.

**2.** **Background**

* 1. Firefighters play an indispensable role in our society, not only rescuing lives during fire accidents but also preventing property damage from hazardous fires. This demanding and life-threatening occupation requires intense physical exertion in perilous environments. To enhance the effectiveness of firefighting efforts and safeguard lives, the provision of appropriate Personal Protective Equipment (PPE) is paramount. Among these protective gears, the fire hood for firefighters stands out as a crucial component, offering thermal protection for the head and neck region. Specifically designed to shield firefighters from radiant heat and direct flames, these hoods play a vital role in minimizing the risk of burn injuries.
  2. Considering the importance of fire hoods for firefighters in ensuring the safety of firefighters in life threatening situations, and with the aim to mitigate the risk of life due to fire induced accidents, it has been decided to undertake a research and development project on fire hoods for firefighters so that the requirements for the fire hoods for firefighter shall be developed on the basis of scientific evidences derived from the data collected from both primary and secondary sources.

**3.** **Objective**

**3.1** To collect and analyse the relevant technical data/information for safety and performance requirements of fire hoods for firefighters from both primary and secondary sources.

**4. Scope**

* 1. Undertake study and analysis of the available literature including but not restricted to the following:

i) National and International standards and regulation,

ii) Journals and research papers,

iii) Guidelines of ministries/departments/regulators/users,

iv) Books and magazines,

v) Any other relevant published information.

**4.2** Collection of the database for manufacturers (small, medium and large-scale), testing infrastructure and user base in the country.

* 1. Collection of import and export data, type of standards and regulation being followed by domestic/foreign manufacturers, comparative analysis of these standards and regulation.
  2. Undertake 2 visits to each of small, medium and large-scale manufacturer and collect the information on the aspects including but not restricted to the following:

1. Data of the requirements of raw materials.
2. Manufacturing process.
3. In-process controls being exercised during manufacturing.
4. Testing method being used.
5. Testing infrastructure available.
6. Post manufacturing quality/in-house data for all the varieties being manufactured.
7. Sampling plan being followed.
8. Marking and labelling of the product.
9. Packaging requirements.
10. Sustainability practices [sustainable raw material, energy efficient processes and methodologies, renewable energy sources, 3Rs (Reduce, Reuse and Recycle), waste management and disposal mechanisms].
11. Focused group discussions with teams involved in production, testing, and R&D to address quality issues, challenges faced, and gather suggestions for improvement.

**4.4.1** The feedback from other manufacturers (where visit is not carried out) shall be collected by circulating suitable questionnaire covering above information through email or any other digital means.

* 1. Undertake 2 visits to users and 2 visits to testing labs (one govt and one private NABL accredited lab) to collect information including but not restricted to the following:

**User**

1. Standards and regulations being followed.
2. Compliance mechanism being followed (test certificate from supplier, third party testing etc.)
3. Focused group discussion on quality issues, challenges being faced and suggestions, if any.

**Labs**

1. Standards and regulation being followed.
2. Testing methods being followed.
3. Testing infrastructure.
4. Focused group discussion on testing related issues, challenges being faced and suggestion.

**4.5.1** The feedback from users and labs where visit cannot be carried out shall be obtained through suitable questionnaire covering above information.

* 1. Collection of the 2 samples each from small, medium and large industry of fire hoods for firefighters and generation of test data for the requirements including but not restricted to the following after getting the samples tested from 2 NABL accredited labs:

1. **Flame spread (material)**
2. **Flame spread (seam)**
3. **Heat transfer (flame)**
4. **Heat transfer (radiation)**
5. **Residual burst strength of material when exposed to radiant heat**
6. **Heat resistance**
7. **Seam burst strength**
8. **Dimensional change due to washing**
9. **Hood opening size retention test**
10. **Thread heat resistance**
11. **Dimensions**

Note: Any other manufacturer or user declared parameter(s) may be identified and tested.

**4.7** Preparation of a comprehensive report with detailed summary of the above information.

**5.** **Research Methodology**:

* 1. Collect and analyse the data/information as specified in the scope [4.1, 4.2 and 4.3].
  2. Visit manufacturers, users and labs and collect data/information as specified in the scope [4.4 and 4.5].
  3. Collect and test the samples as specified in the scope 4.6.
  4. Analyze the data/information and prepare a comprehensive project report.

**6.** **Expected Deliverables**

**6.1** Comprehensive report (both hard copy and soft copy) consisting of outcomes of the study covering all the aspects of the scope appending the survey formats and responses, questionnaire, results and result analysis of testing, reports of visits and other relevant documents/information as specified in scope.

**7.** **Requirement for the CVs:**

**7.1** The person shall be at least graduate in Textile Engineering or Textile Technology or Textiles Chemistry or Fibre science and technology or post graduate in science with minimum 3 years of experience in the area of manufacturing and/or testing of protective textiles.

**8.** **Timeline and Method of Progress Review:**

**8.1** The duration of the project is 120 days from the date of the award of the project. The stagewise indicative timelines are as follows:

|  |  |
| --- | --- |
| **Indicative Time line** | **Method of progress** |
| 0 to 20 days | Literature review, desktop study, collection of data and information  Note: The plan for collection of samples and visit shall be discussed and finalized in consultation with the nodal officer after literature survey and desktop research.  A review by sectional committee shall be done after the literature review. |
| 21 to 50 days | Visit to manufacturer, user, testing lab and collection of samples |
| 51 to 100 days | Testing of samples (Except long duration test for testing time more than 30 days, if any)  preparation and submission of first draft report. |
| 101 to 120 days | Submission of the final project report. |

**9.** **Support BIS will Provide:**

1. All the relevant Indian Standards and international Standards required during the project will be provided by BIS.
2. Licensee details relating to manufacturing similar products.
3. List of BIS approved laboratories testing similar products.

In case of queries/clarification, Shri Mayur Katiyar, Scientist B and Member Secretary of TXD 32 may be contacted on [txd@bis.gov.in](mailto:txd@bis.gov.in), 7317525252.