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Clothing for protection against heat and flame — General recommendations for selection, care and use of protective clothing

*Vêtements de protection contre la chaleur et la flamme —
Recommandations générales pour la sélection, l'entretien et l'utilisation
des vêtements de protection*



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Foreword

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

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

International Standard ISO 2801 was prepared by Technical Committee ISO/TC 94, *Personal safety – Protective clothing and equipment*, Subcommittee SC 13, *Protective clothing*.

This second edition cancels and replaces the first edition (ISO 2801:1973), which has been technically revised.

Annexes A and B of this International Standard are for information only.

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International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

Introduction

Test methods are available which assess the behaviour of materials when exposed to different types of heat (radiant, convective or conductive). The results of these tests are expressed in terms of times to record a certain temperature rise on the inside of the material. These test methods are specified in performance standards which are used to classify the predicted behaviour of protective garments.

It is important to recognize that the times recorded under test conditions do not represent the times for which the protective clothing offers protection against heat and flame. The actual period for which protective clothing can offer protection against heat and flame varies with the intensity of the heat hazard, the fit of the garment, and the capabilities of the wearer. For a particular garment, this period of protection may vary considerably from one wearer to another.

This International Standard provides guidance on the selection of clothing for protection against specific heat hazards by the choice of appropriate performance standards and levels. It also includes some general recommendations on the care and use of clothing for protection against heat and flame, which apply principally to clothing for protection against high levels of radiant heat with or without the presence of flame.

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Clothing for protection against heat and flame — General recommendations for selection, care and use of protective clothing

1 Scope

This International Standard sets out guidelines for the selection, use and care of clothing for protection against heat and flame. It is intended for use as a "checklist" by those responsible for checking safety requirements and recommendations.

2 Selection of protective clothing

2.1 Risk assessment

The first requirement for the selection of suitable protective clothing is an assessment of the risk involved in the specific working environment. The procedures for making this assessment are outside the scope of this International Standard, but they involve consideration of both the level and times of possible exposure to specific hazards and the probability of exposure. As the level of exposure can vary considerably, the aim should be to classify the degree of risk and the type of hazard.

It is convenient to divide the working risks into three groups, which are then sub-divided according to the specific type of hazard involved.

Group A — low risk of localized exposure: where the heat level and the probability of exposure are low, any flame involved is small, and a limited area of the worker's body is likely to be exposed.

Group B — high risk of intense heat exposure: where the heat level and the probability of exposure are high, any flames involved are large, and an extensive area of the worker's body is likely to be exposed.

Group C — high-risk fire fighting: where the risks are generally similar to those of type B but certain additional specific hazards are involved.

2.2 Classification of clothing

The selection of appropriate protective clothing requires the establishment of a relationship between the classification of the risk and the classification of the clothing.

A list of the current International and European Standards providing test methods and performance specifications for clothing for protection against heat and flame is given in annex A. This list has been arranged so as to provide guidance on the relationship between the potential types of risk, as determined in 2.1, and the classes of protective clothing available under current International Standards.

NOTE As these standards are still under development or revision, this list can only represent the latest state of the art (September 1997), and the latest versions of the documents quoted should be consulted.

3 Use of protective clothing

3.1 General

Clothing for protection against heat and flame should only be used for its intended purpose.

Clothing for protection against low-level risks (Group A) is intended for continuous wear and may be designed to provide limited protection for only those parts of the body which are likely to be exposed to a heat or flame hazard which is low in intensity or probability of occurrence.

Clothing for protection against high-level risks (Group B) is intended for use against a heat hazard which is high in actual or probable intensity. The clothing may be designed to provide a high level of protection but to be worn for a limited period in order to perform a specific task (e.g. protective clothing for furnace approach). Alternatively, the clothing may be designed to be worn continuously to provide a limited level of protection against a potential high heat risk (e.g. protective clothing for foundry workers). It is necessary to select the correct type of clothing and to limit the period of wear or the period of exposure, as appropriate, in order to avoid heat stress during wear.

Clothing for firefighting (Group C) may also be designed for short-term protection against high-level risks (e.g. fire entry suits), or for long-term use against lower risks (e.g. wildland firefighting). In a firefighting situation, the level of exposure can increase suddenly and dramatically. The firefighter also requires protection against other hazards besides heat and flame. Firefighters' clothing therefore tends to have higher levels of heat protection and to provide protection against other hazards. Clothing designed for similar applications in Group A or Group B may not always be suitable for use in the other group.

The remaining provisions of this International Standard apply mainly to clothing for protection against high-level risks (Group B or C).

3.2 Heat build-up

Clothing for protection against intense heat is designed to prevent heat from reaching the wearer. During exposure to intense heat, metabolic heat and any heat penetrating the clothing is stored in the body, and the clothing prevents the loss of this heat. If the clothing has been worn for any length of time before entering the region of intense heat, the wearer may already have used up a large part of his/her heat storage capacity, thus reducing the period of protection available.

Clothing for protection against intense heat should preferably be put on immediately before it is required and removed or opened immediately after use in order to reduce heat stress. Consideration should be given to the weight and fit of the clothing as these factors influence the level of protection and the stress on the wearer.

3.3 Additional equipment

For protection against intense heat and in fire-fighting operations, the protective clothing should be worn with suitable head, hand and foot protection, which should provide protection against the risks likely to be encountered. Special consideration should be given to the protection of areas where the protective clothing and the additional protection meet (e.g. by ensuring an overlap of sleeves and gloves, trousers and footwear).

A helmet is normally worn to protect the head against falling objects. Additional equipment may be needed to protect the head against heat. Visors or faceshields of wire gauze or transparent material may be used to protect the face and Balaclavas or drapes may be used to protect the head and neck, as appropriate.

In certain situations, respiratory protection may also be required.

3.4 Clothing assemblies

Clothing for protection against heat and flame is normally made up of a clothing assembly consisting of several layers of material. The level and type of protection can be increased by adding additional layers. The level of heat protection obtained from a clothing assembly is partly obtained from the insulating effect of the air trapped between the different layers. The protection is reduced in areas where the clothing is in close contact with the skin or is

compressed by additional equipment. Protection is also reduced if the clothing shrinks and the air layers are diminished.

Care should be taken in choosing materials used in clothing assemblies so that they do not increase the hazard to the wearer. For example, it would not be permitted to use:

- a) fusible materials (such as certain synthetic textiles and other thermoplastic materials) which may melt under the effect of heat, causing severe skin burns if worn next to the skin;
- b) permeable and absorbent outer materials which may absorb water or flammable liquids, dusts, gases, or vapours.

Flame protection will be drastically reduced in the presence of gaseous or liquid oxygen.

3.5 Electrical hazards

Clothing for protection against heat and flame is not necessarily designed to provide protection against electrical hazards. If protection against electrical hazards is provided, this should be tested against appropriate performance criteria.

In areas contaminated with explosive or flammable gases, the discharge of static electricity from the clothing and equipment must be avoided and the correct type of footwear should be used to allow electrical discharges to dissipate.

4 Operators

4.1 State of health

Working in a high heat risk environment can be highly stressful. The mental and physical health of the user of clothing for protection against heat and flame is therefore an important consideration.

4.2 Training

Users of protective clothing working in high heat risk situations should receive regular training. This has several objectives, the most important of which are as follows:

- a) to acquire a routine for the selection and putting on of appropriate clothing and special equipment;
- b) to accustom the operator to the properties and limiting factors of the clothing which he/she is to wear;
- c) to accustom the operator to working when wearing the clothing;
- d) to allow the operator to recognize his/her physiological limit of endurance, so that he/she can retreat from the hazard before the danger point;
- e) to check that the user has understood the instructions for use and knows the meaning of the classes of marking.

5 Care of protective clothing

5.1 Inspection

Clothing for protection against heat and flame should be used and maintained in accordance with the manufacturer's instructions. Specific responsibility should be assigned for a regular inspection and maintenance programme. Records of inspections and repairs should be maintained (see 5.3). If there is any doubt that the clothing still meets the requirements, it should be replaced.

5.2 Maintenance and cleaning

Garments should be cleaned regularly to keep them free from excessive dirt and grease. The cleaning and repair processes should be in accordance with the manufacturer's instructions. When clothing is dry-cleaned, care should be taken that there are no residual solvents as these may be flammable or toxic.

5.3 Records

A technical file should be maintained for each type of clothing for protection against heat and flame, containing the manufacturer's information on the intended use of the garment, together with the recommended care and use procedures. A detailed record should be maintained of inspections and repairs for each garment, where possible, giving the following information:

- a) name and address of manufacturer and/or supplier;
- b) date of purchase and original classification;
- c) dates of inspections;
- d) dates and details of repairs, including the name of the repairer;
- e) name of the user, if necessary.

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Annex A (informative)

Guidelines on the relationship of type of hazard to class of clothing

Table A.1 — Suggested standards and minimum performance levels

Type of hazard	Example of hazard	ISO standard	CEN standard
Group A — Low risk level: localized exposure to heat and/or flame			
Small flame	All work in proximity to small flames		EN 533
Larger flames + convective heat	Approach to small fires	ISO 11612 level B1	EN 531 level B1
Radiant heat	Approach to furnaces	ISO 11612 level C1	EN 531 level C1
Small molten metal drops	Welding and cutting	ISO 11611 ²⁾	EN 470-1
Molten metal splash	Foundry work — aluminium — iron	ISO 11612 level D1 level E1	EN 531 level D1 level E1
Group B — High risk level: exposure to intense heat with or without flame			
Potential flame immersion*)	Racing drivers	ISO 14460 ¹⁾	EN ISO 14460 ¹⁾
Radiant heat only	Close approach to fires and furnaces	ISO 11612 level C2	EN 531 level C2
Radiant heat plus occasional flame lick	Inside kilns	ISO 11612 levels B2 + C2	EN 531 levels B2 + C2
Radiant heat plus pockets of flame	Inside kilns	ISO 11612 levels B3 + C3	EN 531 levels B3 + C3
Radiant heat plus complete immersion in flame	Fire entry	ISO 11612 levels B4 + C4	EN 531 levels B4 + C4
Group C — High risk level: fire fighting			
Long term firefighting in the open*)	Wildland fire fighting	ISO 15384 ²⁾	EN ISO 15384 ²⁾
Radiant heat only	Approach fire fighting	ISO 11613 ¹⁾ ISO 15538 ²⁾	EN 469 EN 1486:Type 1
Radiant heat plus pockets of flame	Rescue work and proximity fire fighting in buildings	ISO 11613 ¹⁾ ISO 15538 ²⁾	EN 469 EN 1486: Type 2
Radiant heat plus complete immersion in flame	Fire entry	ISO 15538 ²⁾	EN 1486: Type 3
*) Clothing worn continually where protection shall be balanced against heat stress (see 3.1).			
¹⁾ To be published.			
²⁾ Under development.			