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Selection, use and maintenance of chemical protective clothing — Guidance

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Committees responsible for this British Standard

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- British Clothing Industry Association
- British Measurement and Testing Association
- British Safety Industry Federation
- British Textile Technology Group
- Chief and Assistant Chief Fire Officers' Association
- European Trade Association of the Nonwovens
- Fire Brigades Union
- Health and Safety Executive
- Home Office
- Institute of Occupational Medicine
- Institution of Occupational Safety and Health
- London Fire and Emergency Planning Authority
- MAFF
- Personal Safety Manufacturers' Association
- SATRA Technology Centre
- Textile Services Association Ltd.

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Foreword

This British Standard has been prepared under the direction of the Personal safety equipment standards policy committee, PH/3/3. It is a revision of BS 7184:1989.

At the time of publication of the British Standard, no corresponding International Standard exists.

The need to consider the provision of suitable personal protective clothing and equipment in the workplace arises when it is not reasonably practicable to provide an adequate level of protection by other means such as engineering or systems control.

Although particularly applicable to industry, this British Standard might also be relevant to others, e.g. in educational establishments and the field of do-it-yourself activities who need to select and use chemical protective clothing.

In Great Britain, the legal requirements governing the use of personal protective equipment (PPE) in general, and chemical protective clothing in particular, are contained in the Personal Protective Equipment Regulations 1992 (SI 1998 No 543), the Control of Asbestos at Work Regulations (SI 1987 No 2115 as amended by SI 1992 No 3068 and SI 1998 No 3235) and the Ionizing Radiations Regulations (SI 1999 No 3232).

Attention is drawn to regulations concerning protective clothing that could apply to specific industries, e.g. the Control of Lead at Work Regulations (SI 1998 No 543), the Control of Asbestos at Work Regulations (SI 1987 No 2115 as amended by SI 1992 No 3068 and SI 1998 No 3235), the Ionizing Radiations Regulations (SI 1999 No 3232), and to the general provisions of the Health and Safety at Work etc. Act 1974.

The general recommendations given in the standard have been developed in the light of present knowledge concerning the principles that apply to govern the selection, use and maintenance of clothing offering some degree of protection to the skin against occupational exposure to chemicals.

The attitude of the employer, management and employees is vital in promoting the effective use of protective clothing. The danger arising from the use of chemicals varies widely according to the nature of the chemical hazard and the way in which the chemicals are used. Thus, in considering the extent to which the details of the guidance given in this standard should be applied (in particular to the testing and maintenance of garments and the training of operators), employers and other authorities should be guided by decisions that are justified by reference to the specific circumstances of the work place in question.

Annex A, Annex B, Annex C and Annex D are informative.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 21 and a back cover.

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Introduction

Where a chemical hazard exists in the workplace, it is important to assess whether the risk of exposure to chemicals can be avoided or reduced to as low a level as is reasonably practicable. This can be achieved by providing safe working practices, which can include the use of chemical protective clothing.

Consideration of requirements for chemical protective clothing comes only after all other exposure mitigation measures have been considered and a reasonable effort has been made to implement them. This means that the role of chemical protective clothing in reducing an individual's potential remaining health risk is firmly established in the correct context. The performance requirements for chemical protective clothing necessary to control a remaining exposure risk is characterized in terms of the quantity, presentation and likelihood of contamination by the hazardous chemical.

Annex A shows how this approach is implemented in Great Britain through health and safety legislation. (The legal framework differs in Northern Ireland, but the same principles apply.)

1 Scope

This British Standard provides guidance on the selection, use and maintenance of chemical protective clothing where it has been established that the use of such clothing in one form or another is necessary for the task to be undertaken.

The standard is primarily intended for users, specifiers and others who have responsibility for the procurement and provision of chemical protective clothing.

The standard is intended to assist in choosing the correct type of chemical protective clothing for the task to be undertaken, and to help ensure that it is used in the correct manner and continues to provide the protection for which it was intended during the lifetime of the clothing.

For the purposes of this standard, chemical protective clothing is clothing which is used to protect the skin against contact with solids, liquids and gases. This includes asbestos but excludes microbiological or radioactive hazards. The standard does not relate to clothing intended to protect either a product or an environment from contamination by personnel wearing the clothing.

Chemical protective clothing can be a combination of specific individual items or garments. This standard contains advice relating to some such individual items but excludes advice on certain other items where such advice is to be found elsewhere, for example eye protection, boots and gloves (see Annex B).

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS EN 340:1993, *Protective clothing — General requirements*.

BS EN 368:1993, *Protective clothing — Protection against liquid chemicals — Test method: Resistance of materials to penetration by liquids*.

BS EN 369:1993, *Protective clothing — Protection against liquid chemicals — Test method: Resistance of materials to permeation by liquids*.

BS EN 374-3:1994, *Protective gloves against chemicals and micro-organisms — Part 3: Determination of resistance to permeation by chemicals*.

BS EN 464:1994, *Protective clothing — Protection against liquid and gaseous chemicals, including liquid aerosols and solid particles — Test method: Determination of leak-tightness of gas-tight suits (Internal Pressure Test)*.

BS EN 466-1:1995, *Protective clothing — Protection against liquid chemicals — Part 1: Performance requirements for chemical protective clothing with liquid-tight connections between different parts of the clothing (Type 3 equipment)*.

3 Terms and definitions

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

NOTE Where available, these definitions have been taken from a list prepared by the European committee CEN/TC162/WG1.

3.1

air-impermeable materials

materials through which gases cannot pass except by undergoing a process of solution

3.2

air-permeable materials

materials having pores or apertures that allow the transmission of gases

3.3

breakthrough time

elapsed time between the initial application of a chemical to the appropriate surface of the material and its subsequent presence on the other side of the material

3.4

chemical hazard

potential of a chemical to cause harm or damage to the health of the human body

3.5

chemical protective clothing

CPC

combined assembly of garments worn to provide protection to the skin against exposure to or contact with chemicals

3.6

degradation

deleterious change in one or more mechanical properties of a material due to contact with a chemical

NOTE This is distinct from general mechanical wear and tear which any garment will suffer in use. However, the two forms of damage can be mutually detrimental to performance.

3.7

garment

single item of clothing which consists of single or multiple layers

3.8

gas-tight chemical protective clothing

chemical protective clothing which is leak-tight when tested in accordance with the internal pressure test given in BS EN 464:1994

3.9

limited use chemical protective clothing

chemical protective clothing for limited duration of use, i.e. to be worn until hygienic cleaning becomes necessary or chemical contamination has occurred and disposal is required

NOTE This also includes protective clothing for single use and for limited re-use according to the information supplied by the manufacturer.

3.10

liquid-tight chemical protective clothing

chemical protective clothing which is resistant to penetration by liquids in the form of a continuous jet

3.11

penetration

process by which a chemical moves through porous materials, seams, pinholes or other imperfections in a material on a non-molecular level

NOTE When applied to a garment, penetration also includes contaminants which can enter the garment through neck and cuff openings or closures, or the spread of contaminants to the inside as a result of poor donning practice.

3.12**permeation**

process by which a chemical moves through a material on a molecular level

NOTE Permeation involves:

- a) sorption of molecules of the chemical into the contacted (outside) surface of the material;
- b) diffusion of the sorbed molecules in the material;
- c) desorption of the molecules from the opposite (inner) surface of the material.

3.13**personal protective equipment****PPE**

protective equipment, including chemical protective clothing, headgear intended to protect the top and other parts of the head against mechanical impact, eye protection, respiratory protective equipment, and other forms of personal protection equipment

3.14**re-usable chemical protective clothing**

chemical protective clothing which can be cleaned in accordance with the manufacturer's instructions and reused

3.15**risk**

probability of a specific undesired event occurring so that a specific hazard is realized

4 Risk assessment**4.1 Understanding the hazard — Assessing the risk****4.1.1 Sources of data**

Any chemical should be regarded as a substance potentially hazardous to health. Information on the hazards presented by a specific chemical supplied for use in a workplace, including any pure substance or formulated preparation, should be provided by the supplier.

NOTE 1 This is a requirement by law.

Suppliers have a legal duty to label the containers of hazardous substances with standard warning symbols and risk and safety phrases appropriate to the hazard presented by the contents. Suppliers of dangerous substances also have a duty (Health and Safety at Work etc. Act, 1974, Section 6 [1]) to ensure that:

- a) their products are safe, so far as it is reasonably practicable, and without risks to health when properly used;
- b) users are advised of any hazards involved and (where appropriate) to indicate suitable protective clothing.

NOTE 2 In addition to container labels, requirements for notification of hazards to users are addressed by the supply of Materials Safety Data Sheet (or equivalent) with all consignments of relevant product.

Materials Safety Data Sheets are often a good source of information about specific hazards relating to chemicals or formulations. For some substances encountered in the workplace, safety data sheets might not be readily available. It might be necessary to search out further sources of information, and examples of these are given in Annex C.

4.1.2 Assessment of the nature of chemical hazard

The following considerations should be taken into account in assessing the nature of the chemical hazard in the light of the information obtained from the sources given in 4.1.1.

- a) Corrosive chemicals can destroy the skin and flesh by direct attack. Other chemicals such as petrol, paint, solvents and cleaning fluids can dissolve the skin's natural oils, leaving the skin dry and liable to form painful cracks or to develop dermatitis and/or sensitization. Such damage to the skin, together with any existent cuts and grazes, provide entry points for foreign substances and thus increase the risk of harm to the body.
- b) Chemicals can pass through the skin and be carried in the bloodstream resulting in injury to other parts of the body that are remote from the initial point of contact.
- c) Chemicals can also gain access to the body via, for example, the eyes, respiratory and digestive tract.
- d) The body's tolerance and rate of elimination of a foreign substance varies from person to person, and can also vary within the same individual at different times or under different circumstances.
- e) The harmful effects depend broadly on the amount of substance contacted or absorbed, and hence are related to the mass of the substance to which the body has been exposed, the area of contact, the in-use concentration, and to the frequency and duration of exposure.
- f) The impact of a substance on the body depends on a number of factors. Immediate high doses of a chemical can be a major concern and, besides exposure through inadvertent ingestion and inhalation, rapid absorption via the skin can be a very important issue to consider. An example where skin exposure and resultant absorption is a particular concern is poisoning due to phenol and related compounds.
- g) The pattern of skin exposures to substances will vary across the spectra of frequency, duration and concentration. In the longer term, adverse health effects can be linked with low level exposures to small amounts of substances on a regular basis. Acute and chronic exposures can give rise to very different adverse health endpoints which need to be considered in the overall risk assessment.
- h) Mixtures can increase the risk from exposure, e.g. the rate of absorption through the skin can increase if a chemical is formulated with some solvents.

WARNING Exposure of the skin to chemicals can cause harm both to the skin and to the body as a whole.

4.2 Assessment of risk

4.2.1 General

The previous section indicates the need to ensure that processes, in the widest sense, are designed to eliminate or reduce the potential level of exposure to substances. For many processes there will always be a residual risk of exposure and those involved in risk assessment need to think about how to deal with it successfully. Opportunities for contacting chemicals can arise through normal operation or through accidental releases or inadvertent contact with contaminated surfaces. The consequences of these routes to exposure need to be assessed. The assessment should consider the issues described in 4.2.2 to 4.2.4.

4.2.2 Risk in relation to physical form of chemicals

The type of risk associated with chemicals varies with their physical form, as indicated, as follows.

- a) Provided that they are free from volatile products, fumes or dust, solid materials in bulk can usually be contained without undue risk.
- b) Liquids and free-running powders are mobile and can give intimate contact with the skin. Exposure can range from accidental splashes to deluge conditions.
- c) Although gases and vapours present relatively small amounts of matter in contact with the skin, they require more efficient barriers to exclude them. The risk to health through skin exposure, associated with some gases and vapours can be high, especially if they are not detectable by the human senses and they have an enhanced toxicity profile.
- d) Toxic substances released as fine aerosols (solid and liquid) need particular consideration if it is important to prevent skin exposure. Aerosols are highly penetrating and can cause exposure to the skin through evading the protective barrier. In general, if the chemical PPE is not airtight, it will allow exposure to any entrained aerosol.