

Recommendations for

Selection, use and maintenance of chemical protective clothing

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- British Clothing Industry Association
- British Occupational Hygiene Society
- British Rubber Manufacturers' Association
- British Wood Preserving Association
- Chemical Industries Association
- Chief and Assistant Chief Fire Officers' Association
- Ergonomics Society
- Health and Safety Executive
- Home Office
- Industrial Safety (Protective Equipment) Manufacturers' Association
- Institute of Occupational Hygienists
- Ministry of Defence
- National Association of Glove Manufacturers
- Trades Union Congress
- Co-opted member

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Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
0 Introduction	1
1 Scope	1
2 Definitions	1
3 Assessment of chemical hazard	2
4 Assessment of risk and danger	2
5 Assessment of the need for protection	3
6 Selection of protective clothing	3
7 Materials of construction	7
8 Air-impermeable materials	7
9 Air-permeable materials	10
10 Garment types	11
11 Garment make-up	14
12 Protection against additional hazards	15
13 Use and maintenance	15
Appendix A Sources of information	19
Appendix B Examples of protection against a single hazard under differing degrees of danger	19
Figure 1 — Assessment of the need for protection	4
Figure 2 — Procedure for selection of type of garment	6
Figure 3 — Selection of material of construction	8
Figure 4 — Procedure for consideration of design and make-up	9
Figure 5 — Some examples of garments	13
Figure 6 — Possible sequence of cleaning procedures	18
Table 1 — Classification of breakthrough time in relation to type of application	11
Table 2 — Examples of protective clothing related to the activity of the wearer	21
Publications referred to	Inside back cover

Foreword

This British Standard has been prepared under the direction of the Personal Safety Equipment Standards Policy Committee.

At the time of publication of this 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.

The general recommendations given in this 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 chemicals¹⁾.

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.

Attention is drawn to regulations concerning protective clothing that may apply to specific industries and to the general provisions of the Health and Safety at Work etc. Act 1974.

An appendix lists further sources of information.

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.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 22, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

¹⁾ BS 7182 specifies requirements for making-up, performance and sizing for clothing for protection against chemicals.

0 Introduction

0.1 Provisions for safe working practices

Where a chemical hazard exists in the workplace it is important to assess whether the risk of exposure to chemicals may be minimized or avoided. The following are given as appropriate examples of relevant approaches.

- a) The use of alternative chemicals that are less hazardous.
- b) The use of alternative equipment, for example, the use of sealed systems, the use of automatic machinery, and the installation of smaller storage and reaction vessels to reduce the amount of chemical that would be involved in the event of an incident.
- c) The introduction of appropriate working practices and systems of work, for example, by ensuring the clear marking of containers and of high risk areas, by the regular cleaning of work areas, by the efficient ventilation of working areas, by the addition of tracers to liquid chemicals to make contamination easily detectable and by the use of alarms or of instrumental or other monitoring techniques to give early warning of possible exposure.

NOTE Such measures do not obviate the need to employ trained operatives.

0.2 Provision of clothing

The provisions of this standard apply after all reasonable efforts have been made to eliminate or minimize the hazard (see 0.1) by means other than by the use of personal protective equipment. Consideration of the potential remaining health risk is then necessary to determine whether protective clothing is required and, if so, what measures apply to its selection, use and maintenance in the work-place.

1 Scope

This British Standard gives guidance on the selection, use and maintenance of clothing intended to protect the skin against contact with solids, liquids or gases. Such protective clothing may be a combination of garments and include boots, gloves and other protective items. The guidance given in this standard extends as appropriate to other items of personal protective equipment, the primary function of which may be to offer forms of protection other than protection of the skin.

This standard does not include additional or alternative recommendations that may apply to personal protection against nuclear radiation, radioactive contamination or microbiological organisms, or to clothing that is worn to protect a particular environment against the entry of chemicals or living matter that may arise from the wearer.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1

chemical hazard

the potential of a chemical, derived from the intrinsic properties of the chemical, to cause harm to the human body by contact with the skin

2.2

risk

the probability of a specific undesired event occurring so that a chemical hazard will be realized (so as to cause harm to the unprotected wearer) during a stated period of time or in specified circumstances

2.3

danger

the conceptual combination of the chemical hazard (2.1) with its associated risk (2.2), taking into account the quantity of the chemical that may be released during an undesired event

2.4

penetration

the passage of chemicals, in any physical form, from the outside of clothing to the inside via essential openings, fastenings, seams, overlaps between items, pores and any imperfections in the materials of construction

2.5

permeation

a combined process of molecular diffusion of a chemical through a solid material forming the whole or part of clothing and its desorption into a specified medium

2.6

air-permeable materials

materials having pores or apertures that allow the transmission of air

2.7**air-impermeable materials**

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

2.8**breakthrough time**

the 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, measured as described in BS 4724-2

2.9**personal protective equipment**

protective equipment including protective clothing (2.10), headgear that is 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

2.10**protective clothing**

the combined assembly of those garments (2.11), the wearing of which is intended to afford protection to the skin against exposure to or contact with chemicals

2.11**garment**

an individual component (of protective clothing), the wearing of which affords protection to the skin against contact with chemicals

NOTE For the purposes of this standard, gloves and boots are classed as garments.

3 Assessment of chemical hazard**3.1 Sources of data**

Any chemical should be regarded as a potential health hazard to an extent dependent upon the circumstances of use. For information on the chemical hazards presented by a specific chemical or formulation, the supplier should be consulted. In this respect, particular attention is drawn to item 4) in A.1 of Appendix A.

Such information may be supplemented by the use of appropriate sources of reference, examples of which are given in Appendix A.

NOTE Suppliers have a legal duty to label the containers of dangerous substances with standard warning 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), to ensure that their products are safe so far as is reasonably practicable and without risks to health when properly used, to advise users of their products of any hazards involved and (where appropriate) to indicate suitable protective clothing.

3.2 Assessment of nature of chemical hazard

Exposure of the skin to chemicals may cause harm both to the skin and to the body as a whole. The following considerations should be taken into account in appreciating the nature of the chemical hazard in the light of the information obtained from the sources given in 3.1.

- a) Corrosive chemicals may 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 so leaving the skin dry and liable to form painful cracks. 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 may pass through the skin and be carried by the bloodstream so as to cause injury to other parts of the body that may be remote from the initial point of contact.
- c) Chemicals may gain access to the body via, for example, the eyes, respiratory or digestive tract.
- d) The body's tolerance and rate of elimination of a foreign substance varies from person to person.
- e) The harmful effects depend broadly on the amount of substance contacted or absorbed and hence are related to the concentration of the substance to which the body has been exposed or to the concentration in the environment, and to the duration of exposure.
- f) The rate at which a chemical is taken up by the body may depend on whether it is swallowed, inhaled or absorbed through the skin.
- h) Adverse effects on health may arise from a single exposure or repeated exposure to small amounts of a chemical and may be immediate, delayed or long term.
- i) A mixture of chemicals may create a greater hazard than would the same chemicals separately.

4 Assessment of risk and danger**4.1 General**

After steps have been taken to contain, minimize or eliminate the chemical hazard and to reduce the risk as indicated in 0.1, an assessment should be undertaken of how the chemical might inadvertently be released from within the plant or system in which it is contained and what the consequences of such release might be. For this purpose, the aspects described in 4.2 to 4.4 should be considered.

4.2 Risk in relation to the 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 or fumes or dust, solid materials in bulk may usually be contained without undue risk.
- b) Liquids and free-running powders are mobile and can give intimate contact with the skin. Exposure may range from accidental splashes of laboratory reagents 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 danger associated with gases and vapours is high, especially if they are not detectable by the human senses.
- d) The risk of release of airborne particles (fine dusts and liquid mists) and the consequent danger may be very high because particles in such physical forms are both pervasive and dense.

4.3 Risk and danger in relation to storage and distribution

The danger associated with the inadvertent discharge of a chemical depends (for example) on the quantity, mode of transport and the manner of distribution of material present, the method of containment (flow pipes, glass bottles, etc.), the pressure and temperature at which it is held, and its proximity to working areas. The exposure to be considered may range from foreseeable incidents with moderate or high probability of occurrence (spillage whilst handling; contamination by sprays) to infrequent, but more serious, possibilities (for example, the fracture of a pipe in a chemical plant). These aspects are illustrated by the examples in Appendix B.

4.4 Risk in relation to duration of exposure

The duration of exposure may increase when:

- a) contamination of the body is not apparent as soon as it occurs;
- b) a worker has to set emergency procedures in operation (e.g. switching off machinery) before leaving the hazard area;
- c) a worker is some distance from a place where the contaminant can be washed off.

NOTE The protection provided to workers and to rescue personnel should take into account the time needed to carry out necessary emergency actions.

5 Assessment of the need for protection

After the aspects described in clauses 3 and 4 have been considered, the following questions should be answered.

- a) What is the chemical hazard, physical state, quantity, and mode of use of the chemical substance(s) involved?
- b) Do these constitute a potential danger?
- c) If so, can the hazard be removed, or the danger minimized by means other than the use of protective clothing (see 0.1)?
- d) How serious is the potential hazard?
- e) What are the legislative requirements?

If the answers to questions a) to e) indicate that, in addition to other precautions, the need for protective clothing should be considered, the following questions apply.

- f) What form and extent of exposure is envisaged (e.g. spillage, liquid jets)?
- g) What is the probability of exposure?
- h) Will workers be immediately aware of exposure if it occurs?
- i) What is the likely duration of exposure?
- j) Is exposure likely to be restricted to specific parts of the body (i.e. eyes, ears, lungs, head, hands and feet) or to specific areas of the skin?

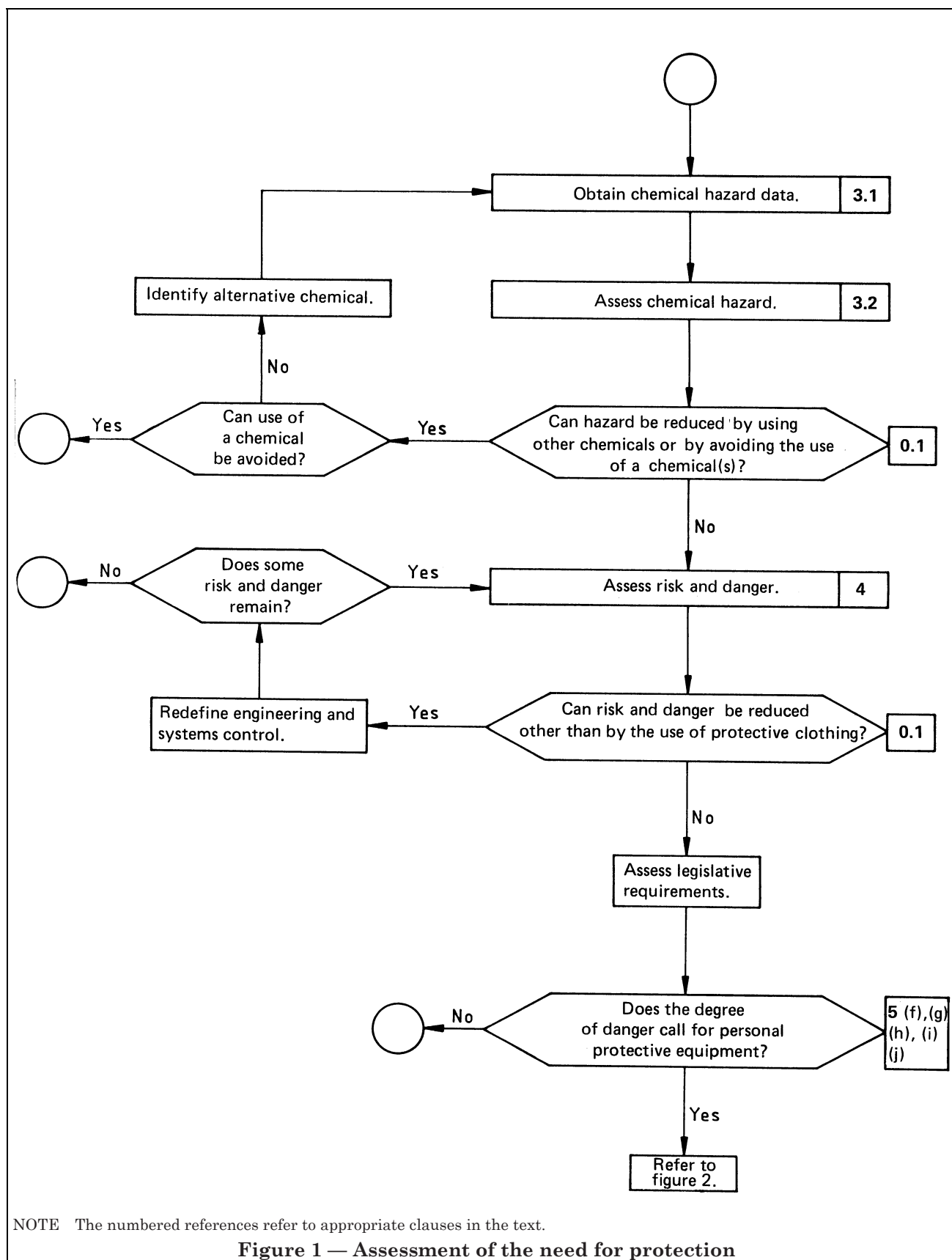
NOTE A flowchart that is appropriate to guide the sequence of the assessment of the need for protection is given in Figure 1.

The subsequent approach to the selection of suitable protective clothing is given in clause 6. Clauses 7 to 12 inclusive give information that is applicable directly or indirectly to the selection procedure described in clause 6.

6 Selection of protective clothing

6.1 Introduction

6.1.1 General. The primary function of protective clothing is to prevent, or reduce to an acceptable level, the exposure of the skin to a chemical hazard.



There may be rigid legislative or performance criteria which need to be observed during the selection process.

The use of protective clothing offering a higher degree of protection than is necessary under routine conditions may be advisable temporarily when the nature of a hazard is unclear, or when steps to reduce it cannot be taken immediately.

It should be recognized that protective clothing is generally inherently prone to permeation and hence the form of protection provided should not be regarded as a complete barrier (to chemicals) under all circumstances.

Subsequent sections consider in detail the various factors which can influence the final selection and the test methods that are available to assess the relevant characteristics of protective clothing materials. However, there are many factors involved in the selection and use of protective clothing which cannot be easily quantified, the relative importance of which may seem different to different people. Hence the views of all interested parties should be considered to achieve the best balance. This should enable the features that determine the ability of the clothing to protect the wearer to be clearly defined and corresponding physical and chemical characteristics to be adequately checked using appropriate test procedures.

The steps to be taken in the selection procedure are shown in the flow charts (see Figure 2, Figure 3 and Figure 4) in which the references are to relevant sections of this standard.

Appendix B illustrates by example how consideration of the particular circumstances of a work place may affect the outcome of the selection procedure, i.e. the choice of appropriate clothing assemblies.

6.1.2 Compatibility. Individual items of protective clothing should not be considered in isolation as they may have to be worn with other protective devices (respiratory protective equipment, goggles, etc.), special tools, or communications equipment. The wearer should not be isolated from other workers and should be able to acknowledge and respond to emergency procedures while wearing the clothing.

6.2 Selection of type of garment (see Figure 2)

Where no specific regulations exist, consideration of the chemical hazard will suggest possible types of protection.

The following check list is an aid to defining the required clothing.

- a) How serious is the chemical hazard (i.e. how serious are the effects of exposure to the skin)?
- b) Is there a risk of inhaling chemicals? If so, will respiratory protection also be needed?
- c) Will eye protection be needed?
- d) Are special boots, goggles or headwear needed?
- e) Are partial cover garments, such as aprons, adequate?
- f) Would disposable garments be suitable?
- g) Is maximum isolation of the wearer necessary (by the use of gas-tight or air-supplied suits)?

6.3 Selection of material of construction

Suppliers of protective clothing should be able to advise on the general suitability and limitations of their garments, and on their practical value for protection against particular chemicals under defined conditions.

In the selection of a suitable material of construction the following questions arise.

- a) What chemical resistance is required of the garment material, and for how long?
- b) What other requirements are there for the garment material (e.g. durability)?
- c) Is an air-permeable garment material acceptable?
- d) If there is a risk of significant chemical permeation through the garment material, will the concentration to which the skin is exposed be acceptably low throughout the period of work?

Discussion with chemical suppliers, safety experts, occupational hygienists and garment suppliers will frequently be necessary to answer these questions and to make an initial choice of protective garments. Further consultations will normally be needed to ensure that the final choice meets the need to provide adequate protection under the circumstances that apply. The decisions to be taken during the selection of the material of construction are shown in Figure 3.