

Recommendations for

The selection, use and maintenance of respiratory protective equipment

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British Ironfounders' Association*

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British Safety Council

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- British Agrochemicals Association

British Gas Council

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Engineering Equipment Users' Association
- Home Office

Institution of Gas Engineers

Ministry of Defence

National Coal Board

Oil Companies' Materials Association

Steel Castings Research and Trade Association

United Kingdom Atomic Energy Authority

Individual users of respiratory protective equipment

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Foreword

These recommendations, which were first published in 1968 to satisfy a demand for a simple guide to the use of such equipment, have been revised to take account of the several British Standards for respiratory protective equipment which have been published since that date.

Respiratory protective equipment should be worn where there is a risk to health from inhaling harmful dusts, fumes, gases or vapours, or where there is likely to be a deficiency of oxygen, or both. It is stressed that in such circumstances every effort should be made to remove that risk by improving the design of the plant and the method of operation. Nevertheless, the use of respiratory protective equipment is essential in certain operations and in these situations appropriate equipment has to be available should the need arise. It will be noted that there are many types of such equipment, and use of the wrong type is dangerous.

It is essential that all persons involved in the use of respiratory protective equipment should be adequately trained and supervised.

Certain toxic substances that may occur in some atmospheres can be absorbed by the skin. Where they do occur respiratory protection alone is insufficient and the whole body should be protected.

There are legal requirements concerning the use of respiratory protective devices in certain processes.

For more detailed information on the various respiratory protective devices references should be made to the following British Standards:

BS 2091, *Respirators for protection against harmful dusts, gases and scheduled agricultural chemicals*.

BS 4555, *High efficiency dust respirators*.

BS 4558, *Positive pressure, powered dust respirators*.

BS 4667, *Breathing apparatus*.

BS 4667-1, *Closed-circuit breathing apparatus*.

BS 4667-2, *Open circuit breathing apparatus*.

BS 4667-3, *Fresh air hose and compressed air line breathing apparatus*.

BS 4667-4, *Escape breathing apparatus*¹⁾.

BS 4771, *Positive pressure, powered dust hoods and blouses*.

NOTE It is important to refer to the latest editions of these standards including amendments.

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 18, 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⁾ In course of preparation.

Introduction

This British Standard is designed to assist in the selection of respiratory protective devices for use against atmospheric contaminants. Atmospheres may be contaminated by dust, or by gas, or may be deficient in oxygen. These hazards may occur singly or in any combination. The meaning of dust is taken to include mist and fume, and of gas to include vapour. These, and other terms, are defined in 1.2 of this standard. Each contaminant may have special characteristics of its own which require protection outside the field of this standard. For instance, they may be radioactive or corrosive and require the wearing of special clothing. Some gases, liquids and soluble solids may be absorbed through the skin and these may also require special protection.

Contaminated atmospheres may be described generally as nuisance atmospheres which are not toxic or immediately dangerous to health; hazardous atmospheres which may be of low toxicity or cause easily reversible biological changes; dangerous atmospheres of a high toxicity or where the health hazards are more severe; and atmospheres immediately dangerous to life.

Respiratory protective devices may either filter the contaminated atmosphere to produce air suitable for respiration, or supply such air from an alternative source. The air is supplied to the breathing area (the nose and mouth of the wearer) by one of the following: a mouthpiece and noseclip; a half-mask covering the nose and mouth; a full facepiece covering the eyes, nose and mouth; a hood covering the head down to the shoulders; or a blouse covering the head and body down to waist and wrists.

In this standard, for each type of respiratory protective device a nominal protection factor has been suggested. This factor is explained fully in Appendix A, and it is a guide to the effectiveness of the device when used correctly. It indicates the degree by which the atmospheric contaminant is reduced by the respirator within the breathing zone. Thus, a device which reduces the level of contamination ten times will have a nominal protection factor of 10, whilst one which reduces it one thousand times will have a nominal protection factor of 1 000. These figures should be used in conjunction with the maximum allowable concentration, or threshold limit value, of the contaminant and its actual concentration in the atmosphere. Generally, a substance with a threshold limit value of 10 parts per million, which has a concentration of 1 000 parts per million in the atmosphere, will require the use of equipment with a nominal protection factor of at least 100. Further examples are given in Appendix A, together with a list of respirators and their nominal protection factors.

Each type of device is dealt with in more detail in the following pages, and it is advisable to read all of this standard before making a selection. Further details can be obtained from other British Standards mentioned in the text, but if the reader is in doubt about any parts of the standard, further explanation and guidance may be obtained from the appropriate authority or the manufacturer of the equipment.

1 General

1.1 Scope

These recommendations describe in general terms the various types of personal respiratory protective equipment, discuss the factors affecting the choice of such equipment and make recommendations for selection, use and maintenance.

These recommendations are written in terms of metric units.

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

1.2 Definitions

For the purposes of these recommendations, the following definitions apply.

- 1) *Ambient*. Surrounding
- 2) *Blouse*. A garment covering the upper part of the body from the head to the waist, and the arms to the wrist, to which air suitable for respiration is supplied.

3) *Breathing apparatus*. Apparatus enabling its users to breathe independently of the ambient atmosphere.

4) *Breathing resistance*. The resistance of a respiratory protective device to the passage of air into (inhalation resistance), or from (exhalation resistance), the wearer.

5) *Breathing tube*. A flexible tube through which air or oxygen flows to the facepiece of a respirator or breathing apparatus.

6) *Canister*. A container of materials which will remove certain contaminants in the air passing through them.

7) *Cartridge*. A small, sealed, replaceable unit containing materials which will remove certain contaminants in the air passing through them.

8) *Contaminant*. Harmful or nuisance dusts and gases.

9) *Demand valve*. A device fitted in a breathing apparatus whereby the wearer receives air on demand from an air supply.

10) *Dust*. Finely divided particulate material that may be present in the air; includes fume and also mist of negligible volatility. (See “fume” and “mist”.)

11) *Exhalation valve*. A non-return valve to release exhaled air.

12) *Facepiece*. A mask fitting to the face and covering the nose and mouth. There are two types: the half-mask (or-nasal facepiece), covering the nose and mouth; and the full facepiece, covering the eyes, nose and mouth.

13) *Faceseal*. A flexible lip or pneumatic cushion sealing the facepiece to the face.

14) *Filter*. A device to remove specific contaminants from the inhaled air.

15) *Fume*. Airborne particles, usually less than a micrometre in size and sometime visible as a cloud or smoke.

16) *Head harness*. An arrangement of straps for holding a facepiece or mouthpiece securely in place.

17) *Hood*. A device that completely covers the head, neck, and portions of the shoulders.

18) *Inhalation valve*. A valve that allows respirable air to enter the facepiece or mouthpiece, and prevents exhaled air from leaving through the intake opening.

19) *Minute volume*. The volume of air breathed in one minute.

20) *Mist*. Airborne liquid droplets. (See “dust”.)

21) *Oxygen deficiency*. Air containing insufficient oxygen to support life.

22) *Nuisance dust*. Coarse non-toxic particles.

23) *Particulate*. Occurring in the forms of minute separate particles, such as dust, fume and mist.

24) *Pre-filter*. A filter fitted in front of the main filter to remove coarse particulate matter.

25) *Pressure reducer (or reducing valve)*. A device that reduces a high pressure to a nominally constant low pressure.

26) *Respirator*. A device in which the inhaled air passes through a filter medium to remove contaminants.

27) *Threshold limit values (TLV)*. The atmospheric concentration of a contaminant to which workers can be repeatedly exposed for an eight hour work-day without adverse effect.

28) *Toxic*. Harmful to health.

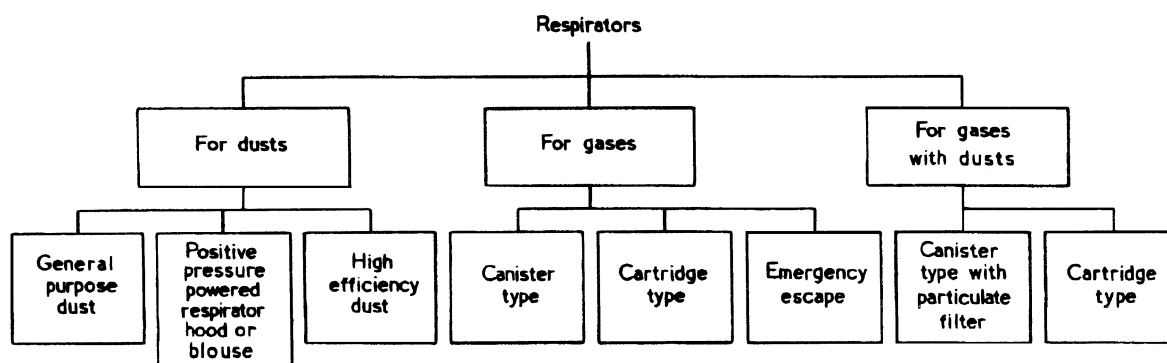
29) *Vapour*. A gaseous substance that is normally solid or liquid at ordinary temperatures and pressures.

1.3 Classification of respiratory protective equipment

There are two distinct methods of providing personal protection against contaminated atmospheres.

1.3.1 By purifying the air breathed. The inhaled air is drawn through a medium that removes the harmful substances, the nature of the medium depending on the contaminating agent. Devices that achieve this are known as respirators.

The different types of respirators are represented below.



NOTE In addition to dust respirators, other devices are available which consist of a filtering medium held to the nose and mouth by simple means to remove coarse nuisance dusts from the inhaled air. They should never be used in the presence of harmful or toxic dusts.

1.3.2 By supplying air or oxygen from an uncontaminated source. The inhaled air is conveyed by air line, or alternatively, air or oxygen is supplied from cylinders or other containers carried by the person at risk. Devices that achieve this are known as breathing apparatus.

The main types of breathing apparatus are represented below.

2 Respirators for dusts and gases

2.1 General description

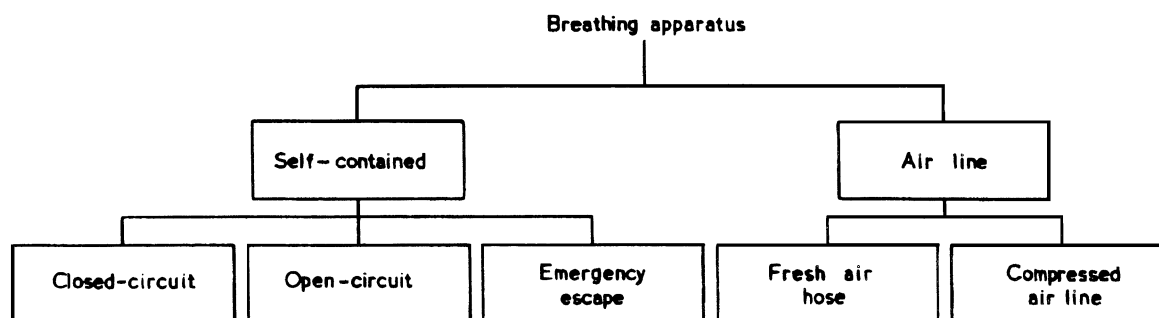
Respirators for protection against dusts and gases consist of half-mask, full facepiece or mouthpiece and noseclip equipped with air-purifying units to remove gases and/or particulate matter from the ambient air prior to its inhalation. In addition, some respirators are provided with a blower which supplies air suitable for respiration under a slight positive pressure. A hood or blouse is sometimes used with this type of equipment.

2.2 General limitations

Respirators do not protect against oxygen deficient atmospheres and they should not be used in atmospheres immediately dangerous to life. The maximum concentration of contaminant against which a respirator will protect is determined by a combination of filter efficiency, facepiece efficiency and outlet valve efficiency as set out in the appropriate British Standards.

In drawing air through the filter, the lungs produce a negative pressure in the facepiece and this may cause unfiltered air to pass between the respirator facepiece and the face. Thus, respirators without blowers to maintain a positive pressure within the facepiece will not provide the maximum designed protection unless the facepiece is carefully fitted to the wearer's face to prevent inward leakage (see 5.2). The time during which protection is provided depends upon the type of canister, cartridge or filter, the concentration of contaminant and the wearer's work rate. The appropriate type of canister, cartridge or filter should be selected for the particular atmosphere and conditions.

The wearing of prescription spectacles or eye protectors may present facepiece fitting problems (see 7.2).



2.3 Respirators for dusts

2.3.1 Description and limitations. Dust respirators are for use against dusts only, and are ineffective against gases or in oxygen deficient atmospheres. The contaminated atmosphere is drawn through a filter system before it is breathed, and the level of contamination is thus reduced. The action of the lungs is used to draw the air through the filter system and a valve into a half-mask or full facepiece. The exhaled air passes through a second valve into the atmosphere. The life of the filters is dependent upon the concentration of contaminant, and their resistance to breathing increases with use. The faceseal leakage and inhalation resistance is considerably reduced in the positive pressure, powered type of dust respirator. In these a power pack, normally worn on the body, drives a motorized fan, which draws air through the filters in excess of the normal breathing requirements and supplies it to a facepiece, hood or blouse. In arduous conditions, this type of respirator may be found easier to use than the lung operated types, and with the hood or blouse, the passage of air over the skin may provide further comfort.

2.3.2 General purpose dust respirators (BS 2091)

Description. These normally consist of a half-mask and dust filter(s) and are designed to protect against harmful dusts. Type A respirators have a lower breathing resistance than Type B but the latter are more efficient in stopping particles of fine dusts.

Limitations. They should not be used in atmospheres immediately dangerous to life. The maximum allowed overall inward leakage is 15 % for Type A and 10 % for Type B, equivalent to nominal protection factors of 7 and 10 respectively.

2.3.3 Positive pressure, powered dust respirators (BS 4558)

Description. These consist of a full facepiece of a half-mask supplied with filtered air from a power pack and provide protection in adverse environmental situations, particularly in hot conditions.

Limitations. They should not be used in atmospheres immediately dangerous to life. The maximum allowed inward leakage is 5 % with standard filters and 0.2 % with high efficiency filters, equivalent to nominal protection factors of 20 and 500 respectively.

2.3.4 Positive pressure, powered dust hoods and blouses (BS 4771)

Description. These consist of a hood, or a hood integral with a sleeved blouse, designed so that the exhaled and surplus air passes from the hood or blouse to the surrounding atmosphere at its lower extremities. Air is supplied to the hood or blouse through a filter(s) by a power pack similar to that used in powered respirators described above.

Limitations. They should not be used in atmospheres immediately dangerous to life. The maximum allowed overall inward leakage is 5 % with standard filters and 0.2 % when high efficiency filters are used, equivalent to nominal protection factors of 20 and 500 respectively.

2.3.5 Dust respirators: high efficiency type (BS 4555)

Description. These consist of a full facepiece, fitted with a high efficiency filter(s) designed to protect against highly toxic particulate materials, including radioactive substances.

Limitations. In general, this type will have an overall maximum allowed inward leakage of 0.1 %, equivalent to a nominal protection factor of 1 000.

2.4 Respirators for gases (with or without dusts)

2.4.1 Description and limitations. These respirators are designed to protect against specific gases. Cartridge filters are connected directly to the facepiece and canister filters are connected to the facepiece by a flexible tube. A system of non-return valves ensures that air inhaled by the wearer passes through the canister or cartridge whilst exhaled air passes directly into the surrounding atmosphere. Particulate filters are incorporated in cartridges, and may be incorporated in canister types. However, no protection is provided against particulate contaminants unless specified on the canister.

These respirators should never be used in stills, tanks, confined spaces, or in any other circumstances where a high concentration of gas is likely to be present, or in atmospheres deficient in oxygen. Canisters and cartridges have a limited life, dependent upon the concentration of the contaminant, and should be replaced regularly. They should be used only against those gases specifically indicated on the canister or cartridge.