Health and Safety Fact File - Protective Clothing

Respiratory Protective Equipment

Respiratory protective equipment (RPE) selected for compliance with the COSHH regulations must conform to an HSE approved standard. Previous standards are being replaced by new European standards.

Classification and Selection for Use

Classification 1,2 divides RPE into two main classes according to whether its use is dependent or independent of the ambient (contaminated) atmosphere:

1. Filter respirators - which filter contaminants out of inhaled air. This type is not suitable for use in environments which are immediately dangerous to life or health (IDLH), including oxygen deficient atmospheres.

2. Breathing apparatus - which supply air or oxygen from a source independent of the contaminated air. BA may be suitable for IDLH environments including oxygen deficient atmospheres.

Performance

All RPE has some potential for inward leakage of contaminated air. An assigned protection factor 3 (APF) obtained under controlled test indicates the maximum level of protection for a particular form of RPE. The APF is dependent on the degree of enclosure of the mouth/nose/face/head, the form of respirator, and the filter specification or, in the case of BA, the source of air. The range of APF’s is 4 to 2000.

Selection for Use

The first step is to decide which main type of RPE is required. Next it is necessary to determine the minimum protection required (MPR) from the RPE:

\[ MPR = \frac{\text{Ambient conc. outside facepiece of RPE}}{\text{OEL}} \]

where OEL (Occupational Exposure limit) is the maximum allowable concentration inside the facepiece of RPE.

The selection of RPE should include a comparison of the MPR and the APF’s of the available equipment and a facepiece fit-test if a tight-fit facepiece is being considered. A lower level of performance should be expected during actual use, especially because of difficulty in obtaining an adequate face seal. Selection will also need to take into account personal and work-related factors (see HSG53). For example, RPE which requires a face seal should not be considered for use in the presence of facial hair and/or spectacles.

Fit Testing of Facepieces

Non-powered filter respirators based on a tight-fitting facepiece, including disposable filtering facepieces, rely on a good seal between the mask and face to provide protection. Facepiece fit testing is a method of ensuring that a tight fitting facepiece is suitable for the wearer and seals adequately to their face. It may be difficult to ensure a good seal if the person has a small face and a variety of masks may therefore need to be fit tested before an appropriate one is selected. Tight fitting facepieces are not suitable for people with facial hair and alternative types of respiratory protection will therefore be required, for example, powered respirators incorporating hoods or helmets.

Face masks, Blouses, Hoods, Helmets

The principal design requirement of all of the many forms of RPE is that the mouth and nose may draw air only from a filtered or clean supply. This and personal and work-related factors has resulted in a variety of forms of RPE and facepiece styles with different degrees of enclosure of the mouth/nose/face/head. There are also gas-tight suits incorporating RPE.
Tight-fit Facepiece  Some RPE employ a face mask: a half-mask enclosing mouth and nose or a full-mask enclosing the whole face. A full-mask actually comprises an inner mask covering the mouth and nose and an outer mask, incorporating a visor, which forms a seal round the periphery of the face.

Loose-fit Facepiece  Other RPE may incorporate a helmet enclosing the face and head, a hood enclosing the face, head and part of the shoulders or a blouse (which covers the head and body down to the waist and the arms to the waist, all of which incorporate a visor.

Filter Respirators

In this class of RPE air passes first through a filter, which traps out contaminants, before it is inhaled. Exhaled air is expelled through an exhalation valve, through the filter medium or round the edges of the respirator. Filter respirators may be subdivided into those which rely on the users lungs to move the air and those in which a small pump moves the air. The first type produce alternate negative and positive pressure within the respirator. This cycling of pressure may interfere with the face seal or reduce the performance of an exhalation valve, if fitted, allowing inward leakage of unfiltered contaminated air. In the second (powered) type a pump, worn by the user, supplies filtered air under positive pressure. Some filter RPE is disposable, others use replaceable filters.

BS EN149:2001 Respiratory protective devices. Filtering half-masks to protect against particles
The simplest type of filter respirator in which a mouth/nose mask is moulded out of the filter material, with or without an exhalation valve. APF 4-20 according to filter type (see below). Protects against both solid and liquid aerosols.

BS EN 405:1993 Respiratory protective devices. Valved filtering half masks to protect against gases or gases and particles APF 4-10 according to filter type.

BS EN 1827:1999 Respiratory protective devices. Half masks without inhalation valves and with separable filters to protect against gases or gases and particles or particles only. Requirements, testing, marking APF 4-20 according to filter type.

BS EN140:1999 half mask and replaceable filter, to BS EN141:2000, BS EN143:2000, BS EN371:1992 or BS EN372:1992 (see below), APF 4-20 according to filter type.


BS EN 12942:1999 Respiratory protective devices. Power assisted filtering devices incorporating full face masks, half masks or quarter masks. Requirements, testing, marking APF 10-40 according to mask and filter type. BS EN 12941:1999 Respiratory protective devices. Power assisted filtering devices incorporating a helmet or hood APF 10-40 according to form and filter type.

Filters

BS EN149:2001 Respiratory protective devices. Filtering half-masks to protect against particles.
The mask, moulded out of the filter material, protects against both solid and liquid aerosols. These masks are classified according to their filtering efficiency and their maximum total inward
leakage. There are three classes in descending order of performance:

FFP1, FFP2 and FFP3.

For all other devices with replaceable filters, the classification of a respirator filter begins with the
class of material the filter is designed to remove from contaminated air.

Particulates, solid and liquid (including (dusts, mists, fume, etc.)

or

Gases and vapours.

These categories are further subdivided by performance in relation to particle size, capacity or
chemical nature of substance.

BS EN143:2000 Respiratory protective devices. Particle filters. Requirements, testing, marking
There are three classes, P1, P2 and P3 (3 being the highest) according to performance against
solid and/or liquid particle size, except that P1 applies only to solids.

BS EN141:2000 Respiratory protective devices. Gas filters and combined filters. Requirements,
testing, marking The specification includes 1, 2 and 3 performance ratings for each of the filter
types for test gas concentrations of 0.1, 0.5 and 1.0%, respectively, but the breakthrough time
and concentration vary from substance to substance.

Each filter type is specified for a limited range of substances as indicated in the table below.

<table>
<thead>
<tr>
<th>Type</th>
<th>Application (NB Confirm manufacturer's recommendations)</th>
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<tbody>
<tr>
<td>A</td>
<td>Certain organic gases and vapours with a boiling point above 65°C, as specified by the manufacturer</td>
</tr>
<tr>
<td>B</td>
<td>Certain inorganic gases and vapours, as specified by the manufacturer (excluding carbon monoxide)</td>
</tr>
<tr>
<td>E</td>
<td>Sulphur dioxide and other acidic gases and vapours, as specified by the manufacturer</td>
</tr>
<tr>
<td>K</td>
<td>Ammonia and organic ammonia derivatives, as specified by the manufacturer</td>
</tr>
<tr>
<td>Special Hg</td>
<td>Mercury vapour</td>
</tr>
<tr>
<td>Special NO</td>
<td>Nitric oxide and nitrogen dioxide</td>
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</tbody>
</table>

There are also combination filters in which two or more filter types may be incorporated into a
single housing. A "Special" filter must always incorporate a P3 particle filter.

NB Filter selection must always be based on the particular manufacturer's recommendations.

BS EN371:1992 Specification for AX gas filters and combined filters against low boiling organic
compounds used in respiratory protective equipment. This standard covers certain substances
not included in BS EN141.

BS EN372:1992 Specification for SX gas filters and combined filters against specific named
compounds used in respiratory protective equipment. Specification for performance against
named substance includes breakthrough concentration of not more than 5ppm and
breakthrough time of 20 minutes at challenge concentration of 0.5% .
Breathing Apparatus

The simplest type of breathing apparatus incorporates a breathing mask with a tube attached which is run from an uncontaminated area. This type of breathing apparatus produces pressure cycling, as for filter RPE, and performance suffers accordingly. In other types of breathing apparatus compressed air is supplied to the breathing mask, either from a cylinder carried by the user, or via an airline connected to a suitable compressor. Some breathing apparatus uses oxygen supplied from a cylinder carried by the user. Where a positive pressure is maintained in the supply to the user a much higher level of performance is to be expected.

Fresh Air Hose

Air is drawn by breathing power or is pumped through a hose connected to a face mask, hood, helmet or blouse with the open end of the hose located in an uncontaminated atmosphere.

BS EN 138:1994 Respiratory protective devices. Specification for fresh air hose breathing apparatus for use with full face mask, half mask or mouthpiece assembly APF 10 for half-mask, 40 for full-mask

BS EN 269:1995 Respiratory protective devices. Specification for powered fresh air hose breathing apparatus incorporating a hood APF 40

BS EN 12083:1998 Respiratory protective devices. Filters with breathing hoses, (non-mask mounted filters). Particle filters, gas filters, and combined filters. Requirements, testing, marking

Compressed air line

Breathing quality compressed air is supplied through a flexible hose of length not greater than 90m. In the demand valve type, air is admitted to a face mask in response to the reduced pressure created by inhalation. In other types a continuous flow of compressed air is supplied to a face mask, hood, blouse or helmet.

BS EN 139:1995 Respiratory protective devices. Compressed air line breathing apparatus for use with a full face mask, half mask or a mouthpiece assembly. Requirements, testing, marking APF 20 for half mask; 100 (constant flow), 40 (negative demand flow), 2000 (positive demand flow) for full mask.


BS EN 1835:2000 Respiratory protective devices. Light duty construction compressed air line breathing apparatus incorporating a helmet or a hood. Requirements, testing, marking APF 10-40.

BS EN 12419:1999 Respiratory protective devices. Light duty construction compressed airline breathing apparatus incorporating a full face mask, half mask or quarter mask. Requirements, testing, marking APF 20 or 100

Self-Contained Breathing Apparatus

Air or oxygen is supplied to a face mask from a compressed gas cylinder carried by the user. Air is available on demand, as above, or as a continuous flow. Oxygen is available only on demand. This equipment can be heavy and bulky and its use demands thorough training and good health and physical fitness. Its period of use is limited by the available amount of air or oxygen in the cylinder.


apparatus compressed oxygen or compressed oxygen-nitrogen type. Requirements, testing, marking. Closed circuit means carbon dioxide in exhaled air is removed by an absorbent and the cleaned air is topped up with oxygen and recirculated. Oxygen type not widely used because of hazard of pure oxygen.

Footnotes

1 BS EN133:1991 Respiratory Protective Devices - Classification
   BS EN 132:1999 Respiratory protective devices. Definitions of terms and pictograms
   BS EN 135:1999 Respiratory protective devices. List of equivalent terms
2 The Selection, Use and Maintenance of Respiratory Protective Equipment - A practical guide HS(G)53, 2nd Ed. 1998, Health and Safety Executive
3 BS 4275:1997 Guide to implementing an effective respiratory protective device programme
4 BS EN140:1999 Respiratory protective devices. Half masks and quarter masks. Requirements, testing, marking
   BS EN 136:1998 Respiratory protective devices. Full face masks. Requirements, testing, marking

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