



Mining & Quarrying
OCCUPATIONAL HEALTH &
SAFETY COMMITTEE

Respiratory PPE - Selection and Use

Promoting Work Health and Safety in the Workplace

The South Australian Mining and Quarrying Occupational Health and Safety Committee

Promoting Work Health and Safety in the Workplace

This workplace industry safety resource is developed and fully funded by the Mining and Quarrying Occupational Health and Safety Committee (MAQOHSC).

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Respiratory PPE – Selection and Use Guide

AIM

The aim of this Guidance Material is to provide Persons Conducting a Business or Undertaking (PCBUs) and workers with practical guidance on the selection and use of suitable and adequate respiratory protective equipment (RPE) in the workplace.

Forward

A PCBU / Mine Operator has duty under the South Australian WHS Regulations 2012, regulation 49, to ensure that no person at the workplace is exposed to a substance or mixture in an airborne concentration that exceeds the exposure standard for the substance or mixture and regulation 636 to ensure that no person at the mine is exposed to 8-hour time-weighted average atmospheric concentrations of airborne dust that exceed—

- a) for respirable dust—3.0 mg per cubic metre of air;
- b) for inhalable dust—10.0 mg per cubic metre of air.

The wearing/use of respirators or breathing apparatus to protect workers' health in the workplace, where there is a risk of inhalation of airborne contaminants entering into the nose, mouth and/or lungs may form part of your controls. These devices are collectively known as respiratory protective equipment (RPE).

1. Selection

All types of respiratory protective equipment must comply with Australian Standard AS/NZS 1715:2009 – Selection, Use and Maintenance of Respiratory Protective Equipment. This guideline will outline other Australian standards that are applicable in selecting various types of respiratory protective equipment.

Personal Protective Equipment (PPE) is the lowest order risk control. Always consider other forms of controls first; this should be documented in your Risk Assessment or Standard Operating Procedure.

When selecting respiratory protective equipment (RPE) there are a number of factors that need to be considered:

- The work environment and the potential respiratory hazards that you are exposed to, which will help determine the most appropriate type of respiratory protective equipment.
- Some respiratory protective equipment is designed to protect you from dust particulates, whilst others are designed to protect you from mists and vapours.




Ensure the respirator fits well.

- The respirator must form an airtight seal on the face to prevent contaminants from bypassing the filters/cartridges.
- Disposable and half-face respirators must cover the nose and mouth. Full-face respirators must cover the eyes, nose and mouth.
- Facial hair, even as little as one days growth can have a negative impact on the performance of a respirator.
- Adjustable straps of the respirator should hold it tight against the face and create a seal.

Ensure the respirator passes the fit test

- To test the seal, cover the filter(s), block with your hand(s) and inhale. If the respirator tried to collapse from the negative pressure created by inhaling, then a sufficient seal has been achieved.
- If a seal has not been achieved, adjust the straps and repeat.
- Perform this seal test every time you use a respirator.

2. Types of RPE

Type	Example	Use
<p>Dusk Mask</p>		<p>Dust masks are disposable respirators that are fitted with a particulate filter, usually referred to as a P1 or P2 filter/mask.</p> <p>They cover the mouth and nose and protect the wearer against airborne contaminants including dusts, mists, liquids and some fumes, but not gases or vapours.</p>
<p>Respirator Half and Full Face</p>		<p>A half-face respirator encloses the lower half of the face and can be fitted with one or more filters. The filters can be replaceable or fixed to the respirator. The overall performance of the respirator depends on the class and type of filter that is fitted.</p> <p>A full-face respirator covers the eyes, nose and mouth. These respirators are fitted with cups which cover the mouth and nose. The inner cups reduce steaming-up of the visor. Some full-face respirators are fitted with speech diaphragms, some also have means to fit spectacles within the face piece. The visor provides protection of the eyes against dust and gases.</p> <p>There are different filter types for both half-face and full-face respirators. This means that the wearer must identify the harmful gases or vapours in the workplace and match it with the filter that reduces exposure.</p>
<p>Powered Air Purifying Respirator (PAPR)</p>		<p>Powered air purifying respirators may be used where there is difficulty obtaining an adequate seal with either a dust mask or a respirator.</p> <p>The lower inhalation resistance is an advantage during hard physical work or for long wear times. The flow of air over the wearer's face is a benefit during hard work, in hot environments, or when wearing protective clothing (which reduces the body's ability to reduce heat).</p>

3. Fit Testing

Many common types of respirators are tight-fitting where performance relies on a good seal between the respirator and the wearer's face.

If there isn't a good seal, contaminated air will leak into the respirator and the wearer may not get the level of protection that is needed to protect their health.

Fit-testing measures the effectiveness of the seal between the respirator and the wearer's face. There are two methods:

- Qualitative - a pass/fail test that relies on the wearer's ability to taste or smell a test agent. This type of test can be used on half-face respirators.
- Quantitative - uses specialised equipment to measure how much air leaks into the respirator. This type of test can be used on half-face and full-face respirators.

Fit testing, must be carried out by a competent in-house person, manufacturer, supplier or consultant:

- each time a new make or model of respirator is issued
- whenever there is a change in the wearer's facial characteristics or features which may affect the facial seal (e.g. large weight loss or gain).

Fit-testing should be repeated on a regular basis based upon risk assessment, and one to two yearly is recommended.

Note: *Everyone's face is a different size and shape so there is no 'one size fits all'.*

Keep a written record of fit-tests carried out for each worker, including the:

- type of test performed
- make, model, style and size of respirator tested
- date of the test
- result of the test.

Issue workers with a fit-test record card after fit-testing.

4. Filter/cartridge life expectancy

In use filters/cartridges should be replaced at least every six months to prevent inhalation of contaminants. The usable life and replacement schedule of filters/cartridges may need replacing more often than six monthly, based on the following:

- concentration of contaminants in the air;
- rate of inhalation of operator; and/or
- suitable storage (away from contaminants) of filters when not in use.

If a respirator is becoming harder to breathe through, then replace the filters/cartridges as they are possibly almost full.

If you can smell contaminant through the respirator, stop using the respirator immediately and change the filters / cartridges.

5. Care and maintenance

RPE needs to be maintained to ensure that it functions properly and provides workers with its designed protection level. The system of maintenance will be determined by scale of use and the type of RPE used.

A system of maintenance should generally include the following:

- Cleaning and disinfection;
- Inspection;
- Repair and replacement of components; and
- Appropriate storage.

Respirators should be stored in a sealed container when not in use to prevent airborne (or other) contaminants from settling on the respirator and becoming a hazard to your respiratory system.

Sharing of respirators is not recommended as improper cleaning can lead to the spread of illness and disease.

If sharing of respirators is required, operators must thoroughly clean the respirator before and after use. Use alcohol swabs to clean the rubber parts of the respirator, paying close attention to the inner surfaces and sealing surfaces. Allow the respirator to dry and then place in into its sealed storage container.

If you have your own respirator, as well as regular cleaning of the mask, once yearly the respirator should be stripped down and the valves cleaned, inspected and replaced as necessary.

All parts of RPE should be inspected and faulty components (including spent or expired filters) should be replaced.

Non disposable RPE will need to be cleaned after each use. The cleaning and disinfection should be conducted as per the manufacturer's instructions.

All persons who are required to maintain RPE must be trained in the cleaning and disinfection procedures.

6. Inspection

An important part of any RPE maintenance program is the inspection of the devices. This will enable any damage or malfunctioning components to be identified.

All RPE is required to be inspected before and after use and during cleaning.

7. Respirator filters and cartridges

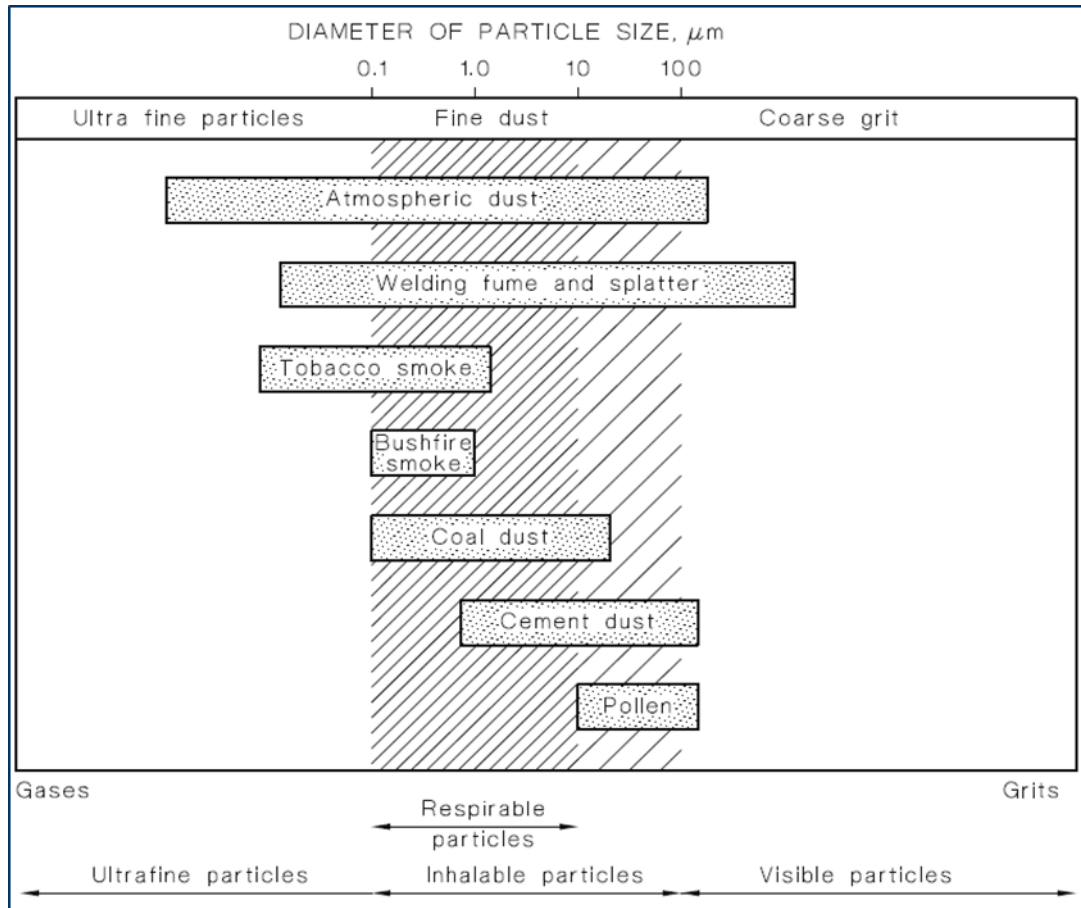
AS/NZS 1716:2012 – Respiratory Protective Devices details the types of particulate and gas filters and their capacity that are available in Australia.

Air-purifying cartridges are types of cartridges that function by removing contaminants from the air. They have filters that remove contaminants by passing the ambient air through the air-purifying element before it reaches the user.

Particulate filters capture particulates in the air such as dusts, mists and fumes. They do not protect the user against gases or vapours. Particulate filters are classified into three groups, relative to the particulate size filtration capacity and toxicity of the particulate. Refer to table below.

CLASS OF PARTICULATE FILTER	TYPE OF PARTICULATE	PARTICULATE SIZE	AVAILABILITY
P1	Mechanically generated particulates, e.g. chrysotile	Up to 100 µm	Powered, replaceable, and disposable
P2	Mechanically and thermally generated particulates, e.g. metal fumes, respirable crystalline silica	< 10 µm	Powered, replaceable, and disposable
P3	All particulates including highly toxic materials, e.g. beryllium	-	Powered and replaceable. <i>NOTE: For P3 filter classification, a full-face respirator is required. When a P3 filter is used in a half-face respirator it has a protection factor equivalent to a P2 filter.</i>

Size range of common particulates



Particulate sizes:

- 100 µm size particulates are inspirable or inhalable.
- <10 µm size particulates are respirable.

Inspirable particulates do not enter the lungs as deeply as respirable ones but may be associated with sensitisation or systemic poisoning.

Respirable particulates can penetrate deep into the lungs.

Source: AS / NZS 1715:2009 Selection, Use and Maintenance of Respiratory Protective Equipment.

7.1. Gas and Vapours

Gas and vapour filters and cartridges are usually used when there are gas or vapour hazards in the air. There are a number of respirator gas filters that are used to remove specific gases or vapours; these do not protect the user against particulates. It is important that your Risk Assessment identifies the chemical hazard/s you may be exposed to in order to select the appropriate cartridge.

FILTER TYPES FOR GASES AND VAPOURS		
Filter	Examples of Contaminants / Uses	Cartridge Colour
Type A – organic vapours	Solvents (with boiling point above 65°C)	Brown
Type B AUS or B1 – acid gases	Chlorine / sterilization of water, chemical manufacture, hydrogen chloride / chlorinated organic chemical manufacture, steel pickling	Grey
Type B2 and B3 – acid gases and hydrogen cyanide (HCN)	Plastics manufacture, gold ore refining, HCN fumigation	Grey
Type E – sulphur dioxide (SO ₂)	SO ₂ /casting of metals, bleach manufacture, manufacture of sulphuric acid, fertilizer manufacture, metal cleaning, petroleum refining	Yellow
Type G – agriculture chemicals	Low vapour pressure (below 1.3 Pa at 25°C) organic vapours, pesticide spraying, mixing manufacture	-
Type K – Ammonia (NH ₂)	NH ₂ /refrigeration, manufacture of fertilizers, explosives, plastics, low boiling point amine/chemical manufacture	Green
Type AX - Low boiling point organic compounds (below 65°C)	As specified by the manufacturer, e.g. dimethyl ether, vinyl chloride	Brown
Type NO - Oxides of nitrogen	Oxides of nitrogen	Blue
Type Hg – Mercury	Metallic mercury/chemical industry, inorganic-mercury compounds	Red
Type MB - Methyl bromide	Fumigation	-

Gas filters are further classified into one of the following absorption capacity classes.

CLASS OF GAS FILTER	ABSORPTION CAPACITY
Class AUS	Low absorption capacity filters
Class 1	Low to medium absorption capacity filters
Class 2	Medium absorption capacity filters
Class 3	High absorption capacity filters

NOTE – Where there is a hazard of both gas/vapours and particulates, both types of filters must be used.

8. Respirator filters and cartridges

AS/NZS 1715:2009 – Required minimum protection factor (MPF) for any situation is the factor that is necessary to reduce the exposure of the wearer below an acceptable level or exposure standard or to minimise the potential exposure.

$$\text{MPF} = \frac{\text{Ambient Airborne Concentration}}{\text{Acceptable Exposure Level/Standard}}$$

If the exposure standard of a substance is set as a peak limit, then the measurement should be taken of the peak ambient concentration. If the exposure standard is a time-weighted average, measurements should be taken to estimate the eight-hour exposure level.

REQUIRED MINIMUM PROTECTION FACTOR	SUITABLE RESPIRATOR PROTECTIVE EQUIPMENT – PARTICULATES	
	MECHANICALLY GENERATED PARTICULATES	THERMALLY GENERATED PARTICULATES
Up to 10	<ul style="list-style-type: none"> P1, P2 or P3 filter half facepiece replaceable filter P1 or P2 disposable facepiece Powered Air-Purifying Respirator (PAPR)-P1 Filter in PAPR with head covering or facepiece 	<ul style="list-style-type: none"> P2 or P3 filter half facepiece replaceable filter P2 disposable facepiece
Up to 50	<ul style="list-style-type: none"> P2 filter in a full facepiece PAPR-P2 filter in PAPR with any head covering or full facepiece PAPR-P3 filter in PAPR with any head covering Half facepiece with positive pressure demand or continuous flow air-line Half facepiece – air-hose with electronic blower 	<ul style="list-style-type: none"> P2 filter in a full facepiece PAPR-P2 filter in PAPR with any head covering or full facepiece PAPR-P3 filter in PAPR with any head covering Half facepiece with positive pressure demand or continuous flow air-line Half facepiece – air-hose with electronic blower
Up to 100	<ul style="list-style-type: none"> P3 filter in full facepiece Full facepiece air-hose (hose mask) natural breathing type 	<ul style="list-style-type: none"> P3 filter in full facepiece Full facepiece air-hose (hose mask) natural breathing type
100+	<ul style="list-style-type: none"> PAPR-P3 filter in PAPR with full facepiece or head covering and blouse Head covering air-hose with electrical blower Head covering air-line respirator – continuous flow Full facepiece air-line respirator – positive pressure demand or continuous flow modes Full facepiece air-hose with electric blower 	<ul style="list-style-type: none"> PAPR-P3 filter in PAPR with full facepiece or head covering and blouse Head covering air-hose with electrical blower Head covering air-line respirator – continuous flow Full facepiece air-line respirator – positive pressure demand or continuous flow modes Full facepiece air-hose with electric blower

SUITABLE RESPIRATOR PROTECTIVE EQUIPMENT – GAS AND VAPOURS		
REQUIRED MINIMUM PROTECTION FACTOR	MAXIMUM GAS/VAPOUR CONCENTRATION PRESENT IN AIR PPM (BY VOLUME)	SUITABLE RESPIRATOR PROTECTIVE EQUIPMENT
Up to 10	1 000	<ul style="list-style-type: none"> Class AUS, 1,2 or 3 filter with half facepiece replaceable filter or disposable facepiece Class PAPR-AUS, PAPR-1 or PAPR-2 filters in a PAPR with any head covering or facepiece
Up to 50	1 000	<ul style="list-style-type: none"> Class AUS or Class 1 filter with full facepiece
Up to 50	5 000	<ul style="list-style-type: none"> Half facepiece air-line respirator with positive pressure demand – or continuous flow Half facepiece air-hose with electric blower
Up to 100	5 000	<ul style="list-style-type: none"> Class 2 filter with full facepiece Class PAPR-2 filters, with full facepiece PAPR
Up to 100	10 000	<ul style="list-style-type: none"> Class 3 filter with full facepiece Full facepiece air-line respirator – negative pressure demand SCBA negative pressure demand Full facepiece air-hose (hose mask) natural breathing type
100+		<ul style="list-style-type: none"> Full facepiece, head covering or air-supplied suit with air-line respirator – positive pressure demand or continuous-flow SCBA positive pressure demand Full facepiece air-hose with electric blower

9. Detailed description of types

9.1. Half-face respirators

A half-face respirator encloses the lower half of the face and can be fitted with one or more filters. The filters can be replaceable or fixed to the respirator. The overall performance of the respirator depends on the class and type of filter that is fitted. It may be difficult to achieve a satisfactory fit with a half-face respirator due to the complexity of the shape of the face. If the wearer has facial hair and/or wears prescription spectacles this can reduce the performance of the respirator.

Half-face respirators are low performance devices, with a minimum protection factor of up to 10 when:

- fitted with gas filters, with a maximum gas/vapour concentration of 1000 ppm;
- fitted with any particulate filter;
- fitted with any combination gas and particulate filters.

9.2. Full-face respirators

A full-face respirator covers the eyes, nose and mouth. These respirators are fitted with cups which cover the mouth and nose. The inner cups reduce steaming-up of the visor. Some full-face respirators are fitted with speech diaphragms, some also have means to fit spectacles within the facepiece. The visor provides protection of the eyes against dust and gases. It may be difficult to achieve a satisfactory fit with a full-face respirator if the wearer has facial hair and/or if they wear prescription spectacles. Close fitting facepieces may cause discomfort and/or heat build-up.

Full-face respirators are low to moderate performance devices. The minimum protection factor (MPF) can vary from up to 10, to up to 100 depending on the type of filter fitted to the facepiece.

When fitted with particulate filters only, the MPF against particulates is:

- Up to 10 when fitted with P1 filters
- Up to 50 when fitted with P2 filters
- Up to 100 when fitted with P3 filters

When fitted with gas filters only, the MPF against gases is:

- Up to 50 when fitted with Class AUS and Class 1 gas filter only, and with a maximum gas/vapour concentration in air of 1000 ppm.
- Up to 100 when fitted with Class 2 gas filters only, and with a maximum gas/vapour concentration in air of 5000 ppm.
- Up to 100 when fitted with Class 3 gas filters only, and with a maximum gas/vapour concentration in air of 10 000 ppm.

When fitted with gas and particulate filters with MPF of the respirator is given by the MPF assigned to the relevant filter class, e.g. with A1 gas filters (MPF up to 50) and P3 particulate filters (MPF up to 100).

9.3. Dust masks

A dust masks are disposable respirators that are fitted with a particulate filter, usually a P1 and P2 filter. They cover the mouth and nose and protect the wearer against airborne contaminants including dust, mists, liquids and some fumes, but not gases or vapours.

Dust masks are not suitable where:

- Contaminant concentrations are dangerous to life and health, unknown or exceed the relevant exposure standard
- Toxic gases or vapours are present
- A satisfactory fit of the mask is not obtained due to facial hair or other characteristics that prevent a good seal between the edge of the mask and the wearer's face
- If the atmosphere is deficient in oxygen, a confined space or poorly ventilated area
- If there is a smell or taste of a contaminant and/or if persons in the area experience nose and/or throat irritation

10. Understanding the cartridge (examples)

Example 1 – Cartridge AXP3

AX	P3
Low boiling point organic compounds (boiling point less than 65°C)	All particulates including highly toxic materials

Example 2 – Cartridge A1HgP3

A1	Hg	P3
Organic gases and vapours with low to medium absorption capacity filters	Metallic mercury	All particulates including highly toxic materials

Example 3 – Cartridge A1B1E1K1

A1	B1	E1	K1
Organic gases and vapours with low to medium absorption capacity filters	Inorganic gases and vapours with low to medium absorption capacity filters	Sulphur dioxide and other acid gases and vapours with low to medium absorption capacity filters	Ammonia and organic ammonia derivatives with low to medium absorption capacity filters

Example 4 – Cartridge A2B2E2K2P3

A2	B2	E2	K2	P3
Organic gases and vapours with medium absorption capacity filters	Inorganic gases and vapours with medium absorption capacity filters	Sulphur dioxide and other acid gases and vapours with medium absorption capacity filters	Ammonia and organic ammonia derivatives with medium absorption capacity filters	All particulates including highly toxic materials

11. Selecting an appropriate respirator cartridge

Hazard Types		Type of Filter to Wear	Things to consider when selecting
<ul style="list-style-type: none"> Mechanically generated particles Silica dust. 	<ul style="list-style-type: none"> Chrysotile 	<ul style="list-style-type: none"> P1 	<ul style="list-style-type: none"> A P1 particulate filter will not provide protection against anything more than that.
<ul style="list-style-type: none"> Solid and liquid particles that do not contain oil. non-toxic dusts from sanding, grinding, sawing and insulating particles 	<ul style="list-style-type: none"> Non-toxic household cleaners and disinfectants. 	<ul style="list-style-type: none"> P2 	<ul style="list-style-type: none"> P2 particulate filter - Mechanically and thermally generated particulates.
<ul style="list-style-type: none"> Solid and liquid particles, including those containing oil. Mist droplets from spraying. 	<ul style="list-style-type: none"> Dusts, mists, and fumes from sanding, grinding, cutting, drilling metal. 	<ul style="list-style-type: none"> P3 	<ul style="list-style-type: none"> P3 particulate filter – All particulates including highly toxic materials.
<ul style="list-style-type: none"> Agricultural chemicals such as pesticides and herbicides with a low vapour pressure. 		<ul style="list-style-type: none"> GP1 	<ul style="list-style-type: none"> Filter Type G – Organic compounds with vapour pressures less than 1.3 Pa at 25°C. P1 particulate filter – Mechanically generated particulates.
<ul style="list-style-type: none"> Non-toxic particulate matter such as dust from sanding, sawing, grinding, and sweeping. 	<ul style="list-style-type: none"> Non-toxic particulate matter such as odours from solvents, degreasers and paint thinners. 	<ul style="list-style-type: none"> Carbon layer odour reduction respirator with a GP2 filter. 	<ul style="list-style-type: none"> Filter Type G - Organic compounds with vapour pressures less than 1.3 Pa at 25°C. P2 particulate filter - Mechanically and thermally generated particulates. A GP2 filter is used in non-toxic oil and non-oil environments.
<ul style="list-style-type: none"> Organic vapours with a boiling point greater than 65°C. Organic solvents such as toluene, and xylene. 	<ul style="list-style-type: none"> Paint thinners, lacquers and glues. 	<ul style="list-style-type: none"> A1 	<ul style="list-style-type: none"> Filter Type A – Organic gases and vapours. Class 1 filter – Low to medium absorption capacity filter.
<ul style="list-style-type: none"> Organic vapours with a boiling point greater than 65°C. Organic solvents such as toluene, and xylene. 	<ul style="list-style-type: none"> Paint thinners, lacquers and glues. 	<ul style="list-style-type: none"> A2 	<ul style="list-style-type: none"> Filter Type A – Organic gases and vapours. Class 2 filter – Medium absorption capacity filters. A2 filter provides protection against the same chemicals as A1 filter. A2 is used when persons are exposed to higher concentrations.
<ul style="list-style-type: none"> Ammonia 	<ul style="list-style-type: none"> Methylamine 	<ul style="list-style-type: none"> K1 	<ul style="list-style-type: none"> Filter Type K - Ammonia and organic ammonia derivatives. Class 1 filter – Low to medium absorption capacity filter.
<ul style="list-style-type: none"> Low boiling point organic vapours (boiling point < 65°C). 	<ul style="list-style-type: none"> Highly volatile solvents such as methanol and 1,3-Butadiene. 	<ul style="list-style-type: none"> AXP3 	<ul style="list-style-type: none"> Filter Type AX – Low boiling point organic compounds (boiling point is less than 65°C). P3 particulate filter – High absorption capacity filter.

Hazard Types		Type of Filter to Wear	Things to consider when selecting
<ul style="list-style-type: none"> Organic vapours with a boiling point greater than 65°C. Solvents and/or acid gases such as toluene, chlorine, sulphur dioxide, and hydrochloric acid. 	<ul style="list-style-type: none"> A1B1E1 	<ul style="list-style-type: none"> Filter Type A – Organic gases and vapours. Filter Type B – Inorganic gases and vapours. Filter Type E – Sulphur dioxide and other acid gases and vapours. Class 1 filter – Low to medium absorption capacity filter. 	
<ul style="list-style-type: none"> Organic vapours with a boiling point greater than 65°C. Inorganic vapours and acid gases Acid gases Chlorine Hydrogen chloride Sulphur dioxide Hydrogen fluoride Hydrogen sulphide Ammonia Methylamine Formaldehyde 	<ul style="list-style-type: none"> A1B1E1K1 	<ul style="list-style-type: none"> Filter Type A – Organic gases and vapours. Filter Type B – Inorganic gases and vapours. Filter Type E – Sulphur dioxide and other acid gases and vapours. Filter Type K – Ammonia and organic ammonia derivatives. Class 1 filter – Low to medium absorption capacity filter. 	
<ul style="list-style-type: none"> Organic vapours with a boiling point greater than 65°C. Mercury vapours. Chlorine Gas and particulates 	<ul style="list-style-type: none"> A1HgP3 	<ul style="list-style-type: none"> Filter Type A – Organic gases and vapours. Filter Type Hg – Metallic mercury. Class 1 filter – Low to medium absorption capacity filter. P3 particulate filter – All particulates including highly toxic materials. 	
<ul style="list-style-type: none"> Organic vapours with a boiling point greater than 65°C. Chlorine Hydrogen chloride Sulphur dioxide Hydrogen fluoride Hydrogen 	<ul style="list-style-type: none"> A2B2E2K2P3 	<ul style="list-style-type: none"> Filter Type A – Organic gases and vapours. Filter Type B – Inorganic gases and vapours. Filter Type E – Sulphur dioxide and other acid gases and vapours. Filter Type K – Ammonia and organic ammonia derivatives. Class 2 filter – Medium absorption capacity filter. P3 particulate filter – All particulates including highly toxic materials. 	

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