Dräger

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An Introduction to Personal Protection Technology

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An introduction to Personal Protection Technology

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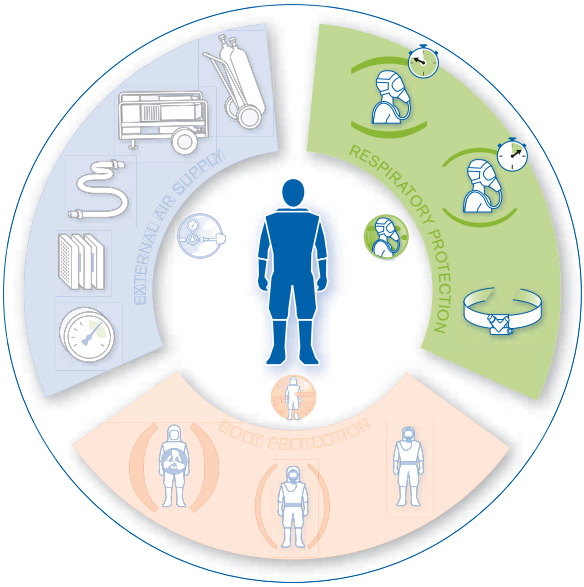
INTRODUCTION

1.1 Air is life, you can't survive without it

By the age of 68, you will have inhaled approximately 300,000 m^3 of air – an enormous amount. For this volume, it is vital that the air flowing through your lungs is clean. This applies equally to ambient air as well as to air that is supplied to you externally (via a device or filter). Externally supplied air is necessary if the ambient air is contaminated or oxygen deficient. Types of external air supply include, for example, air from compressed-air cylinders that are filled with breathing air, or air from external breathing-air pipes.

When breathing air becomes dangerous

Is the concentration of hazardous substances at your workplace too high and/or the oxygen content in ambient air too low? If so, you need respiratory protection. Wearing respiratory protection is always an additional burden, this is why the following principle applies: as much protection as necessary, as little a burden as possible. But how much protection is necessary? The answer to this question depends on your area of application.



OUR ATMOSPHERE

1.2 When does air become dangerous?

The normal atmosphere is only made up of about 21% O_2. If the breathing air contains too little oxygen, it can be life threatening. Particularly dangerous is the fact that you cannot detect a lack of oxygen with your nose.

Our atmosphere is made up as follows (in ppm):

Gas		Composition Dry	Humid
Main gases	N_2 – Nitrogen	780,840	768,543
	O_2 – Oxygen	209,450	206,152
	H_2O – Water vapour	0	15,748
	Argon	9	9,193
	CO_2 – Carbon dioxide	340	335
Trace gases			

How does oxygen deficiency come about?

If inert gas flows into the atmosphere, it displaces the oxygen at the same time. Since only approximately one-fifth of the atmosphere is oxygen, the oxygen concentration is only reduced by one-fifth of the concentration of inert gas.

Danger of inertisation

Industrial firms regularly use liquid nitrogen (-196 °C). If it evaporates, this can quickly lead to a lack of oxygen. If nitrogen in the ambient air reaches 10%, the concentration of oxygen decreases by 2%.

A lack of oxygen causes the following symptoms:

Oxygen concentration in Vol.-%	Oxygen partial pressure in hPa	Symptoms
< 17	< 170	Tendency towards danger from lack of oxygen
11 to 14	110 to 140	Unnoticeable reduction in physical and mental capabilities
8 to 11	80 to 110	Possibility of loss of consciousness without warning after a certain period of time
6 to 8	60 to 80	Loss of consciousness in a few minutes (resuscitation possible if initiated immediately)
< 6	< 60	Immediate loss of consciousness

CONTAMINANTS

1.3 What are contaminants?

Generally speaking, ‘contaminants’ mean substances or mixtures that are harmful to people, animals, plants, organisms and entire ecosystems. According to the German Ordinance on Hazardous Substances, contaminants not only include pure substances but also mixtures, preparations or products.

Contaminants can be divided into two main groups:

– natural (e.g. mineral dust and hydrogen cyanide in bitter almonds)
– synthetic and created by man (e.g. vehicle exhaust gases and industrial fumes)

When do contaminants become dangerous?

If contaminants get into your body, they can cause illness. Their impact depends on their respective characteristics and their interaction with the human body.

DRÄGER GAS DETECTION AND WARNING DEVICES

In order to detect dangers from flammable and toxic gases simply and quickly, Dräger offers a wide range of gas-measurement and warning devices for the widest range of uses.

Additional information is available in the Dräger handbook entitled Introduction to gas-detection technology (order number 90 72 609 (German version); order number 91 00 729 (English version) and on the Dräger website. Or you can simply ask your local Dräger representative.

IMPACT CATEGORIES OF CONTAMINANTS

1.4 How do contaminants get into the body?

Contaminants can enter the body in three different ways:

- Inhalation: via the respiratory tracts
- Oral: via the mouth (mostly when swallowing)
- Dermal: via the skin

How can a risk be recognised?

The Globally Harmonized System of Classification and Labelling of Chemicals (GHS) internationally prescribes uniform labelling of hazardous substances, mixtures and products using pictograms for physical, health and environmental dangers.

Examples of pictograms:

Acute toxicity

Corrosive/irritant

How do contaminants work?

Roughly speaking, there are three chronological impact categories:

Hyperacute → leads to death in a relatively short space of time

Acute → rapid impact (e.g. poisoning, cauterisation, irritation and burns (for example after explosions))

Chronic → longer impact duration leading to chronic genetic changes (tumours, deformities) or to long-term poisoning with organ damage (e.g. to the liver, lungs or kidneys)

HAZARDOUS SUBSTANCES IN THE WORKPLACE

1.5 How can I protect myself from unclean air?

Are you uncertain whether the air in a certain workplace or working area is free of hazardous substances? Before starting work, you should carry out a risk analysis to identify risks and stresses for you and your employees. You can only protect yourself from hazardous substances effectively when you know which substances you're dealing with.

Can I protect myself from hazardous substances in the workplace without respiratory protection equipment? In order to limit the risk from hazardous substances, you can take the following precautions:

- Replace hazardous substances with less dangerous substances (substitution)
- Avoid hazardous substances being released by exhaust air, ventilation technology or encapsulation
- Eliminate intake of hazardous substances via organisational measures

What if these measures are ineffective or can't be implemented? Or what if you're not entire sure that there's no danger left in the air? In any of these cases, you should definitely take extra safety precautions, such as respiratory or body protection.

Employee safety is mandatory

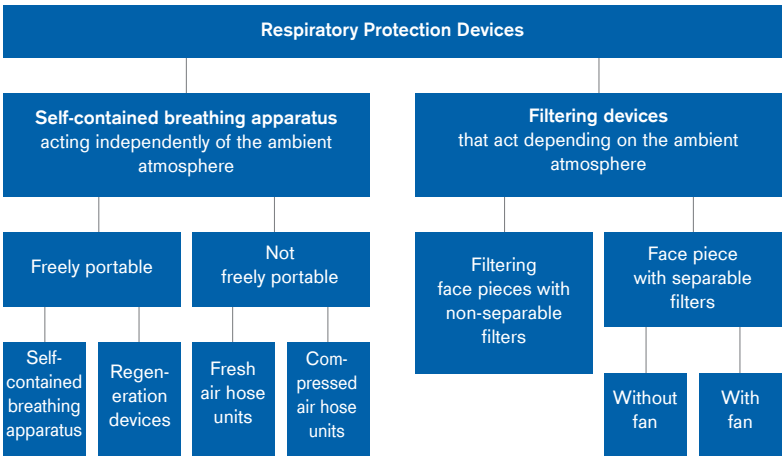
Employers are duty-bound to ensure that the ambient air in which employees work contains sufficient oxygen. They must also ensure that employee health is not damaged by contaminants. The occupational exposure limits (OELs) provided by the Committee on Hazardous Substances apply. Additional national and local regulations must be followed.

DEVICE TYPES

1.6 What types of respiratory protection devices are there?

Respiratory protection devices are divided into different types, depending on whether the device acts independently of the ambient air conditions or not.

An overview of respiratory protection devices:



When should I use respiratory protection?

Wearing a respiratory protection device is an additional burden. Therefore, you should only consider respiratory protection if the limits in your workplace cannot be met with any other protective measures.

You can avoid wearing respiratory protection with the following protective measures:

- Substitution of the hazardous substance
- Technical solutions, such as exhausts, ventilation measures or encapsulation
- Organisational measures

How do I select the right respiratory protection for my field of work?

The guide EN 529 “Respiratory protection devices – Recommendations for use, care and maintenance” provides important information at the European level. In Germany, the professional association regulation 190 (BGR 190) “Use of respiratory protection” applies. This regulation includes information about selecting and using respiratory protection as well as any relevant prerequisites.

ST-8681-2007

ST-5458-2007

ST-14947-2008

ST-3559-2003

D-21187-2009

D-85029-2013

ST-6132-2007

D-9388-2014

2 Lightweight Respiratory Protection

USING FILTER DEVICES

2.1 Is a filter device sufficient to protect against hazardous substances in the workplace?

It depends on the ambient air conditions and conditions in your workplace. A filter device only offers sufficient protection if certain preconditions exist. If these preconditions do not exist, you have to use self-contained respiratory protection.

Filter devices may be sufficient when:

- Oxygen content in the air is at least 17% Vol. (with CO filters at least 19% Vol.
- The type of hazardous substance is known and there is a filter material for it
- The concentration of the hazardous substance is within the permitted limits for the application of filter devices

Filter devices are insufficient when:

- There is a risk the hazardous situation may change (e.g. poorly ventilated containers, tanks, tunnels and vessels)
- The hazardous substances have low warning characteristics (smell or taste)
- The concentrations of hazardous substances are immediately dangerous to life or health
- The hazardous substance is not retained by the filter material

What is the right protection for each hazardous substance?

Hazardous substance (absorbed via the respiratory tract)	Protection
Dust and smoke	Particle filter
Gases and vapours	Gas filters + masks
Particles + gases + vapours	Combination filters and masks
Oxygen deficiency and/or too high concentrations of hazardous substances	Self-contained respiratory protection

Masks and filters by Dräger

You can find out more about masks and filters on the Dräger website, or you can simply ask your local Dräger representative.

CHOOSING THE RIGHT FILTER DEVICE

2.2 Usage recommendations for masks and filters

OVERVIEW

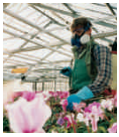
HM = Half mask, FM = Full-face mask

Area/where?	Activity/what?	Substances, materials/with, from what?
General	Handling	Chemicals
	Sampling	
	Inspections	
	Measuring	
	Mixing	of epoxy and polyester resins
	Spraying/lubricating	Cooling lubricant mist
	Treatment	with preservatives
	Transportation	of hazardous materials
	Cleaning	High-pressure steam-blasting (water)
	Cleaning	Degreasing
	Cleaning	Disinfecting
	Cleaning	Disinfecting with substances containing aldehyde
	Cleaning	Handling petroleum ether or cellulose thinner (solvent-containing)
	Cleaning	with acids
Construction	Pouring/spraying	of concrete, cement (foundations)
	Redevelopment	Asbestos work
	Grinding, cutting, drilling	of brickwork, concrete, stone and plaster
	Grinding, cutting, drilling	of cement
	Grinding, cutting, drilling	of putty or filler
	Road topping	Tar
	Finishing	Processing of glass and mineral fibres, e.g. roof insulation
	Finishing	Plastering
	Finishing	Sealing, filling
	Finishing	Clinkering (adhesive)
	Finishing	Roofing, tiling
	Preparations	Removal of contaminated / soiled ground
	Preparations	General demolition of brickwork, concrete and stone

Contaminants	Mask*	Filter*
Particles and substances to be identified	HM or FM	ABEKHg P3 [1]
Particles and/or substances to be identified	HM	P3 / ABEKHg P3 [1]
Particles and substances to be identified	HM	ABEK P3 or escape devices
Particles and/or substances to be identified	HM	P3 /ABEK P3 [1]
Organic vapours	HM	A1
Oil particles	HM / FFP2	P2
Various	HM	ABEK P2
Various	FM	ABEK2Hg P3
Soap-solution mist with sprayed-off deposits	HM / FFP1	P1
Grease particles	HM / FFP2	P2
Organic vapours	HM	AB P2
Organic and inorganic vapours	HM	AB P2
Solvent vapours	HM	A2
Acids	HM	ABE P2
Concrete dust	HM / FFP2	P2
Asbestos fibres	HM	P3
Stone dusts	HM / FFP2	P2 [2]
Dust particles	HM / FFP1	P1
Dust particles	HM / FFP1	P1 [3]
Organic vapours, particles	HM	A1 P2 / A2 P2 [4]
Dust particles and fibres	HM / FFP2	P2
Fine plaster dust	HM / FFP2	P2
Organic vapours	HM	A1 P2 / ABE1 P2
Organic vapours	HM	A1 P2 [5]
Tile and brick dust	HM / FFP2	P2
Gases, solvents, dust particles	HM	ABE1 P2
Dust particles	HM / FFP3	P3

Area/where?	Activity/what?	Substances, materials/with, from what?
Wood processing	Paint removal	Burning off old paint
	Paint removal	Pickling old paint with solvent-based agents
	Paint removal	Pickling old paint with ammonia-based substances
	Paint removal	Grinding/brushing of old paint/coatings
	Paint removal	Grinding/brushing of old paint/coatings containing chrome
	Adhesive removal	Scraping off/grinding of adhesives, e.g. polyester resin
	Glueing	with solvent-containing substances
	Glueing	with solvent-containing substances (spray glue, e.g. polyester resin)
	Glueing	with strong epoxy resin adhesive
	Grinding, cutting, drilling	of wood
	Grinding, cutting, drilling	of beech or oak wood
Metal processing	Galvanising	
	Soldering	
	Soldering	with soldering paste
	Grinding, cutting, drilling	of rust
	Grinding, cutting, drilling	of metals
	Grinding, cutting, drilling	of iron
	Grinding, cutting, drilling	of steel
	Grinding, cutting, drilling	of stainless steel (high alloy)
	Cutting	with laser beam
	Welding	of aluminium
	Welding	of motor vehicles
	Welding	Manual arc welding with coated rod electrodes or laser-beam welding
	Welding, riveting	of construction steel and zinc
	Welding, riveting	of stainless steel (thorium electrode)
Paintwork/ enamelling work	Grinding, cutting, drilling	of paint, varnishes and anti-rusk coatings
	Grinding, cutting, drilling	of paint, varnishes and anti-rust coatings (containing chrome)
	Grinding, cutting, drilling	of anti-fouling varnishes
	Spraying, painting	with water-soluble paint
	Spraying, painting	with water-soluble wood coating containing copper, chrome or arsenic
	Spraying, painting	with solvent-containing paints, synthetic enamel and bleach
	Spraying, painting	of latex paints

Contaminants	Mask*	Filters*
Gases, vapours, smoke, fine particles	HM or VM	ABEK P2
Solvent vapours	HM	ABEK P2 [5]
Solvent vapours, ammonia	HM	ABEK P2
Fine paint particles	HM / FFP2	P2
Fine paint particles	VM / FFP3 [2]	P3
Fine particles	HM / FFP2	P2
Solvent vapours	HM	A2
Adhesive mist, solvent vapours	HM	A2 P2
Vapours	HM	A2 P2
Wood dust particles	HM / FFP2	P2
Wood dust particles	HM / FFP3	P3
Possibly hydrogen cyanide	HM	AB P2
Smoke particles	HM / FFP2	P2
Smoke particles, gases, poss. ammonia	HM	ABEK P2
Rust dust, metal dust	HM / FFP1/2	P1 / P2
Metal fumes	HM / FFP2/3	P2 / P3
Metal fumes	HM / FFP1	P1
Metal fumes	HM / FFP1/2	P1 / P2
Metal fumes	HM / FFP2/3	P2 / P3
Metal fumes	HM / FFP3	P3
Aluminium oxide smoke, ozone	HM / FFP3	P3 / A P3 [4]
Metal smoke, ozone, NOx	HM	AB P2
Metal dust, smoke	HM / FFP3	P3
Metal dust, welding fumes	HM / FFP2	P2 / ABE1 P2 [4]
Metal dust, metal oxide fumes	VM / FFP3	P3 / ABE1 P3 [4]
Fine paint particles	HM / FFP2	P2
Fine paint particles	VM / FFP3 [2]	P3
Fine paint particles	HM	A1 P3
Fine paint mist	HM	A1 P2
Fine paint mist	VM / FFP3 [2]	P3
Solvent vapours and mist	HM	A2 P2 [5]
Paint particles	HM / FFP2	P2

Area/where?	Activity/what?	Substances, materials/with, from what?
Paintwork/ enamelling work	Spraying, painting	of latex paints in the presence of residual solvents or odours
	Spraying, painting	of isocyanates (solvent-containing)
	Spraying, painting	with varnishes and wood preservatives
	Brushing, rolling	of water-soluble paint
	Brushing, rolling	Solvent-containing paint, varnishes and wood preservatives
	Brushing, rolling	of anti-fouling paint
Plastic processing	Grinding, cutting, drilling	of plastics
Disposal	Sweeping	of dust
	General handling	Waste sorting with the occurrence of odours, bacteria and spores
	General handling	of mould/fungal spores
Power plant works	Filter replacement and revision	
Agriculture	General handling	Working with liquid manure
	Spraying	of plant-protection products (aqueous solutions)
	Spraying	of plant-protection products (organic/evaporating)
	Sweeping	of barns
	Cleaning, use	of animal feeding systems
	Cleaning, draining	of containers with chicken or pig manure
Medical	General handling	Contact with bacteria
	General handling	Contact with viruses
Cleaning	swimming pools	
	Cleaning	Additional water treatment with chlorine
Car repair shops	Contact	with diesel soot/smoke
	Repair	Replacement of clutch linings and break pads

[1] Observe exceptions
[2] Dependent on the concentration
[3] P2 if caustic
[4] Depending on concentration
[5] AX for low-boiling substances
[6] FM depending on concentration
[7] AB if gases could be produced
[8] FFP2 Odour for gases below the OELs
[9] Ensure sufficient ventilation in closed rooms!

Contaminants	Masks*	Filters*
Solvent vapours and paint particles	HM	A2 P2
Solvent vapours and paint particles	HM	A2 P2
Organic vapours	HM	A1 P2/A2 P2 [4]
Large paint droplets and splashes, vapours	HM	A1 / A1 P2
Solvent vapours	HM	A1 / A1 P2 [5]
Solvent vapours	HM	A1 / A1 P3
Plastic dusts	HM / FFP2	P2 / AB P2 [7]
Dust particles	HM / FFP3	P3
Gases and dust particles	HM	A P3
Fungal spores	HM / VM / FFP2	P2 [5]
Contaminated dust particles	HM / FFP3	P3
Gases and vapours	HM	ABEK
Insecticides/pesticides	HM / FFP2	P2
Insecticides/pesticides	HM	A1 P2
Dust particles	HM / FFP2 Odour	P2
Dust particles	HM / FFP2 Odour	P2
Dust particles, ammonia, H_2S	HM	ABEK P2 [8] [9]
Bacteria	HM / FFP2	P2
Viruses	VM / FFP3	P3
Bacteria	HM / FFP2	P2
Bacteria and gases	VM	AB2 P2
Soot particles	HM / FFP3	P3
Fine dust, asbestos	HM	P3

***Notes:** This table offers guidance when selecting the right respiratory protection device. It provides no release from the observance of national application rules and laws and is no replacement for the observance and comprehension of the instructions for use supplied with products.

1. What do I need to consider when selecting a filter device?

The nature and concentration of the hazardous substances as well as the local working conditions must be known. The required protection factor for the filter apparatus must then be determined. Filter and mask are seen as a single unit. Please read the instructions for use supplied with the devices thoroughly before use.

2. Check the following with regard to the intended operating conditions:

- Is there sufficient oxygen in the ambient air? (Please check your local regulations – in Germany a minimum of 17% Vol. is required; different values may apply in other countries.)
- What contaminants are there in the ambient air?
- What are the concentrations of the contaminants?
- Which form are the contaminants in? Gaseous, particles or a mix of the two?
- Do the contaminants have adequate warning properties (e.g. smell or taste?)
- What are the applicable occupational exposure limits (OELs), e.g. AGWs in Germany?
- Is other personal protection equipment needed in addition to respiratory protection, e.g. eye or ear protection?

3. Which filter device do I need?

Answer all of the above questions to determine the protection factor you need. Table 1 sets out the nominal protection factors (NPFs) and the factors for the maximum usage concentration for each filter device. The NPF is derived from the highest permissible leakage level for the respective device in accordance with the requirements of the applicable European standard. It indicates the mathematically calculated maximum protection performance of a respiratory protection device. The factor for maximum application concentration is the practical recommendation in the German regulation BGR 190 “Use of Respiratory Protection Devices”, which is derived (deducting a safety margin) from the NPF. These are the applicable values in Germany. The concentration and limit value of the contaminant are required in order to determine the minimum protection factor required. A limit value, or the assigned Occupational Exposure Limit (OEL) of the substance, is the concentration of a specific airborne substance – averaged over a reference period – which shows no evidence of the substance being hazardous to ones health if exposed to it, at that concentration, on a daily basis.

TABLE 1: LIST OF RESPIRATORY PROTECTION DEVICES

Device	Description	Nom. protection factor [1]	Factor for maximum usage concentration
Particle-filtering devices			
Half mask with filter	FFP1	4	4
	FFP2	12	10
	FFP3	50	30
Quarter or half mask with filter	P1	4	4
	P2	12	10
	P3	48	30
Full-face mask with filter	P1	5	4
	P2	16	15
	P3	1,000	400
Air-purifying respirator with helmet or hood	TH1P	10	5
	TH2P	50	20
	TH3P	500	100
Air-purifying respirator with quarter, half or full-face mask (device switched on)	TM1P	20	10
	TM2P	200	100/100
	TM3P	2,000	500
Gas-filtering devices			
Quarter or half mask with filter		50	30
Full-face mask with filter		2,000	400

Example: Determining the required protection factor

Contaminant:	Lead dust (particle protection required)
Concentration at the workplace:	3 mg/m^3
Limit value (OEL):	0.1 mg/m^3
Protection factor required:	$\frac{\text{Concentration of contaminant}}{\text{OEL}} = \frac{3}{0.1} = 30$

[1] Please note that the performance indicated by the NPF can only be achieved if the respiratory device is used and maintained correctly, in accordance with the instructions for use. Make sure you choose the right-sized device for your face and that you only wear the device when cleanly shaven, as facial hair in the sealing area may cause leakage. The values have been taken from the 2005 EN 529 report. Other national or local regulations must be observed.

You can see in Table 1 that for a required minimal protection factor of 30 (lead dust) you will need a P3 filter – either with a half mask, a full-face mask or an air-purifying respirator.

In the event the contaminant is present as both gas and particles, the nominal protection factor must be established separately for each form. For the selection of the filter device, the higher protection factor must be applied. The concentration of gases is measured in ppm (parts per million = volume of the substance within 1 m^3 of ambient air) or in mg/m^3 (= weight of a substance within 1 m^3 of ambient air) and the concentration of particles (dust) only in mg/m^3. As mg/m^3 deals with weight and ppm with volume, mg/m^3 cannot be directly converted into ppm. Higher concentrations are often given in % per volume, 10,000 ppm = 1% Vol.

4. What is the maximum concentration of contaminant for which I can use the filter device?

You can determine the maximum permissible concentration by multiplying the maximum usage concentration factor with the limit value (OEL) of the contaminant.

maximum contaminant concentration =
maximum permissible concentration × OEL

(Example: Determining the maximum permissible contaminant concentration [2)]

Contaminant:	Chlorine
Limit value (OEL):	0.5 ppm
Respiratory protection:	Full-face mask (maximum usage concentration factor of a full-face mask with gas filter: 400)
Factor × OEL	= maximum permissible contaminant concentration
400 × 0.5	= 200 ppm or 0.02% Vol. chlorine

The maximum permissible contaminant concentration for chlorine when using a full-face mask with gas filter is therefore 200 ppm or 0.02% Vol. chlorine.

[2)] Values and calculations have been taken from the 2005 European Norm EN 529: and the German regulation BGR 190. Other national or local regulations must be observed. OELs are based on German regulations. Time-weighted average values over a reference period apply rather than any short-term exposure limits.

5. How do I select the right filter?

Contaminants come in different forms, as aerosols (particles or droplets), gases or vapours. Depending on their occurrence, you must protect yourself against one of these forms or a mixture of them.

Aerosols (particles): Dusts, fibres, fumes, micro-organisms (e.g. viruses, bacteria, fungi and their spores) and mists

Gaseous substances: Gases or vapours

The following table shows the colour coding of filters according to EN 14387. This coding is intended to help you select the right filter for use against a contaminant.

TABLE 2: FILTER COLOUR IDENTIFIER

Colour code	Filter type	Main application area
	AX [3]	Gases and vapours of organic compounds with a boiling point ≤ 65 °C
	A	Gases and vapours of organic compounds with a boiling point > 65 °C
	B	Inorganic gases and vapours, e.g. chlorine, hydrogen sulphide and hydrogen cyanide
	E	Sulphur dioxide, hydrogen chloride
	K	Ammonia and organic ammonia derivatives
	CO [4]	Carbon monoxide
	Hg [5]	Mercury vapour
	NO [6]	Nitrous gases including nitrogen monoxide
	Reactor [7]	Radioactive iodine including radioactive methyl iodide
	P	Particles

[3] AX filters may only be used as supplied from the factory. Re-use and use against gas compounds is strictly forbidden.
[4] CO filters may only be used once and are to be disposed of after use. Instructions based on local regulations apply.
[5] Hg filters can only be used for a maximum of 50 hours in accordance with EN 14387.
[6] NO filters may only be used once and are to be disposed of after use.
[7] Reactor filters: Instructions based on local regulations apply.

Differentiation of filter types

Filters are divided into classes based on their capacity (gas filter) or their efficiency (particle filters) (Table 3). Class 2 gas filters may be used at higher concentrations or for longer periods than Class 1 filters. The particle filter class indicates the efficiency of the filter for particles from the ambient air (Class 1: 80%, cl. 2: 94%, cl. 3: 99.95%).

TABLE 3: DIFFERENTIATION OF FILTER TYPES

Filter type	Filter class	Protection against	Maximum permissible concentration of contaminant
Gas filter		Gases and vapours	
		Capacity:	30 × OEL with half masks / 400 × OEL with full-face masks, however maximum:
	1	Small	0.1% Vol. (1,000 ppm) [8)]
	2	Medium	0.5% Vol. (5,000 ppm) [8)]
	3	Large	1.0% Vol. (10,000 ppm) [8)]
Particle filter		Particle efficiency (separation ability)	
	1	Small	4 × OEL [10)]
	2	Medium	10 × OEL with half-face masks / 15 × OEL with full-face masks [10)]
	3	Large	30 × OEL with half-face masks / 400 × OEL with full-face masks [10)]
	(Example: Lead dust OEL = 0.1 mg/m³ 4 × 0.1 mg/m³ = 0.4 mg/m³ = maximum permissible concentration of lead dust using P1 filters.		
Combination filter		Gases, vapours, particles	
	1-P2 2-P2 1-P3 2-P3	Appropriate combination of gas and particle filters	Appropriate combination values

[8)] Values taken from the European standard EN 14387
[9)] Values taken from the European standards EN 12941 and 12942
[10)] Values taken from the German regulation BGR 190

Example filter type:  A2B2 P3

This filter is suitable for use against:

- **A** Gases and vapours from organic compounds with a boiling point higher than 65 °C up to concentrations of filter class 2 (maximum 5,000 ppm); and
- **B** Gases and vapours from inorganic compounds such as chlorine, hydrogen sulphide and hydrogen cyanide up to concentrations of filter class 2 (maximum 5,000 ppm); and
- **P** Particles up to concentrations of filter class 3.

6. The following instructions are to be strictly observed when using filter devices:

Never use a filter device...
- in oxygen-deficient environments (observe local regulations, e.g. in Germany when O_2 is less than 17% Vol.)
- in poorly ventilated areas or confined spaces such as containers, tanks, small rooms, tunnels and vessels
  in atmospheres where contaminant concentrations are unknown or are immediately dangerous to life or health (IDLH)
- if contaminant concentrations exceed either the maximum permissible concentrations and/or the filter-class capacity
- if the contaminant has poor or no warning properties (smell, taste and irritations), e.g. aniline, benzene, carbon monoxide and ozone

Leave the area immediately if...
- breathing resistance increases noticeably
- you begin to feel dizzy or pain
- you smell, taste or become irritated by the contaminant
- the filter device is damaged

Ensure that...
- the filter device fits properly and is being worn correctly
- you use a combination filter if gaseous and particulate contaminants are/may be present

7. How long does a filter last?

The service life of a filter depends on its filter class and on the ambient conditions.
Factors affecting service life:
- Concentration of the contaminants in the ambient air
- Composition of the contaminants

Factors affecting service life:
- Concentration of the contaminants in the ambient air
- Composition of the contaminants
- Humidity
- Temperature
- Breathing rate of the user

It is not possible to give an estimated service life as it is influenced by many factors. Local or company regulations must be observed.

The end of a filter's service life can be recognised by...

- a noticeable smell/taste in gas filters
- increased breathing resistance in particle filters
- both of the above in combination filters

This is only a small selection of contaminants as an example. For more information and a wide choice of contaminants, please try our hazardous substances database Dräger VOICE on the Internet (www.draeger.com/voice).

TABLE 4: EXAMPLES OF CONTAMINANTS, THEIR OELs AND FILTER RECOMMENDATIONS

Contaminants	Limit value / OEL ppm	Limit value / OEL mg/m³	Filter type	Colour code
A				
Acetic acid	10	25	B [E] P2	
Acetone	500	1,200	AX	
Ammonia	20	14	K	
Asbestos	carcinogen (cat.1)		P3	
B				
Benzene	1	3.2	A (P3)	
1.3-Butadiene	carcinogen (cat.1)		AX (P3)	
C				
Chlorine	0.5	1.5	B (P3)	
Cyclohexane	200	700	A (P2)	
D				
DDT	–	1	A (P3)	
Dimethyl ether	1,000	1,900	AX (P3)	
E				
Ethanol	500	960	A (P2)	
F				
Formaldehyde	0.3	0.37	B (P3)	
G				
Glycerine	–	50	A (P2)	

Contaminants	Limit value / OEL ppm	mg/m³	Filter type	Colour code
H				
n-Hexane 50	180	A (P2)		
Hydrochloric acid, fuming (37%)	–	–	B [E] P2	
Hydrogen chloride	2	3	B [E] P2	
Hydrogen cyanide	1.9	2.1	B (P3)	
Hydrogen fluoride	1	0.83	B [E] P3	
Hydrogen peroxide	0.5	0.71	CO [NO] P3	
Hydrogen sulphide H_2S	5	7.1	B (P3)	
I				
Isooctane	500	2,400	A (P2)	
L				
Lindane	–	0.1	A (P3)	
M				
Mercury vapour	–	0.1	Hg (P3)	
Methanol 200	270	AX (P3)		
Methyl isobutyl ketone	20	83	A (P2)	
N				
Nitrous gases	–	–	NO-P3	
O				
Ozone	carcinogen (cat. 3B)		NO-P3	
P				
n-Pentane	1,000	3,000	AX (P3)	
Phosgene	0.02	0.082	B (P3)	
S				
Sulphur dioxide	0.5	1.3	E (P3)	
T				
Toluene	50	190	A (P2)	
V				
Vinyl chloride	3	7.77	AX (P3)	
X				
Xylene, all isomers	100	440	A (P2)	

Note on filter recommendation:

e.g. A (P2): Gas filter is required (e.g. A); if the contaminant is also present in particulate matter or particles occur then a combination filter is needed (e.g. A P2).

e.g. B [E] P2: B P2 filter is required; alternatively, an E filter can be used instead of a B filter.

No responsibility is taken for the accuracy of this information. Please check your local regulations!

DRÄGER X-PLORE® TWINFILTER SERIES

2.3 Dräger X-plore® Twinfilter masks

If you combine Dräger's extensive experience in the field of respiratory protection technology with the sound practical knowledge of industrial and trade users, the result is a modern, practice-oriented respiratory protection series excelling in wearing comfort and acceptance: the Dräger X-plore® Twinfilter series. Two half masks (Dräger X-plore® 3300 and Dräger X-plore® 3500) and one full-face mask (Dräger X-plore® 5500) are complemented by a wide range of bayonet filters offering suitable protection for all essential applications. The modern and compact design and the "swept back" position of the filters ensure unrestricted view making Dräger X-plore® Twinfilter masks the ideal companion for day-to-day work. Special highlights include accessories such as the Dräger X-plore® Pure adapter, allowing the optimal mask/filter combination to be individually configured to meet your specific needs.

The Dräger X-plore® Twinfilter masks combine flexibility, safety and comfort at the highest level:

- Selected materials for high-level protection and comfort
- High acceptance due to a fresh and appealing design
- Dräger-specific bayonet connection for easy and safe filter installation
- Even weight distribution due to side-filter connections
- "Swept back" concept for a wide and unrestricted field of view

OVERVIEW OF MASKS

Mask	Size	Order no.
Dräger X-plore® 3300	S	R 55 331
	M	R 55 330
	L	R 55 332
Dräger X-plore® 3500	S	R 55 351
	M	R 55 350
	L	R 55 352
Dräger X-plore® 5500	Polycarbonate visor, universal size	R 55 270
	Triplex visor, universal size	R 56 655

Dräger X-plore® 5500

The ideal full-face mask for comprehensive respiratory and eye protection. Developed on the basis of proven and reliable technology.

Dual face seal
Combined with triple sealing edges, it provides secure protection and a tight fit for almost every shape of face.

5-point harness
Allows you to don/doff the mask quickly and easily without catching or pulling on hair.

Large visor
Made from polycarbonate or triplex allowing a large field of vision and ideal visibility while working. The Triplex material is characterised by high scratch and chemical resistance.

ST-946-2008

Dräger X-plore® 3300

The low-maintenance half mask. The right choice for anyone requiring affordable and comfortable respiratory protection.

Dräger X-plore® 3500

A particularly comfortable half mask for long-term use in demanding environments. An innovative “drop down” harness system allows you to remove the mask without e.g. having to remove the helmet.

Dräger “FlexiFit” head harness
Novel, pliable material ensures an excellent fit for varying head sizes. No annoying pressure – not even under a helmet.

“DrägerFlex” material
Specially developed for the Dräger X-plore® 3500 mask body, “DrägerFlex” combines skin comfort with excellent resilience.

Innovative X-guide strap system
An easy to adjust harness that ensures ideal weight distribution resulting in comfortable wearing characteristics.

ST-5456-2007

2.4 Particle filters

A particle filter provides perfect respiratory protection against dust or vapours. Since filters are divided into different classes, the substances that may occur – and the level of protection required – need to be determined in advance. The particle filter classes indicate how efficiently particles are filtered from the ambient air.

Filter class	Particle efficiency (separation rating)	Maximum permissible concentration of contaminant
1	Small	4x limit value
2	Middle	10x limit value with half masks / 15x limit value with full-face masks
3	Large	30x limit value with half masks / 400x limit value with full-face masks

Values applicable in Germany in accordance with BGR 190

Particle filter with housing

- P3 version
- Robust plastic housing to optimally protect the filter media

Pure filter: Particle filter without housing

- Lightweight and flexible
- Tear-drop shape and eccentric connection for an unrestricted view
- Flat design for ideal combination under a visor
- Versatile use – can be used as a pure particle filter or in combination with gas filters
- Additional odour version for filtering unpleasant odours below the permissible limit value

Particle filter pads

- Versatile use: can be used as a pure particle filter or in combination with Dräger X-plore® gas filters and the pad cap
- Economic solution for frequent filter replacement

OVERVIEW OF PARTICLE FILTERS

Filter type	Filter class	Colour code	Order no.
 Dräger X-plore® Pure	P2 R		67 38 353
	P3 R		67 38 354
 Dräger X-plore® Pure Odour	P3 R		67 38 391
 Particle filters with housing	P3 R		67 38 011
 Particle filter pad	P1 NR		67 38 001
	P2 R		67 38 002

R = particle filter is suitable for use during several work shifts
NR = particle filter may only be used for a maximum of one work shift

2.5 Gas filters

Gases are often invisible, odourless and tasteless. Therefore, it is specially important to wear the correct respiratory protection when working with contaminants. These respiratory protection devices must demonstrate high wearing comfort – low weight, low breathing resistance and straightforward operation. The gas filters are identified by a colour code for easy and unmistakable identification:

Filter class	Gas and vapour capacity	Maximum permissible contaminant concentration [1]
1	Small	0.1% Vol. (1,000 ppm)
2	Medium	0.5% Vol. (5,000 ppm)
3	Large	1.0% Vol. (10,000 ppm)

[1] maximum 30x limit value with half mask / maximum 400x limit value with full-face mask
Values taken from the European standard EN 14387

The gas filters of the Dräger X-plore® Bayonet series offer

- Very long service life with low respiratory resistance
- Expansions of gas to combination filters
- Minimum shelf life of four years

FILTER COLOURS

Colour coding	Filter type	Main area of application
	A	Gases and vapours from organic compounds with a boiling point > 65°C
	AX	Gases and vapours from organic compounds with a boiling point ≤ 65 °C
	B	Gases and vapours from inorganic compounds, e.g. chlorine, hydrogen sulphide and hydrogen cyanide
	E	Sulphur dioxide, hydrogen chloride
	K	Ammonia and organic ammonia derivatives
	CO	Carbon monoxide
	Hg	Mercury vapour
	NO	Nitrous gases including nitrogen monoxide
	Reactor	Radioactive iodine including radioactive iodomethane
	P	Particle

OVERVIEW OF GAS FILTERS

Filter type / class	Colour code	Order no.
 A1		67 38 005
 A2		67 38 006
 A2B2		67 38 358
 A1B1E1		67 38 359
 A1B1E1K1		67 38 007

R = particle filter is suitable for use during several work shifts
NR = particle filter may only be used for a maximum of one work shift

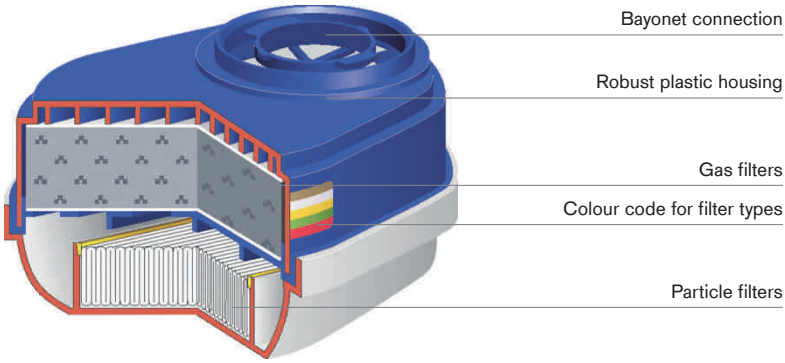
2.6 Combination filter

Particles, gases and vapours occur simultaneously in many applications. In such cases, combination filters, consisting of a gas filter with an upstream particle filter, are used. The same filter classes apply for both filter components as for the individual gas or particle filters.

Ready-to-use combination filters are available for easy and safe handling. They contain both particle and gas filters in a plastic housing. In addition, as in a modular system, the desired combination filter can be individually put together from gas and particle filters using an adapter (see “Accessories and combination options”).

The benefits of Dräger X-plore® combination filters:

- Compact and lightweight
- Robust plastic housing
- With marking “R”: approved for re-use during more than one work shift
- With marking “D”: clogging test passed, i.e. even at high dust concentrations the breathing resistance remains low over a long period of time
- Optional pre-filter prevents fast clogging of the particle filter with coarse dust and thus extends its service life



ST-1167-2003

OVERVIEW OF COMBINATION FILTERS

Filter type/class	Colour code	Order no.
 A1-P3 R D		67 38 015
 A2-P3 R D		67 38 016
 A2B2-P3 R D		67 38 368
 A1B1E1K1 Hg-P3 R D		67 38 017
 A2B2E2K2 Hg-P3 R D1 [1]		67 38 369

[1] Use only in conjunction with a full-face mask

2.7 Accessories and combination options

Flexibility and economy are factors that are necessary for success in industry and trade. Thanks to the innovative accessories of the Dräger X-plore® Bayonet series, gas and particle filters can be individually combined with each other to be able to respond flexibly, easily and with competitive prices to changed conditions.

ACCESSORIES

Filter type	Order no.
 Dräger X-plore® Pure Adapter	67 38 356
Pre-filter	67 38 159
 Pre-filter cap	67 37 576
 Pad cap for the use of pads	67 38 038
 Pad plate for the use of pads	67 38 039

The following diagram shows a small selection of the different combination options.

OVERVIEW OF COMBINATION FILTERS

Pad as pure particle filter

Pad cap
Pad P1 or P2
Pad plate

Pad in combination with gas filter = combination filter

Pad cap
Pad P1 or P2
Gas filter

Pure in combination with gas filter = combination filter

Pure
Adapter
Gas filter

Combination filter with pre-filter

Pre-filter cap
Pre-filter
Combined filters

2.8 Sets

We have put together the appropriate sets for typical applications in industry and trade. This simplifies the selection of suitable respiratory protection. Each set consists of a half mask from the Dräger X-plore® Twinfilter series and the corresponding filters.

ST-12430-2008

Painter set:

Specially designed for working with paints and varnish. Consisting of the Dräger X-plore® 3300 (size M) half mask and two filters A2-P3 R D. To reduce the rate at which the particle filter becomes clogged a single pre-filter can be combined using a pre-filter cap. [1]

ST-12429-2008

Chemical work set

Comprehensive protection is required when handling chemicals. The Dräger X-plore® 3300 (size M) half mask and two filters A1B1E1K1 Hg-P3 R D provide adequate protection during daily work.

ST-12431-2008

Construction set for work in dusty conditions

Dusty conditions are found in many professions – as well as in the home. Here too, respiratory protection is required for one's health. With the construction work set for dusty work, consisting of a half mask Dräger X-plore® 3500 (size M) and two Pure P3 R filters, you are well protected for several hours.

ORDERING INFORMATION

Set	Order no.
Painter set [2]	R 55 686
Chemical work set [2]	R 55 740
Construction set for work in dusty conditions [2]	R 56 960

[1] Not included in the scope of delivery

[2] A wide selection of replacement filters can be purchased separately for all sets

2.9 Paint and enamelling work

Health risks from organic solvents, isocyanates and particles during the processing of paints are frequently underestimated today. However, they harbour material health risks, even if the damage to health only becomes evident after 10 to 15 years. Don't let it get that far – use the correct respiratory protection!

APPLICATION

Spraying, painting	Contaminants	Filters
Water-soluble wood coating with Copper, chrome or arsenic[1]	Fine paint mist	P3
Paints containing solvents, synthetic enamel, bleach	Solvent vapours, paint particles	A2-P2
Latex paint	Paint particles	P2
Latex paint with residual solvents or odours	Solvent vapours, paint particles	A2-P2
Isocyanates	Solvent vapours, paint particles	A1-P1 / A2-P2
Varnishes, wood preservatives	Organic vapours	A1-P1 / A2-P2

Brushing, rolling	Contaminants	Filters
Water-soluble paints	Large paint droplets, vapours	A1 / A1-P1
Paints containing solvents, enamel, wood preservatives	Solvent vapours	A1 / A1-P1
Anti-fouling paint	Solvent vapours	A1 / A1-P1

[1] Use of a full-face mask recommended

SPECIAL SOLUTIONS FROM DRÄGER

Painter set
- Half mask Dräger X-plore® 3300 and two A2-P3 filters

Pre-filter
- Prevents fast clogging of the particle filter
- Individually replaceable, thus extended service life of the combined filter

Combination filter of gas and Pad P2 filter
- As an alternative to the "ready-made" combination filter, an A2-P2 combination filter can be made from a gas and Pad P2 filter
- Pad can be replaced independently of the gas filter

Full-face mask (with Triplex visor)
- The Dräger X-plore® 5500 full-face mask for optimum Eye protection
- Suitable protection if working above the head with a spray gun

Visor films for a full-face mask
- Protect the visor of the full-face mask from getting dirty
- Easy removal and disposal

2.10 Metalworking

Divers activities are involved in metal working. Whether you drill, grind or saw, weld, solder or glue, the resulting hazardous gases and particles pose a risk for the respiratory organs. Wouldn't it be convenient to have a single mask with the corresponding filter for protection from all application contaminants? The half and full-face masks from the Dräger X-plore® Twinfilter series are a good choice for all applications and provide suitable protection – not only for metal processing work.

APPLICATION

Welding	Contaminants	Filters
Aluminium	Aluminium oxide	P3 / A-P3
Automobiles	Metal vapours, ozone, No_x	AB-P2
Manual arc welding with coated rod electrodes, laser-beam welding	Metal dust, vapours	P3

Welding, rivetting	Contaminants	Filters
Construction steel	Metal dust,	P2 / ABE1-P2
Zinc	Welding vapours	P3 / A-P3
Stainless steel (thodium electrode) [1]	Metal dust, Metal oxide fumes	P3 / ABE1-P3

Soldering	Contaminants	Filters
	Vapourised particles	P2
With soldering paste	Smoke particles, gases	ABEK-P2

Grinding, cutting, drilling	Contaminants	Filters
Rust	Rust dust, metal dust	P1 / P2
Metals	Metal fumes	P1 / P2
Iron	Metal fumes	P1
Steel	Metal fumes	P1 / P2
Stainless steel (high alloy)	Metal fumes	P2 / P3

Galvanising	Contaminants	Filters
	Possibly hydrogen cyanide	AB-P2

[1] Use of a full-face mask recommended

SPECIAL SOLUTIONS FROM DRÄGER

Construction set for work in dusty conditions
- The suitable solution if only particle protection is required
- Dräger X-plore® 3500 half mask with two Pure P3 particle filters

Protective visor for welding
- For the full-face mask Dräger X-plore® 5500 Triplex version (optional)
- The lens frame of the mask is completely surrounded by the visor
- Tool-free attachment of the protective visor for welding to the lens frame of the mask

Pad P2
- Economic alternative for all applications requiring class P2 particle protection
- The pad plate, pad P2 and pad cap are combined to make a P2 filter
- Plate and cap can be reused

2.11 Woodwork

Dust that is hazardous to health can arise during the machining and processing of wood and wooden materials – beech and oak wood in particular can cause cancer in humans. Besides activities relating only to wood, there is also a multitude of tasks where other materials are used. In such cases a gas filter might also be necessary in addition to just particle protection. The most important activities have been summarised in the table below and combined with the recommended filter.

APPLICATION

Paint removal	Contaminants	Filters
Burning off old paint	Gases, vapours	A1 B1-P2
Stripping off old paint using agents containing solvents	Solvent vapours	A1 / ABEK
Stripping off old paint using agents containing ammonia	Solvent vapours	ABEK
Grinding, brushing off old paint, coatings	Fine paint particles	P2
Grinding brushing off old paint, coatings containing chrome[1]	Fine paint particles	P3

Adhesive removal	Contaminants	Filters
Scraping off, grinding e.g. polyester resin	Fine particles	P2

Glueing	Contaminants	Filters
Substances containing solvents	Solvent vapours	A2
Substances containing solvents (spray glue)	Adhesive mist, solvent vapours	A2-P2

Grinding, cutting, drilling	Contaminants	Filters
Wood	Wood dust particles	P2
Beech and oak wood	Wood dust particles	P3

[1] Use of a full-face mask recommended

SPECIAL SOLUTIONS FROM DRÄGER

Construction set for work in dusty conditions
- Set consisting of a Dräger X-plore® 3500 half mask with two Pure P3 particle filters
- Optimum protection in dusty environments due to particle class P3

Pad P2
- Economic alternative for all applications requiring particle protection
- The pad plate, pad P2 and pad cap are combined to make a P2 filter

2.12 Chemicals

When working with chemicals, very different substances can pose a health hazard. Often several contaminants occur simultaneously and are thus a special challenge for respiratory protection. The combined filters of the Dräger X-plore® Twinfilter series cover a wide range of hazardous gases and vapours. If required, a multi-range protection is available in a filter with simultaneous high filter performance and long service life for additional safety.

APPLICATION

Activity	Contaminants	Filters
Handling chemicals	Particles, substances to be identified	ABEK Hg-P3
Sampling	Particles, substances to be identified	P3 / ABEK Hg-P3
Inspection	Particles, substances to be identified	P3 / ABEK Hg-P3
Measurements	Particles, substances to be identified	P3 / ABEK-P3
Mixing of epoxy and polyester resins	Organic vapours	A1
Disinfection	Organic vapours	A1-P2
Disinfection using aldehydes	Organic and inorganic vapours	AB-P2
Handling petroleum ether, Nitrothinner	Solvent vapours	A2
Cleaning with acids	Acids	ABE-P2
Transport of hazardous goods [1)]	Miscellaneous	ABEK2 Hg-P3

[1)] Use of a full-face mask recommended

SPECIAL SOLUTIONS FROM DRÄGER

Chemical work set
- Dräger X-plore® 3300 half mask and two filters A1B1E1K1 Hg-P3 RD
- Provides respiratory protection against a multitude of hazardous substances
- Optimum visibility due to laterally placed flat bayonet filters

Full-face mask with A2B2E2K2 Hg-P3 filter
- Optimum safety where increased gas protection is required
- Additional protection for your eyes

2.13 Working with dust

A lot of dust is generated on building sites and when working at home. This may sound unspectacular but it causes constant stress for the respiratory tracts. Even work not immediately associated with dust, such a mixing dry mortar or tile adhesive, can also cause high concentrations of dust. This remains in breathing air for hours and as a result is hazardous.

APPLICATION

Pouring, spraying	Contaminants	Filters
Concrete, cement	Concrete dust	P2

Redevelopment	Contaminants	Filters
Asbestos work	Asbestos fibres	P3

Grinding, cutting, drilling	Contaminants	Filters
Brickwork, concrete, stone and plaster	Stone dust	P2
Brickwork, concrete, stone and plaster with high silica content	Stone dust	P2
Cement	Dust particles	P1
Putty, filler	Dust particles	P1

Road topping	Contaminants	Filters
Tar	Organic vapours, particles	A1-P2 / A2-P2

Finishing	Contaminants	Filters
Processing of glass and mineral fibre	Dust particles and fibres	P2
Plasterwork, roof laying, tiling	Plaster, tile and brick dust	P2
Sealing, filling, clinkering (adhesive)	Organic vapours	A1-P2 / ABE1-P2

Preparation	Contaminants	Filters
Digging off contaminated, dirty soil	Gases, solvents, dust particles	ABE1-P2
General demolition of brickwork, concrete and stone	Wood dust particles	P2

SPECIAL SOLUTIONS FROM DRÄGER

Construction set for workplaces in dusty environments
- Dräger X-plore® 3500 half mask with two Pure P3 particle filters
- Particle class P3 provides optimum protection in dusty environments

Pad P2
- Economic alternative for all applications requiring particle protection
- The pad plate, pad P2 and pad cap are combined to make a P2 filter

Gas filter with Pad P2
- The gas filter and Pad P2 with cap can quickly become a combination filter
- The particle filter can be replaced separately if clogged

2.14 Mining

There are few industries where safety is more important than in mining. Dräger has been working with the mining industry for more than 100 years and has made a considerable contribution to employee safety.

Dust is a considerable health risk in surface mining. Irrespective of whether the dust is generated by blasting or thrown up by vehicles, miners must be protected against the dust – for health reasons. Even below ground the use of respiratory masks may be necessary if dust and particles are present in the air. The Dräger X-plore® series provides thorough protection even in extreme working conditions.

SPECIAL SOLUTIONS FROM DRÄGER

Construction set for work in dusty conditions
- Dräger X-plore® 3500 half mask with two P3 particle filters
- You're always on the safe side with particle class P3

Pad P2
- An economic alternative for all applications requiring class P2 particle protection
- The pad plate, pad P2 and pad cap are combined to make a P2 filter
- Only the pad needs replacing if it is clogged; plate and cap can be reused

Cover cap for the Dräger X-plore® 3000 series
- Cover cap for the Dräger X-plore® series half masks prevents the clogging of the exhalation valve; is ideal for overhead work especially when working with water
- The cover cap can be clicked easily onto the mask without tools

All filter recommendations serve only as guidance when selecting the right respiratory protection device. They provide no release from the observance of national application rules and laws and are no replacement for observing the instructions for use supplied with products.

D-24929-2009

2.15 An overview of lightweight respiratory protection by Dräger

every task?

Particles, gases and vapours

Half masks

Single filter

Dräger X-plore® 4700

Dual filter

Dräger X-plore® 3300

Dräger X-plore® 3500

Full-face masks

Dual filter

Dräger X-plore® 5500

Single filter

Dräger X-plore® 6000

Powered air purifying respirator

Dräger X-plore® 8000

3 Self-Contained Respiratory Protection

WEARING-TIME SPECIFICATIONS

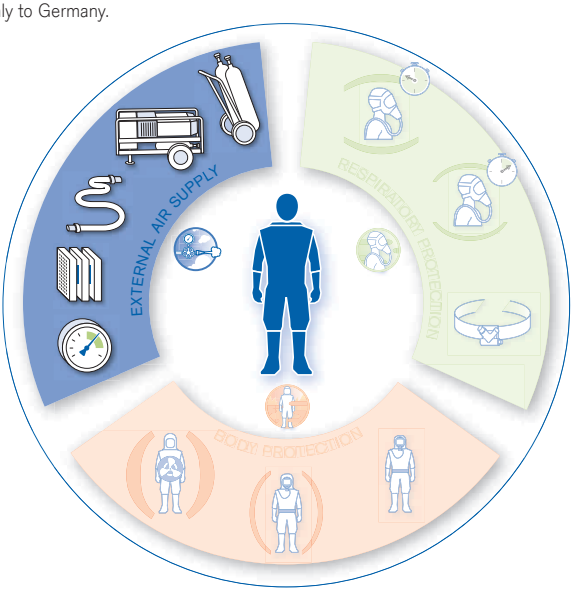
3.1 What do I need to consider when wearing a respiratory protection device for long periods?

If you want to use the respiratory protection device at work for more than 30 minutes every day then you first have to undergo the preventive medical examination required under Convention 26 (BGI 504-26) "Respiratory protection devices". You also have to comply with fixed recovery times.

Example: Extract from the BGR 190 (November 2009)

Self-contained breathing apparatus (SCBA)	Wearing time (min)	Recovery time (min)	Uses per shift	Shifts per week
More than 5 kg total mass	60	30	4	4 (2-1-2) 2 days 1 day rest 2 days
Up to 5 kg total mass	Contingent on function	10	Dependent on wearing time	5

Please note: You need to take different local requirements into account in each country. The data in the table apply only to Germany.



SELF-CONTAINED BREATHING APPARATUS

3.2 How do I use an SCBA?

Self-contained breathing apparatus (SCBA) are freely portable respiration devices. They are worn either on the back or the hip with an appropriate harness.

Specific requirements for SCBA as a safety device in accordance with EN 137:
- Pressure gauge that can be read easily by the wearer (manometer)
- Warning device that gives an alarm at a residual pressure of 55 ± 5 bar

EN 137-1: applies to industrial applications
EN 137-2: contains additional requirements for fire fighting.

Example: The Dräger PAS Micro breathing apparatus

How long can I use an SCBA at a stretch?

The duration of usage for breathing apparatus is between 10 minutes (short-term SCBA) up to about 45 minutes (long-term SCBA). Depending on requirements, you can use cylinder volume, pressure and thus the amount of compressed air specific to your application. In addition, duration of usage depends on your personal air consumption.

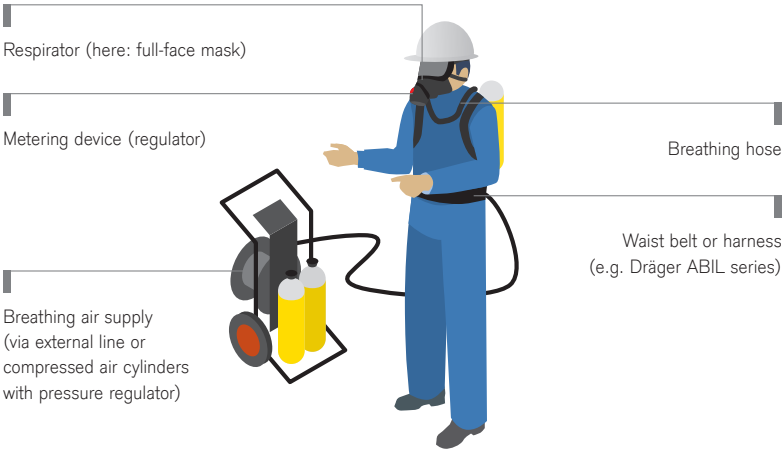
For example:

Compressed gas cylinder:	Volume: 3 l
Pressure:	200 bar
Volume of air:	approximately 600 l
Average air consumption:	approximately 40 l/min
Usage time:	approximately 15 min

COMPRESSED AIRLINE SYSTEMS

3.1 How do I use a compressed airline system?

A compressed-air hose unit is a type of non-freely portable breathing apparatus. This means that by using a compressed-air delivery hose you can supply necessary breathing air from the outside – either from an external air line or via breathing air cylinders provided.



The requirements for compressed-air hose units are governed by EN 14593.

There are three different types of compressed-air hose units:

- With control valve
  These devices provide a continuous stream of air.
  → High air consumption
  Use: with stationary air supply
- With normal-pressure regulator
  The breathing air is used only for the inhalation cycle.
  → Low air consumption
  Use: for air supply from compressed-air cylinders
- With pressure regulator
  The units generate an excess pressure of maximum 5 mbar in the respirator (e.g. in the full-face mask). This is to prevent hazardous substances in the ambient air from entering the mask.
  Use: e.g. in atmospheres containing substances that exhibit acute toxicity.

FREELY WEARABLE OR NOT?

3.4 Which respiratory protection device for which work?

Your choice of either a freely or non-freely portable breathing device depends on the conditions of use and intended application. Self-contained breathing apparatus and compressed-air hose units are both open-circuit devices. They both offer the same protection against airborne contaminants and oxygen deficiency.

The type of equipment you prefer to rely on at work depends on the conditions of use and the intended application.

Self-contained breathing apparatus

Advantage: You can move around freely at work.

Disadvantage: Your breathing air supply is limited.

→ Use, for example, in tight spaces or for temporary work with respiratory protection

Compressed-air hose unit

Advantage: You have an unlimited supply of breathing air.

Disadvantage: You are severely limited in your range of motion.

→ Long-term use, such as extended maintenance and cleaning work or if the chemical protective suit needs to be ventilated

COMPRESSED AIR CYCLINDERS

3.5 What type of cylinders are there?

Compressed-air cylinders are available with a filling pressure of 200 to 300 bar. The pressure tank is made of steel, aluminium or carbon fibre composites (CFRP). CFRP cylinders are the lightest and therefore offer the highest wearing comfort. The pressure tank is fitted with a shut-off valve. The SCBA's regulator is connected to this valve.

Design of a carbon fibre cylinder:

Important Instructions

In order to prevent the ingress of moisture and contaminants into the cylinder, you should never lower the pressure below 2 bar. Compressed-air cylinders must be regularly maintained.

What information does the compressed-air cylinder code give me?

What are the dangers of the cylinder? What does it contain? This information is given to you in the clearly visible cylinder code, in accordance with EN 1089-3. A cylinder with a black-and-white colour on its collar is a compressed-air cylinder. The colour coding only applies to the collar of the cylinder. You are free to choose the colour of the shell, although yellow has become the norm in industry and fire fighting.

A label on the compressed-air cylinder provides the following information:

- Composition of the gas mixture
- Risk and safety phrases
- UN number and gas name
- Name, address and telephone number of the gas manufacturer

GENERATING EXTERNAL BREATHING AIR

3.6 This air is pure

If the concentration of hazardous substances at your workplace is too high and/or the oxygen too low to protect your employees with filtering respiratory protection, then you need to use self-contained respiratory protection.

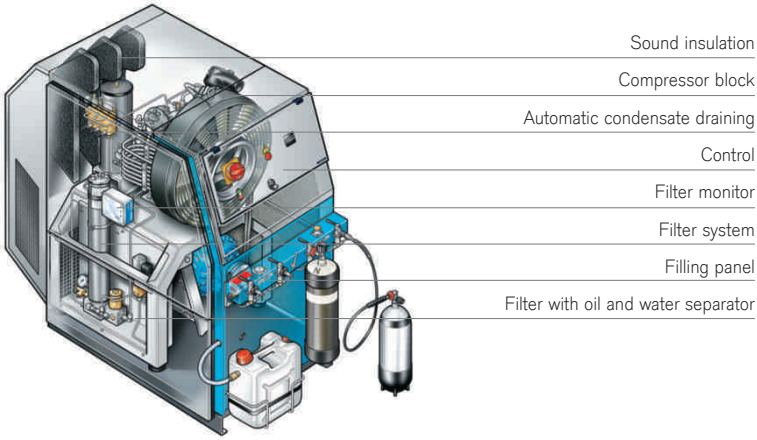
External air can be provided in two different ways:

- from a compressed-air supply: directly via a compressor or compressed air network (pressure range 7 to 10 bar)
- from compressed-air cylinders (nominal filling pressure maximum 300 bar)

How will the breathing air be extracted for self-contained respiratory protection?

Using compressors (mobile or stationary), external air is compressed for the direct compressed-air supply or to fill the compressed-air cylinder. Separators and filters in the compressor ensure that the air is cleaned.

Compressor design:



LIMIT VALUES FOR EXTERNAL AIR

3.7 How can I guarantee the quality of external breathing air?

Whether it's exhaust gases and water in the external air or lubricants from the compressor, when creating breathing air you can never remove all impurities completely. For the quality of the breathing air to comply with the requirements of EN 12021, you must check it every six months in accordance with BGR 190. This does not just depend on the accuracy of the methods, as the detection limits of the methods must also be within the permitted values required.

Limit values for impurities in external breathing air in accordance with EN 12021:

- Lubricants (droplets or mist): 0.5 mg/m^3
- Carbon dioxide content: (500 ppm)
- Carbon monoxide content: 15 ppm
- Water content*:
  50 mg/m^3 (at a nominal pressure of 40 to 200 bar) or
  35 mg/m^3 (at a nominal pressure of more than 200 bar)

(European reference condition: 1 bar absolute, 20 °C – published 2010)

* The current draft of EN 12021 (published July 2010) specifies various water-content limit values for the low-pressure range from 5 to 30 bar.

How can I ensure that external breathing air is pure?

Compliance with limit values for carbon monoxide, carbon dioxide and water:
With Dräger's proven tubes, you have a simple test system on hand – both for low and high-pressure areas. This means you can check, quickly and comfortably on-site, compliance with the limit values.

Compliance with lubricant limit values:
You can use the Dräger Impactor to check compliance with lubricant limit values. You can also measure synthetic oils regardless of type and viscosity.

Manual and automatic Dräger products for monitoring breathing air

Mobile, handy solution for random measurement

D-11163-2011

Dräger Aerotest 5000

The mobile Dräger Aerotest 5000 allows you to check the purity of the breathing air supplied in a low-pressure system (or, with accessories, in a high-pressure system), e.g. of a compressor or compressed-air cylinder. The reading is a quantitative measurement of impurities in the stream of compressed air. All components are immediately within reach in a carrying case.

Stationary device for permanent monitoring

D-22428-2010

Dräger Air Guard

The Dräger Air Guard enables continuous, fully automatic monitoring of the purity of compressed air for medical applications. Dräger's proven sensors also measure trace gases. An automatic alarm sounds if pre-set limits are exceeded – even in the event of short-term impurities. Alarms can also be forwarded as potential-free contacts and used to shut down e.g. the air compressor.

3.8 An overview of self-contained respiratory protection by Dräger

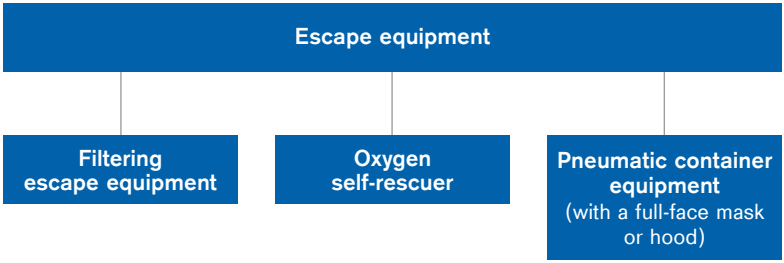
4 Escape Equipment

4.1 How do I use an escape device?

Is there a risk at your workplace of chemicals suddenly entering the air? Or of there not being enough oxygen in the air? Then you should always play it safe and carry an escape device with you. It can save your life in an emergency, as it provides you with clean air on the way out.

Escape equipment must meet certain requirements. These are governed by EN 529.

What types of self-contained escape devices are there?



KO$_2$ SELF-RESCUER

4.2 How do I use a KO$_2$ self-rescuer?

KO$_2$ self-rescuers, or chemical oxygen self-rescuers, are regeneration escape devices in accordance with EN 401. The substance of the chemical cartridge is made of potassium superoxide (KO$_2$).

Functionality:

(1) A chlorate starter provides enough oxygen for the first few minutes before the subsequent reaction starts.

(2) The humidity of the exhaled air (H_2O) transforms the KO$_2$ into oxygen (O_2) and potassium hydroxide (KOH):
$KO_2 + H_2O \rightarrow 2\ KOH + 1.5\ O_2 + \text{heat}$

(3) The potassium hydroxide in turn binds the carbon dioxide (CO_2) in the exhaled air:
$KOH + CO_2 \rightarrow K_2CO_3 + H_2O + \text{heat}$

(4) Excess oxygen escapes into the ambient air via a pressure relief valve. The resulting heat is dissipated through a radiator.


D-17070-2010

1. Intake of breath from the starter


D-17071-2010

2. First exhalation into the breathing bag


D-17072-2010

3. Inhalation from the breathing bag


D-17073-2010

4. Exhalation with release of excess

COMPRESSED-AIR ESCAPE DEVICE

4.3 What are compressed-air escape devices?

These devices are small, portable air cylinders that provide the wearer with fresh air for 10 to 15 minutes – depending on the cylinder size. The requirements for compressed-air rescuers are set out in EN 402/EN 1146.

ST-225-2000

How it works:
Fresh air is available from the small compressed-air cylinder, either via a hood or a full-face mask with regulator. If the air supply is almost exhausted, a warning whistle sounds, which means the user knows he must now find a safe environment as quickly as possible.

What are the advantages of each escape device?

Compressed-air escape device with hood:
- Easy to put on – even by inexperienced users
- Fits regardless of shape of face: also suitable for glasses and beards
- Constant flow rate (disadvantage: higher air consumption)

Compressed-air escape device with excess pressure and full-face mask:
- High sealing capacity
- Lower air consumption for users who are accustomed to wearing full-face masks
- Possible to wear protective helmets and ear protection

FILTERING ESCAPE DEVICES AND HOODS

4.4 When is a filtering escape device sufficient?

Filtering escape hoods are closed-head hoods with an integrated filter that prevents the ingress of toxic substances in the event of e.g. fires and explosions. However, in contrast to self-contained breathing apparatus, an escape hood does not protect against oxygen deficiency in the ambient air. Filter devices are only made up of the filter and a mouthpiece.

Filtering escape hood and devices are affordable, easy-to-use solutions if the type, properties and composition of the possible contaminant is known. They are ready to use straight from the packaging and suitable even for inexperienced users.

Depending on the filter used, filtering escape hoods protect against:

Filters	Application
ABEK P3 Filter	Protection against toxic industrial gases, vapours and particles
CO P2 Filter	Protection against toxic fire-related gases, vapours and particles, additionally tested for use against H_2S (at 2,500 ppm) in accordance with DIN 58647-7
ABEK CO P3 Filter	Protection against toxic industrial gases, vapours, particles and fire-related gases

D-84575-2013

Open the packaging

D-84596-2013

Put the hood on

D-84604-2013

Leave the hazardous area

D-830029-2013

4.5 An overview of escape equipment by Dräger

yourself during an evacuation?

Ambient air independent

Emergency escape breathing devices (EEBDs)

Dräger Saver CF

Dräger Saver PP

Oxygen self-rescuers

Dräger Oxy K 30 HS / HW

Dräger Oxy 3000 / 6000

5 Eye Protection

DRÄGER X-PECT 8000

5.1 The protective eyewear collection from Dräger

Whether in the laboratory, when grinding or painting, when handling gases, vapours or smoke, or when faced with UV radiation in your free time, your eyes are exposed to a large number of risks in everyday life. In just a few seconds, irreparable damage can be caused to the retina, lens or optic nerve – and dramatically change the rest of your life.

These risks can damage your eyes:

- Mechanical: dust, invasive foreign bodies (e.g. splinters or sparks)
- Chemical: gases, vapours, droplets, splashes
- Visual: e.g. UV radiation

Dräger X-pect 8000: the right protection for every situation

Dräger X-pect 8000 protective eyewear protects your most important sensory organ. From a range of 10 models including cover spectacles, spectacles and goggles, you're certain to find the right one for you – for both professional and private use.

Every fifth injury is to the eyes

Did you know that one in five industrial injuries concerns the eyes? Almost 100% of these accidents could have been avoided. Often all that's needed is to wear a pair of well-fitting, stable protective glasses or goggles.

An overview of the protective eyewear range by Dräger

Type	Use	Model
Cover spectacles	Protection that fits over prescription glasses	Dräger X-pect 8110 Dräger X-pect 8120
Spectacles	Protection in approximately 75% of all industrial applications	Dräger X-pect 8310 Dräger X-pect 8320 Dräger X-pect 8330 Dräger X-pect 8340
Goggles	Increased protection in more dangerous conditions	Dräger X-pect 8510 Dräger X-pect 8520

This is what you can expect from the Dräger X-pect 8000 protective eyewear range:

High level of wearing comfort

- No restriction of activities
- Lightweight material
- Ergonomic design
- Large field of vision
- Individually adjustable (most models)
- Can be comfortably combined with other personal protection equipment, particularly respiratory protection by Dräger (e.g. the filtering face-pieces X-plore 1300 and X-plore 1700 or the half masks X-plore 3000 and X-plore 4000)

Tested for safety

- CE certified in accordance with EN 166 (European Standard for Personal Eye Protection)
- Highest optical quality: class 1
- Highest UV protection: 99.9%
- Anti-scratch and anti-fog coating (most models): clear vision even in extreme situations

Lens quality is defined by its optical class

Class	Quality	Application
1	Highest	For continuous work
2	Medium	For intermittent work
3	Low	For occasional work

Design

– Modern, sporty look – for industrial, trade or private use

Lens colours – which one is the right one?

Lighting conditions vary from one application to the next. Lens colours therefore play an important role when selecting your spectacles.

Clear: maximum light transmission; for general purpose use

Yellow: offers enhanced contrast in poorly lit conditions

Grey: reduces eye fatigue; for use in glare conditions or sunlight

SYMBOLS AND MARKINGS

5.2 What do the symbols and markings mean?

Symbols: Functions and properties

Anti-scratch coating
Long service life

Anti-fog coating
Clear vision

Weight
Lightweight

Polycarbonate
Unbreakable

Acetate
Chemical resistant

Aerosols, liquids, gases
Comprehensive protection

Soft temple tips
Pressure-free

Clip-cord option
For optional neck strap

Fits with prescription glasses
Excellent vision

Adjustable temples
Adjustable fit

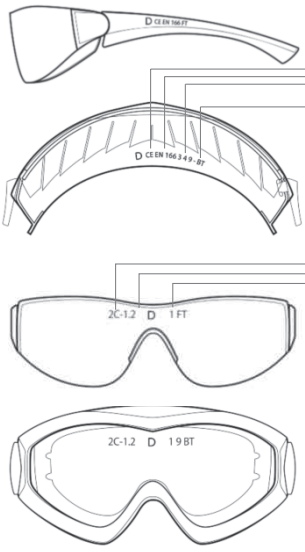
Adjustable temple length
Adjustable fit

Soft nose bridge
Pressure-free

Spectacles and respiratory protection fit together
Best protection and wearing comfort

Packaging unit:
– 5 pieces per box
– 6 pieces per box
– 10 pieces per box

Markings:



CE
Symbol of conformity to
EU standards
EN 166
European standard for personal eye protection

Symbols for field of use
(eyewear with full field of vision)
3 Droplets and splashes of liquids
4 Large dust particles
5 Gas and fine dust particles
8 Electric arc
9 Molten metals and hot solids
Mechanical strength
S Increased robustness
FT Low-energy impact
(45 m/s) even at temperature extremes
(-5° C to 55 °C)
BT Medium-energy impact
(120 m/s), even at extreme temperatures
(-5° C to 55 °C)
Followed by the name of the individual models

Filter type
2 UV filter
2C UV filter with good colour perception
4 Infrared filters
5 Glare filters
6 Glare filter with IR specification
Protection level number
1.2 Clear or amber (yellow)
1.7 Indoor/outdoor use
2.5 Bronze or smoky grey
3.1 Red mirror

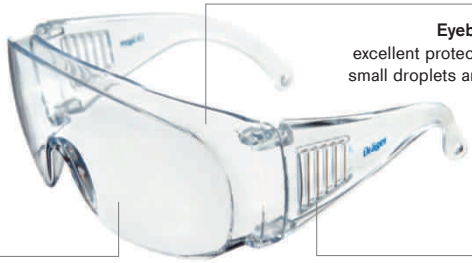
Visual class
1 Highest quality: for continuous use
2 Medium quality: for frequent use
3 Low quality: for occasional use

COVER SPECTACLES X-PECT 8110

5.3 One for everyone: perfect protection for visitors and many applications

Advantages at a glance:

- Suitable for almost every shape of face
- Can be worn with or without prescription glasses
- Very large field of vision
- Very easy to use – even by inexperienced users
- Clip-cord option: for an optional neck strap (spectacles within reach at all times)



D-33519-2009

Eyebrow guard:
excellent protection against small droplets and splashes

Robust polycarbonate lens:
for long service life

Lateral ventilation slots:
prevent fog on prescription glasses

Particularly suitable for the following application areas (examples):

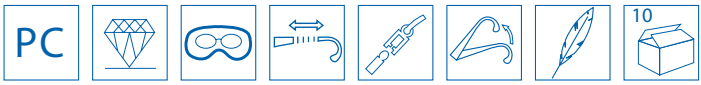
- Visitors to industrial plants (all sectors)
- Construction and agriculture
- Medical assistance and emergency personnel

TECHNICAL DATA

Lens material	Polycarbonate
Frame material	Polycarbonate
UV protection	99.9%
Lens colour	Clear
Anti-scratch coating	–
Anti-fog coating	–
Weight:	45 g

ORDER INFORMATION

No. of pieces per box	Order no.
10	R 58 247



COVER SPECTACLES X-PECT 8120

5.4 The all-rounder: very robust and adaptable to every face shape

Advantages at a glance:

- Very big field of vision
- Can be worth with or without prescription glasses
- Highly adjustable for optimum wearing comfort
- Only 43 g in weight
- Clip-cord option: for an optional neck strap (spectacles within reach at all times)

Particularly suitable for the following application areas (examples):

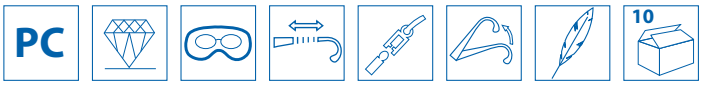
- General industry
- Maintenance, construction and agriculture
- Laboratory and pharmaceutical environments

TECHNICAL DATA

Lens material	Polycarbonate
Frame material	Nylon
UV protection	99.9%
Lens colour	Clear
Anti-scratch coating	Yes
Anti-fog coating	–
Weight:	43 g

ORDER INFORMATION

No. of pieces per box	Order no.
10	R 58 248



SPECTACLES X-PECT 8310

5.5 Sporty design with universal fit

Advantages at a glance:

- Available with clear or yellow lenses
- Comfortable to wear
- Excellent unisex design
- Extremely lightweight: only 24 g

D-33518-2009

Flat temples:
Hearing protection or helmet can be worn comfortably together with protective eyewear, excellent fit without pressure

Universal nose bridge: suitable for almost every shape of nose, can be combined with respiratory protection

Polycarbonate lens and temples:
for a long service life

9.75 curve:
All-round protection, first class fit and large field of vision

Particularly suitable for the following application areas (examples):

- General industry
- Laboratory and pharmaceutical environments
- Maintenance and servicing
- Medical assistance and emergency personnel
- Visitors to industrial plants
- Sport and private use

D-33517-2009

with yellow lens, enhanced contrast

TECHNICAL DATA	
Lens material	Polycarbonate
Frame material	Polycarbonate
UV protection	99.9%
Lens colour	Clear or yellow
Anti-scratch coating	Yes
Anti-fog coating	Yes
Weight:	24 g

ORDER INFORMATION	
Number of pieces per box	Order no.
10 (clear)	R 58 249
10 (yellow)	R 58 266

SPECTACLES X-PECT 8320

5.6 Ultra-light for extended use

Advantages at a glance:

- For intensive use
- New generation – wrap-around, modern design
- Ultra-lightweight: only 21 g for extended use
- Available with clear or grey lenses

D-33520-2009

Flexible temples: minimum pressure on the head and excellent fit

Soft nose bridge for high wearer comfort: a good fit for every nose

Polycarbonate lens: very robust

9.5 curve: Perfect all-round protection and a large field of vision

Particularly suitable for the following application areas (examples):

- General industry
- Laboratory and pharmaceutical environments
- Maintenance and servicing
- Medical assistance and emergency personnel
- Extreme temperatures (heat or cold)

D-33526-2009

with grey lens, under glare conditions

TECHNICAL DATA

Lens material	Polycarbonate
Frame material	Polycarbonate
UV protection	99.9%
Lens colour	Clear or grey
Anti-scratch coating	Yes
Anti-fog coating	Yes
Weight	21 g

ORDER INFORMATION

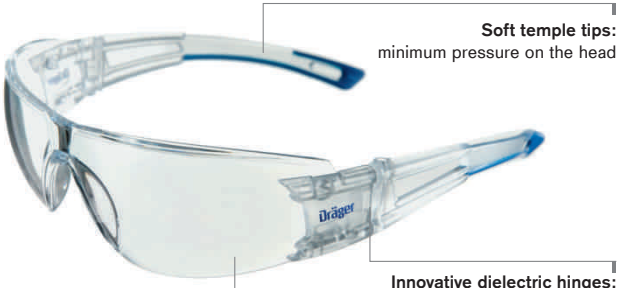
No. of pieces per box	Order no.
10 (clear)	R 58 268
10 (grey)	R 58 269

SPECTACLES X-PECT 8330

5.7 The individualist: all-round protection, metal-free, adjustable temples

Advantages at a glance:

- Metal-free for safe working in high-voltage environments
- Adjustable to suit individual shapes of face
- Innovative lens-pivoting system



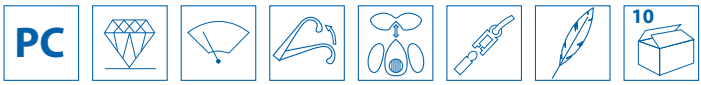
D-33521-2009

Particularly suitable for the following application areas (examples):

- General industry (not food industry)
- Laboratory and pharmaceutical environments
- Medical assistance and emergency personnel
- Construction
- Work in high-voltage environments (e.g. electricians, lift maintenance, etc.)

TECHNICAL DATA	
Lens material	Polycarbonate
Frame material	Polycarbonate
UV protection	99.9%
Lens colour	Clear
Anti-scratch coating	Yes
Anti-fog coating	Yes
Weight:	27 g

ORDER INFORMATION	
No. of pieces per box	Order no.
10	R 58 267



SPECTACLES X-PECT 8340

5.8 Individual safety that makes a clear design statement

Advantages at a glance:

- For extended use – inside and outside
- Sporty, classic design for those who want to be safe and trendy at the same time

Particularly suitable for the following application areas (examples):

- General industry
- Laboratory and pharmaceutical environments
- Construction, maintenance, servicing
- Lorry drivers, couriers
- Logistics
- Outdoor work

TECHNICAL DATA

Lens material	Polycarbonate
Frame material	Nylon
UV protection	99.9%
Lens colour	Clear
Anti-scratch coating	Yes
Anti-fog coating	Yes
Weight:	27 g

ORDER INFORMATION

Number of pieces per box	(Order no.
10	R 58 270

GOGGLES X-PECT 8510 / 8515

5.9 Robust with polycarbonate or acetate lens

Advantages at a glance:

- A choice of two different lens materials:
  1) robust polycarbonate lens with indirect ventilation, 2) chemical-resistant acetate lens without ventilation for safe working in chemical environments
- Large field of vision and safe, all-round protection thanks to wrap-around design
- Can be combined with other personal protection equipment (e.g. half masks)
- Fits with prescription glasses

D-33527-2009

Soft, flexible PVC frames:
optimal fit for users

Rotatable buckle and wide strap:
easy to adapt to all head sizes

Particularly suitable for the following application areas (examples):

- Chemical environments
- Laboratory and pharmaceutical environments
- Petrochemical industry
- Emergency and first-response personnel

D-33527-2009

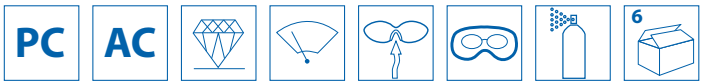
With acetate lens

TECHNICAL DATA

Lens material		Polycarbonate or acetate
Frame material		PVC
UV protection		99.9%
Lens colour		Clear
Anti-scratch coating		Yes
Anti-fog coating		Yes
Weight	X-pect 8510	101 g
	X-pect 8515	86 g

ORDER INFORMATION

Number of pieces per box		Order no.
6	X-pect 8510 PC lens	R 58 373
6	X-pect 8515 AC lens	R 58 271



GOGGLES X-PECT 8520

5.10 Premium protection: a modern design for optimum all-round protection

Advantages at a glance:

- Modern, highly ergonomic design
- Wrap-around design for safe fit and protection
- Can be combined with other personal protection equipment (e.g. half masks)
- Fits perfectly with prescription glasses

D-27829-2009

Soft eyebrow guard:
additional protection against dust and chemical splashes

Optimally curved frame:
for a large, undistorted field of vision

Wide strap:
easy to adapt to all head sizes

Particularly suitable for the following application areas (examples):

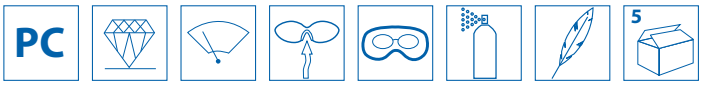
- Chemical environments
- Laboratory and pharmaceutical environments
- Petrochemical industry
- Emergency and first-response personnel

TECHNICAL DATA

Lens material	Polycarbonate
Frame material	PVC
UV protection	99.9%
Lens colour	Clear
Anti-scratch coating	Yes
Anti-fog coating	Yes
Weight:	88 g

ORDER INFORMATION

Number of pieces per box	Order no.
10	R 58 272



INCREASED PROTECTION: MASKS AND FILTERS

5.11 Good protection fits you and fits together

Whenever you have to protect your eyes at work, most situations require that you protect your respiratory system as well (and vice versa). One of the most important factors for safety and wearing comfort is the compatibility of protective eyewear with respiratory protective masks. This is why Dräger, when creating the X-pect protective eyewear series, placed great emphasis on achieving the best-possible dovetailing of spectacles and masks at key points. For maximum safety and optimum wearing comfort.

Disposable mask series Dräger X-plore® 1300

- Effective protection against fine dust as well as solid and liquid particles
- Specially moulded mask body
- Proven and reliable
- Maximum comfort
- User-friendly
- Available in all three EN protection classes FFP1, FFP2 and FFP3

Disposable mask series Dräger X-plore® 1700

- Effective protection against fine dust particles, solid and liquid particles in a wide range of application areas
- COOLSAFE™ filter material: for effective protection
- COOLMAX™ exhalation valve: for light and easy breathing

Twinfilter series Dräger X-plore® 3000

Flexible protection for users in a wide range of application areas.

Dräger X-plore® 3300 half mask:

- Low maintenance
- Affordable and comfortable

Dräger X-plore® 3500 half mask:

- For demanding, continuous use
- Specially equipped with comfortable DrägerFlex material

5.12 An overview of protective eyewear by Dräger

From which risks do you want to protect your eyes?

Particles

Cover spectacles

Dräger X-pect 8110

Dräger X-pect 8120

Spectacles

Dräger X-pect 8310

Dräger X-pect 8320

Dräger X-pect 8330

Dräger X-pect 8340

Dräger X-pect 8351

Particles, gases, vapours

Goggles

Dräger X-pect 8510

Dräger X-pect 8520

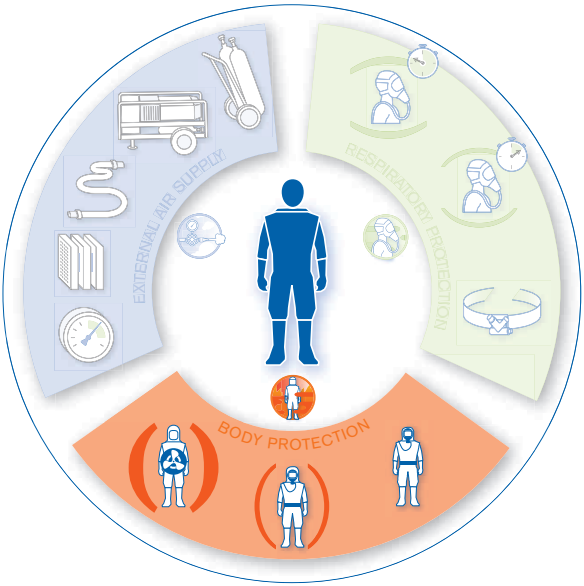
6 Chemical Protection Suits

6.1 Safe from head to toe

Whether as liquids, solids or gases: chemicals in the air can irritate the skin, damage the body or enter it via the skin – with potentially serious consequences for your health. You should therefore protect your skin and that of your employees thoroughly from hazardous substances in the workplace, for example with protective spectacles, gloves, boots and aprons, or with the complete form of body protection: a chemical protective suit. But what protection is appropriate for your application area?

The right choice of protective clothing depends on three factors:

- The chemicals in your workplace
- Your work
- The ambient conditions



PERFORMANCE REQUIREMENTS

6.2 What are the requirements of chemical protection suits?

In terms of mechanics, chemical protection suits must be, for example, abrasion-proof, tear-resistant and puncture-resistant. Chemically, they must be able to resist the penetration of hazardous substances.

Performance types of chemical protection suits:
Depending on the resistance, chemical protection suits can be classified into different performance types, for which they undergo rigourous testing.

Type 1	Gas tight	Type 1a	Self-contained breathing apparatus worn on the inside
		Type 1b	Self-contained breathing apparatus worn on the outside
		Type 1c	Air supply via a compressed-air hose system
Type 2	Non-gas tight		Air supply via a compressed-air hose system
Type 3	Liquid proof		
Type 4	Spray proof		
Type 5	Particle protection		
Type 6	Spray proof to a limited extent		

What standard applies to chemical protection suits?
Different levels of requirements apply for chemical protection suits, depending on the performance type. The are specified in the following standards:
- EN 943-1: Type 1a, 1b, 1c and 2
- EN 943-2: Type 1a ET and Type 1b ET (for emergency teams)
- EN 14605: Type 3 and 4
- EN ISO13 982-1:2005: Type 5
- EN 13 034:2005: Type 6

Is disposable protective clothing subjected to the same high requirements as reusable protective clothing?
No. The standard distinguishes between these two forms of protective clothing. Mechanical resistance and flame resistance must be significantly higher for reusable protective suits.

MATERIALS

6.3 What constitutes good protection material?

As a rule of thumb, the longer a chemical needs to penetrate a material, the more effective the chemical protection of the material. Resistance to permeation is therefore an important test criterion under EN 943-1 and EN 943-2.

A measure of safety: penetration time

In order to discover how long a material can withstand the penetration of a particular chemical, the penetration time, i.e. how long it takes for a certain concentration of the chemical to penetrate from the outside in, is measured. This penetration time is one of the most important core values for the operating time of a chemical protective suits.

In accordance with DIN-EN ISO 6529 test procedures, chemical protective suits are divided into six classes depending on their penetration time:

Suit class	Penetration time	Suit class	Penetration time
1	> 10 min	4	> 120 min
2	> 30 min	5	> 240 min
3	> 60 min	6	> 480 min

How can I ensure that my chemical protective suit can withstand a particular hazardous material? Always check before use whether the selected suit has sufficient resistance against the particular hazardous substance. The information you need is given in the manufacturer's resistance list. The test requirements on which resistance lists are based are considerably stricter than conditions in the workplace.

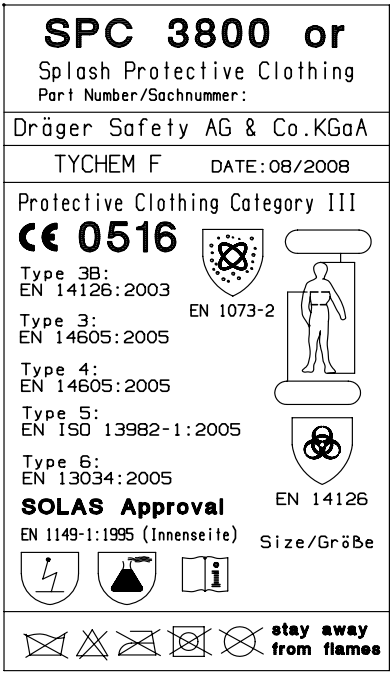
MARKINGS

6.4 What information does the labelling on a chemical protective suit provide?

Among other things, the identification plate inside the suit provides information about:

- Manufacturer, trade name
- Classification (type)
- Suit size
- Performance types and the corresponding EN standards
- Use and care instructions
- Additional permissions

Sample identification plate:



The symbols have the following meanings:


Protective clothing against radioactive contamination.


Protective clothing against infectious agents.


Protection against electrostatic charge in accordance with EN 1149-1:1995


Protective clothing against chemicals.


Attention! Follow the instructions for use.


Do not wash!


Do not bleach!


Do not iron!


Do not dry in dryer!


Do not clean using chemicals!

Avoid open flames!

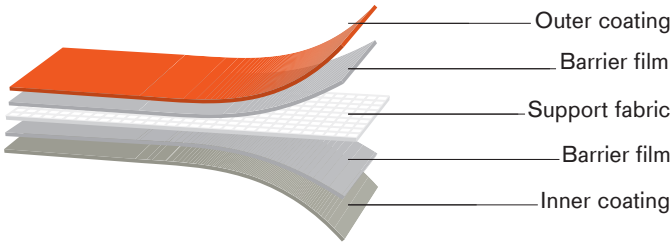
MATERIALS

6.5 Gas-tight materials (Type 1)

D-MEX –

Maximum protection even in the severest of conditions

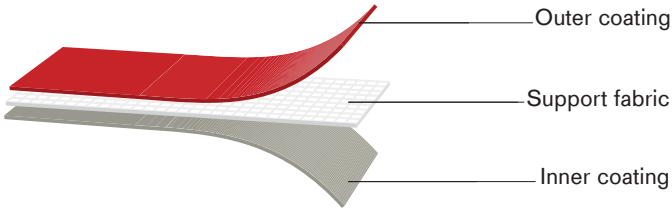
- Reusable
- Mechanically extremely strong and resilient but light and flexible
- Highest penetration times against industrial chemicals, warfare agents, etc.
- Does not become brittle in contact with supercooled materials
- Flame retardant and self-extinguishing even in open flames



SYMEX –

Good resistance against acids, alkalis and oils

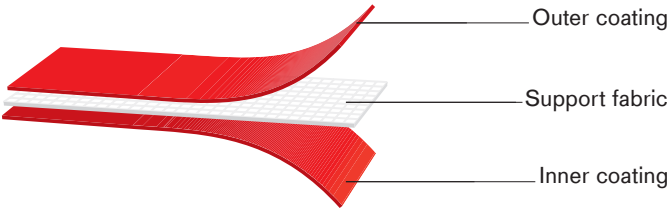
- Reusable
- Lightweight material
- Highly abrasion-resistant and flexible



UMEX –

Particularly suitable for work involving chlorine and ammonia

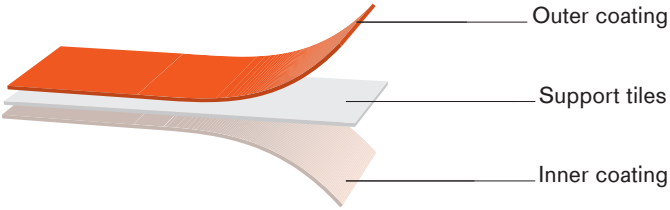
- Reusable
- Lightweight, soft material
- Does not become brittle in contact with supercooled materials



ZYTRON 500 –

High level of protection against various hazardous goods

- Disposable material for work with low mechanical stress
- Flexible and very light, so offers a high level of wearing comfort
- High penetration times for industrial chemicals and warfare agents



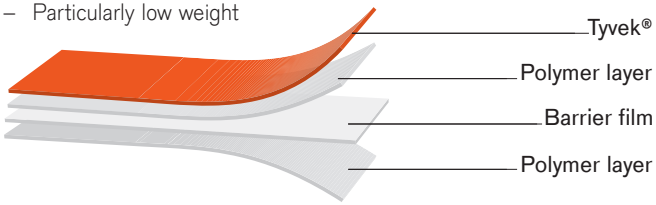
MATERIALS

6.6 Liquid-proof materials (Type 3)

TYCHEM F –

Ideal for handling liquids and solids

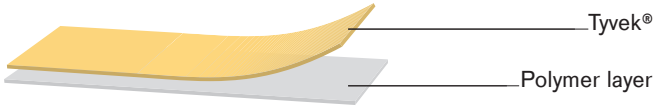
– Disposable material for work with low mechanical stress
– Good protection against organic and highly concentrated inorganic hazardous substances
– Particularly low weight



TYCHEM C –

Ideal for use with infectious agents and acids

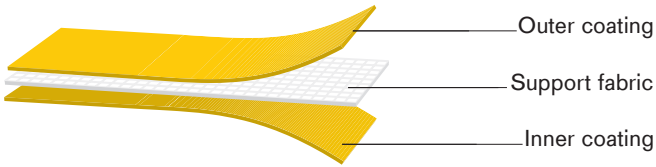
– Disposable material for work with low mechanical stress
– Particularly low weight



PVC –

Good protection against low concentrations of acids and alkalis

– Reusable
– Highly flexible and tear-resistant
– Liquid proof, even in strong liquid jets (e.g. pressure washers)



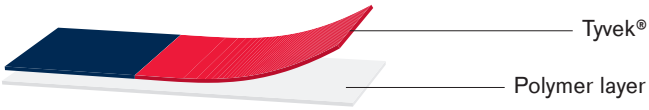
MATERIALS

6.7 Spray-proof materials (Type 4)

FLEXOTHANE –

Good protection against crude oil, machine oil, kerosene, paint and dust

- Reusable
- Lightweight and flexible
- Water vapour permeable



ACCESSORIES

6.8 What accessories do I need for a chemical protective suit?

Boot and gloves

Boots and gloves are necessary when handling hazardous materials. If they're not integrated into the chemical protective suit, you should look for the following points when making your choice:

- Appropriate safety class for dealing with the particular chemical
- Easy to don and doff

Useful information

For reasons of hygiene, it is advisable to wear cotton gloves. Over-gloves protect the actual protective glove against mechanical influences.

Ventilation systems

Wearing a suit is heavy physical work. Temperature and humidity rise quickly inside the suit, which increases the risk of heart and circulatory failure. In order to reduce the inside temperature, some suits have ventilation systems. This means that humid, warm air is extracted from the suit via a pressure-relief valve. The flow of fresh air from the external supply accelerates evaporation and provides a pleasant cooling effect.

Comfort vests

Inserting reusable cooling elements into a comfort vest or connecting the vest to a ventilation system can provide real relief, especially during longer usage.


ST-5692-2014


ST-15204-2010

D-4802-2010


D-37651-2015

CARE AND MAINTENANCE

6.9 Keeping equipment ready for use

In order to be able to fully rely on your protective suit the next time you use it, you must clean and maintain it thoroughly after each use and if necessary repair and inspect if. There are different cleaning methods depending on the degree of contamination.

Contamination can take different forms:

- Dust and particles stay adhered to the surface of the suit → adhesion
- Liquids or gases and vapours are absorbed by the suit material → absorption
- Liquids are deposited on the suit material → adsorption

How do I maintain and care for my chemical protective suit after working with hazardous substances?

You have to assume that the chemical protective suit is contaminated. You must therefore decontaminate your suit.

Care and maintenance equipment by Dräger

Dräger provides you with the complete range of care-and-maintenance equipment. For care and maintenance, you need:

- Special industrial washing machines
- Cleaning and disinfecting agents
- Drying systems
- Extensive testing equipment to check for functionality and leaks in accordance with EN 943 or other local requirements – for suits, masks and self-contained breathing apparatus

THE RIGHT CHOICE

6.10 Five questions to obtain the right protective suit

1. Which hazardous substances are you exposed to during your work?
   - If you know the hazardous substance, you can take concrete measures to protect yourself. The Dräger VOICE hazardous substances database tells you which suit protects you against which hazardous substance and for how long.
   - If you don't know the hazardous substance, always assume the worst-case scenario and select the next highest degree of protection.

2. Do you have to wear breathing apparatus during your work?
   - If no respiratory protection is needed, simple overalls or other protective clothing that shields you from the respective chemical agents will suffice.
   - If you work with filter equipment, it's best to use a suit equipped with integrated full-face mask or facial sleeve.
   - If you need an SCBA, ensure the equipment is comfortable to wear either over or under your protective suit.

3. What's your work environment like?
   - A traffic accident requires you to reach in between or handle sharp-edged objects. Here, or if your work environment is similarly unpredictable, you need a protective suit with a higher mechanical strength, such as a reusable model.
   - If damage is unlikely, you can also use a limited-use suit*.
   - When working in confined spaces, such as tanks with manholes, it is best to select a close-fitting suit and wear the SCBA over the suit. This way, the SCBA is easier to remove when going through narrow passages.

4. How easy is it to remove the pollution caused by the hazardous substance (decontamination)?
   - If the hazardous substance is difficult to remove from surfaces, you should wear a protective suit with the breathing apparatus worn on the inside. This way, you can protect it against contamination.

*Protective suit reusable only to a limited extent

5. What risks are the associated risks of working with the hazardous substance?
   - If it is a very cold hazardous substance, e.g. liquefied gas, the suit material must not become brittle or fracture when exposed to the cold.
   - If the hazardous substance is flammable at ambient temperatures, the protective suit must be flame-resistant.
   - If there is a risk of explosion in the area where the hazardous substance is leaking, the suit must have the relevant electrostatic properties.
   - If the hazardous substance is a toxic gas, only a gas-tight chemical protective suit should be used, never a splash-proof suit.

Chemical
Protective Suits

6.11 An overview of chemical protective suits by Dräger

From which hazardous materials

Solid and liquid chemicals

Disposable suits	Limited use	Reusable
		
Dräger Protec Plus TC	Dräger SPC 3800	Dräger WorkStar Flexothane
		
Dräger Protec Plus TF	Dräger SPC 3700	Dräger WorkStar PVC

do you want to protect yourself?

Gas*

Limited use

Dräger
CPS 5800

Reusable (SCBA outside)

Dräger
CPS 6800

Dräger
WorkMaster Industry

Dräger
CPS 7800

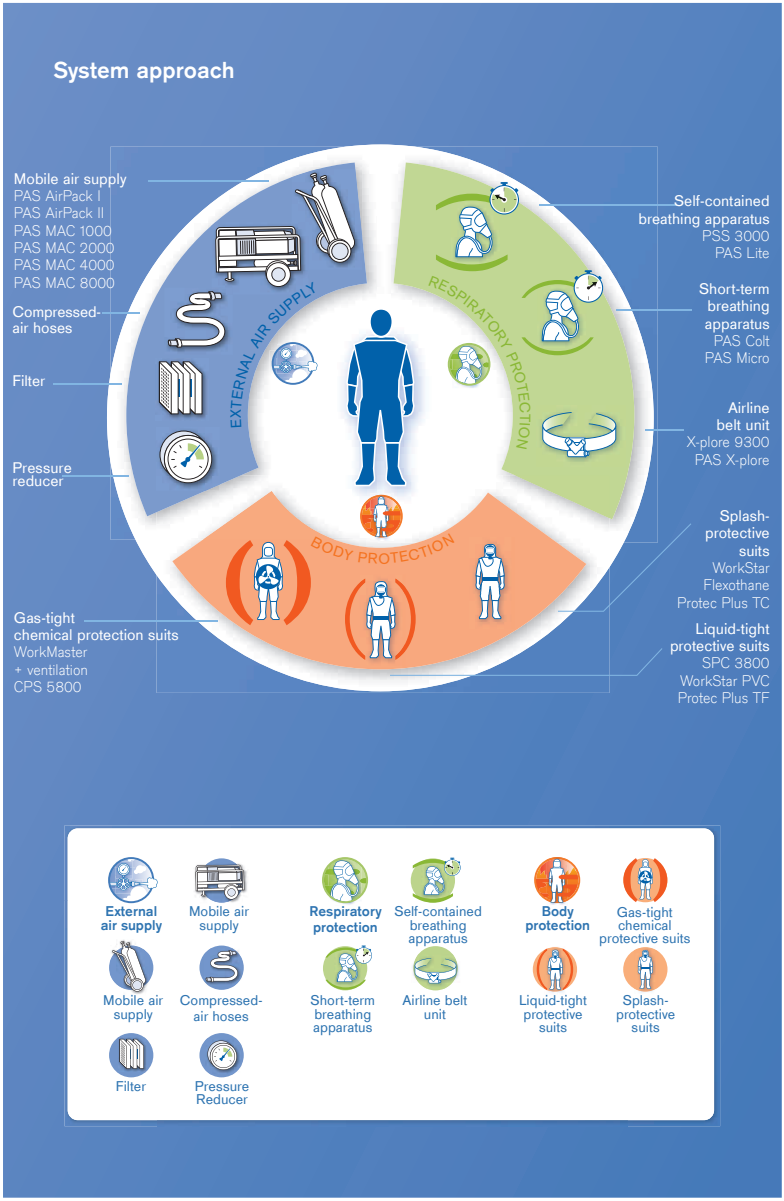
Reusable (SCBA inside)

Dräger
CPS 6900

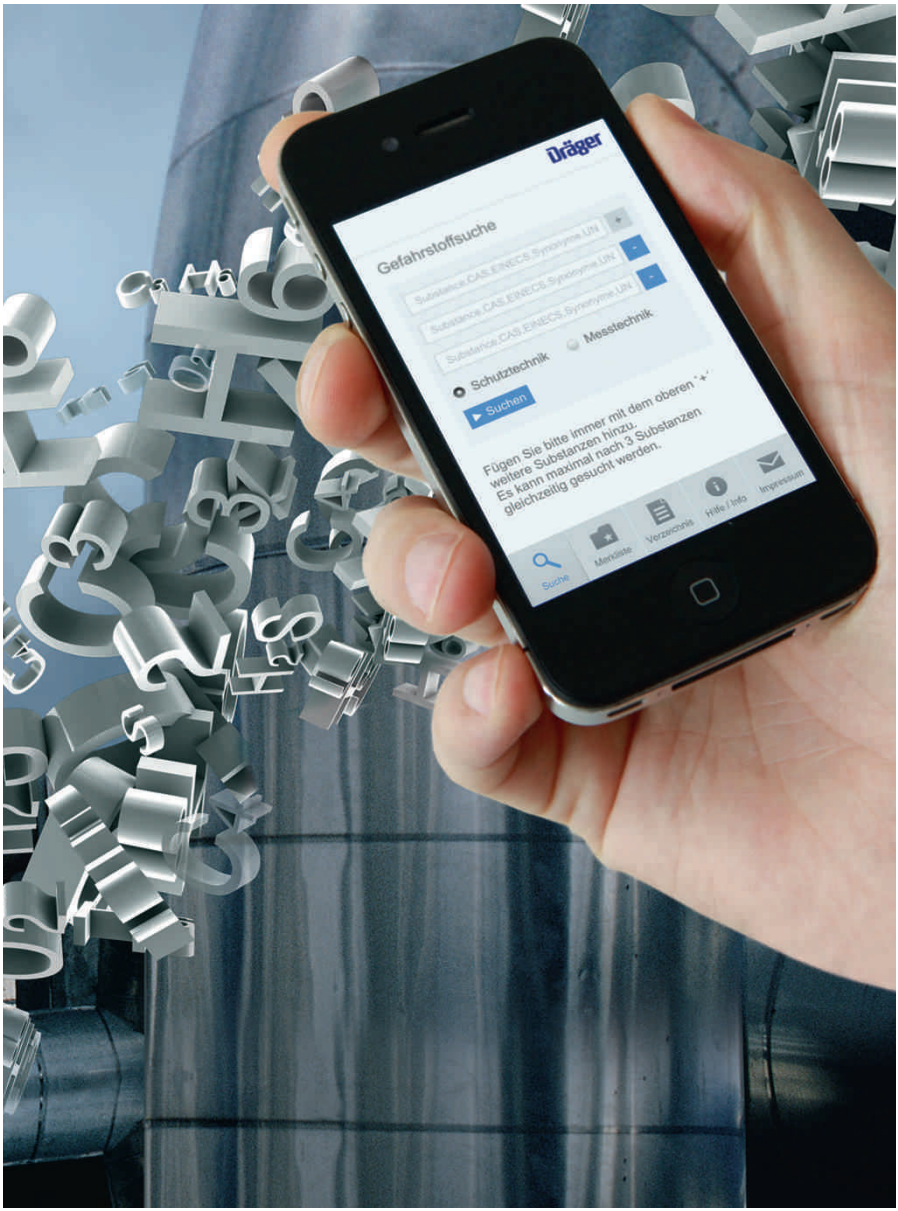
Dräger
CPS 7900

* Gas-tight chemical protective suits are also suitable to protect against solid and liquid chemicals

7 System Overview



8 Dräger VOICE®



VOICE® – THE DRÄGER HAZARDOUS SUBSTANCE DATABASE

8.1 Security information with a single click

The increasing technological orientation of our society means an increase in the number of different hazardous substances and consequently an increase in the risk to humans – both in the environment and at work. But what are the right protective measures you company needs to adopt and for which hazardous substances? Dräger VOICE® provides you with the wealth of information you need to ensure your safety. It's quick, comprehensive and available at any time.

What is VOICE®?

VOICE® is a vast online database of constantly updated information on more than 1,700 hazardous substances and 11,500 synonyms. With seconds, it makes a link between hazardous substances, measuring options and protective equipment. You can also get advice on how to how to use the equipment properly.
In each case, please compare the information with the latest instructions for use supplied with your equipment. The hazardous substance database is available on the Dräger website at **www.draeger.com/voice**

In VOICE®, you will find:

- Comprehensive chemical and physical information about substances
- German, English and American limit values
- R/S statements
- Information on measuring hazardous substances
- Help in selecting measurement and protection equipment including a search option
- Information on personal protection equipment
- Sampling recommendations to use in collection systems
- Additional information (e.g. instructions for use*)

*In each case, please compare the information with the latest instructions for use supplied with your equipment.

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