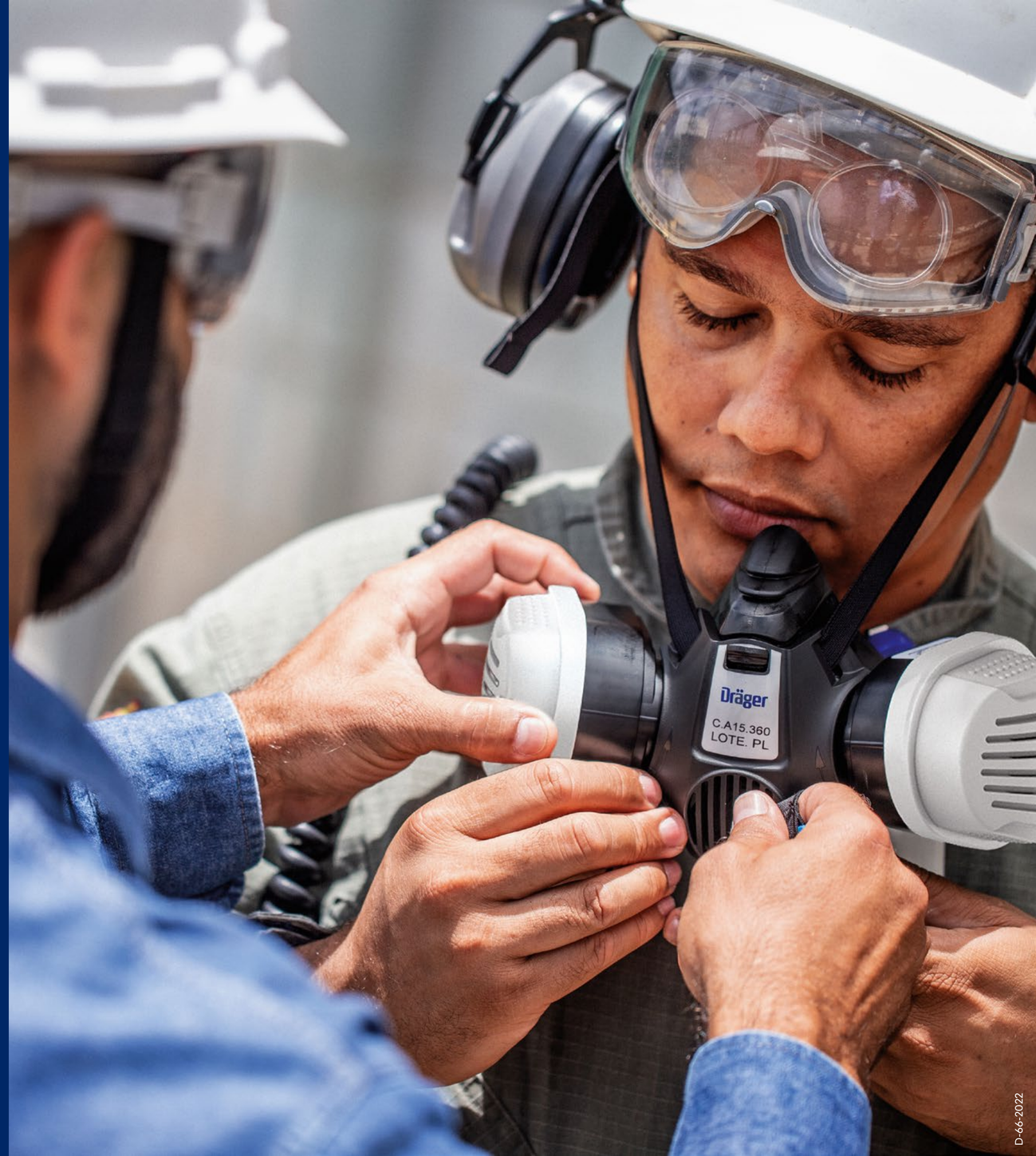
Selection Guide for Air-Purifying Respirators

Dräger

Technology for Life



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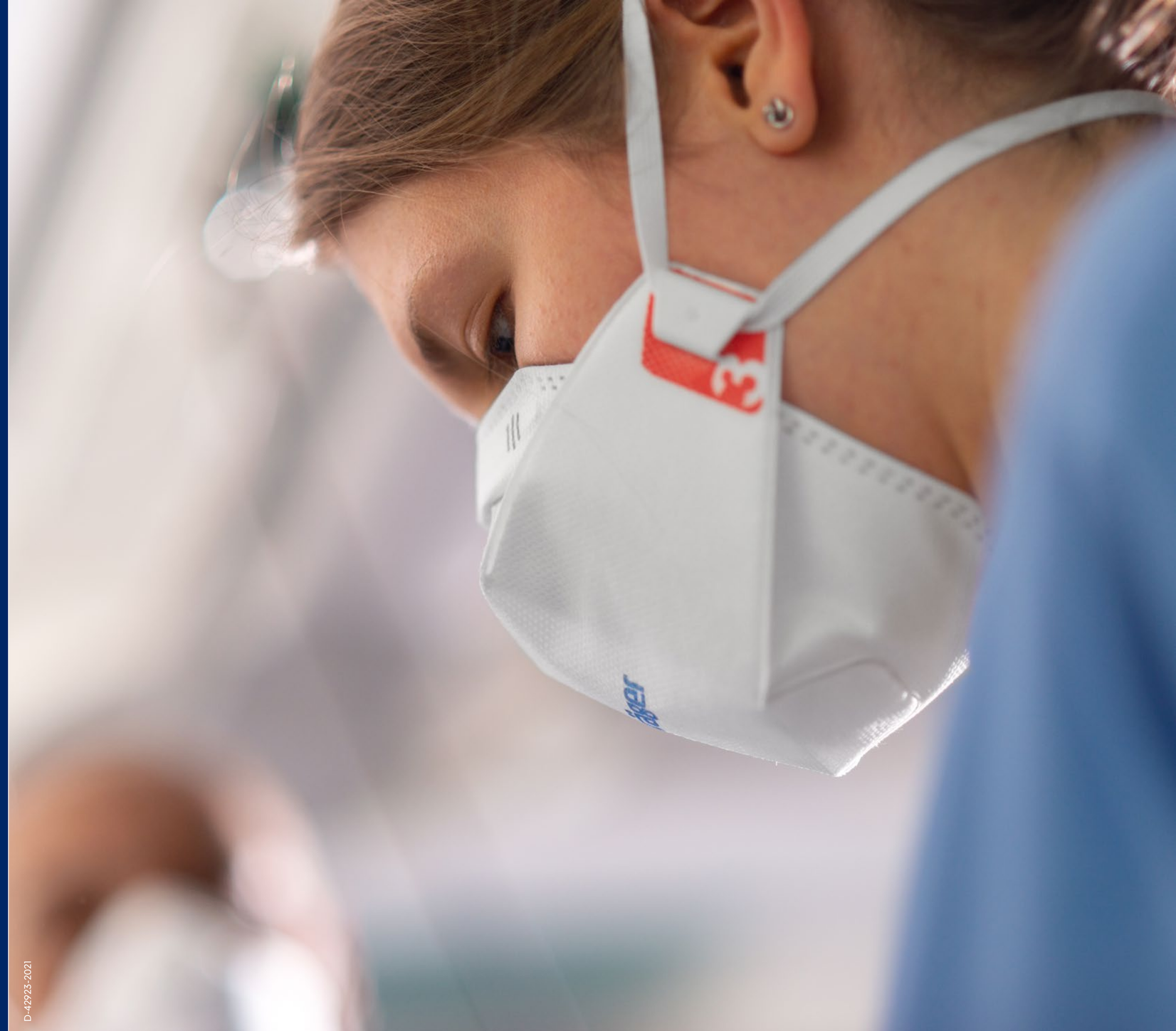
Information on selection & use

Is an air-purifying respirator (APR) / filtering 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, self-contained respiratory protection is required.

On the following pages you will find the corresponding requirements as well as recommendations for use of masks and filters.



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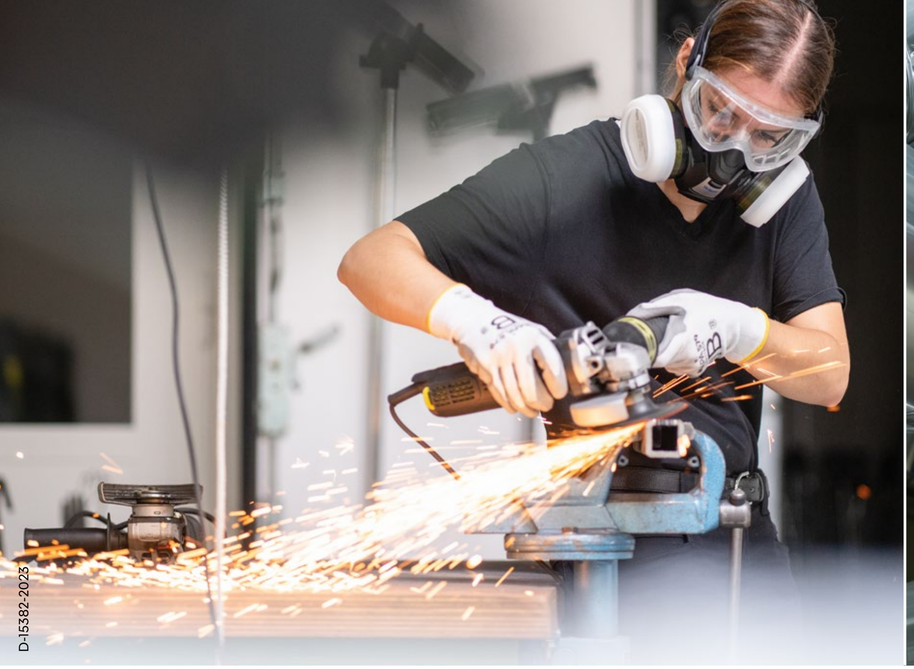
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When may a filtering device be sufficient?

- Oxygen content in the air is at least 17 Vol% (with CO filters at least 19 Vol% - values may be different in your country, see also your local legislative requirements)
- 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

When is a filtering device insufficient?

- 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 with half mask / FFP
Gases and vapours	Gas filter with half or full-face mask
Particles, gases and vapours	Combination filter with half or full-face mask
Oxygen deficiency and/or too high concentrations of substances	Self-contained respiratory protection

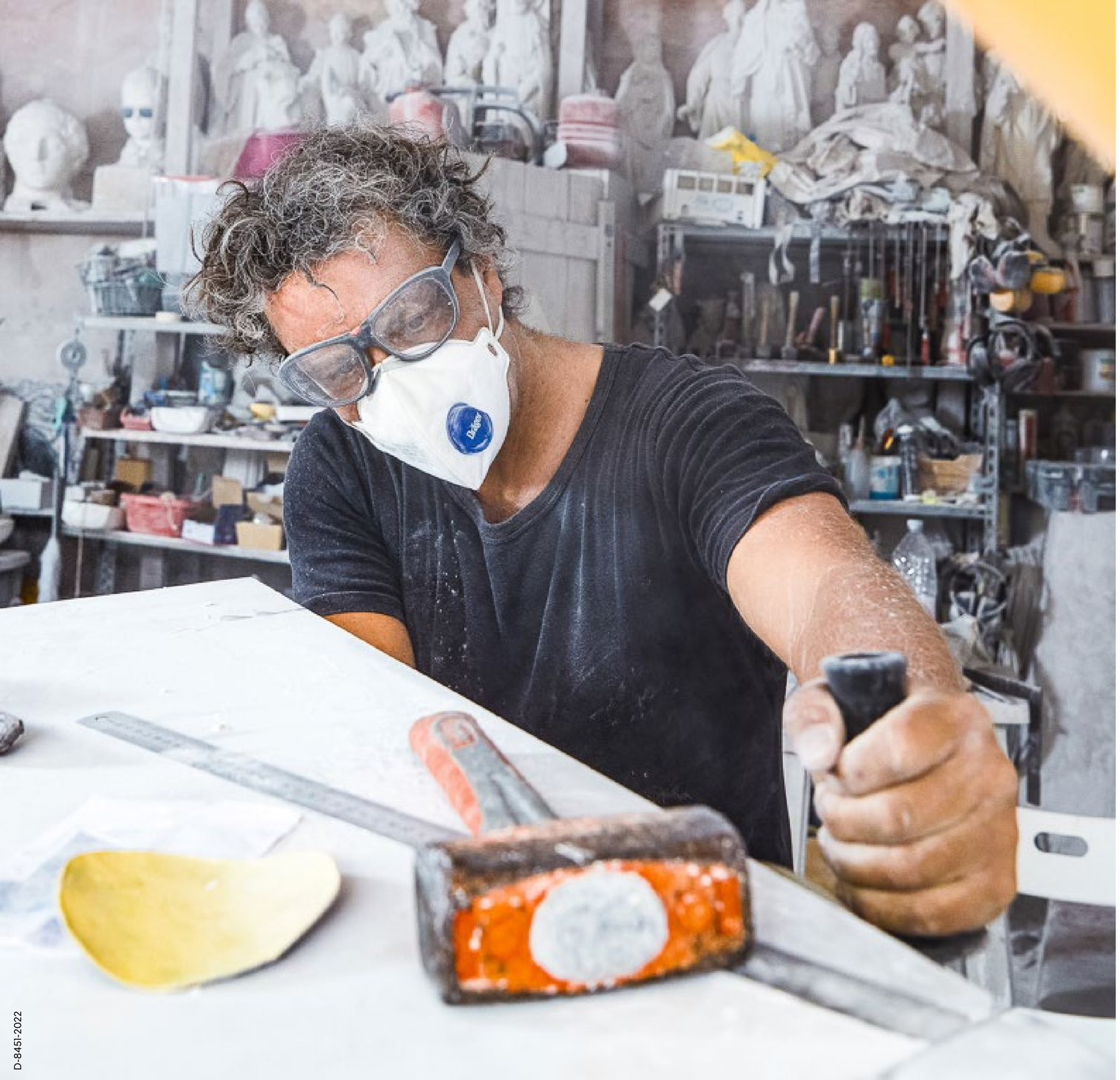
Choosing the right filter device

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 – e.g. in Germany a minimum of 17 Vol% is required)
- What contaminants are there in the ambient air?
- What are the concentrations of the contaminants?
- Are the contaminants in gas, particle, or vapour form? Or are they a mixture?
- Do the contaminants have adequate warning properties (e.g. smell or taste)?
- What are the applicable occupational exposure limits (OELs)?
- Is other personal protection equipment needed in addition to respiratory protection, e.g. eye or ear protection?



3. Which air-purifying respirator do I need?

After answering all the previous questions, the protection factor must be determined. This factor indicates the protection level expected by a certain class of respirators. There are different protection factors available: the Nominal Protection Factor (NPF) and the Assigned Protection Factor (APF).

The NPF was developed in laboratory tests. Therefore, this may not represent the true protection factor achieved by an individual in the workplace. These values are used more as a reference. The APF shows the realistic level of respiratory protection that can be achieved by 95 % of properly trained workers. If available, these APF values should be used when selecting respirators. Please note that the APF can vary greatly from country to country, as these are established at national levels.

In order to determine the minimum protection factor, the concentration and limit value of the contaminant are required. A limit value, or the 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 one´s health if exposed to it at that concentration on a daily basis.

The following table gives you a brief overview of the NPFs and APFs for each filter device.

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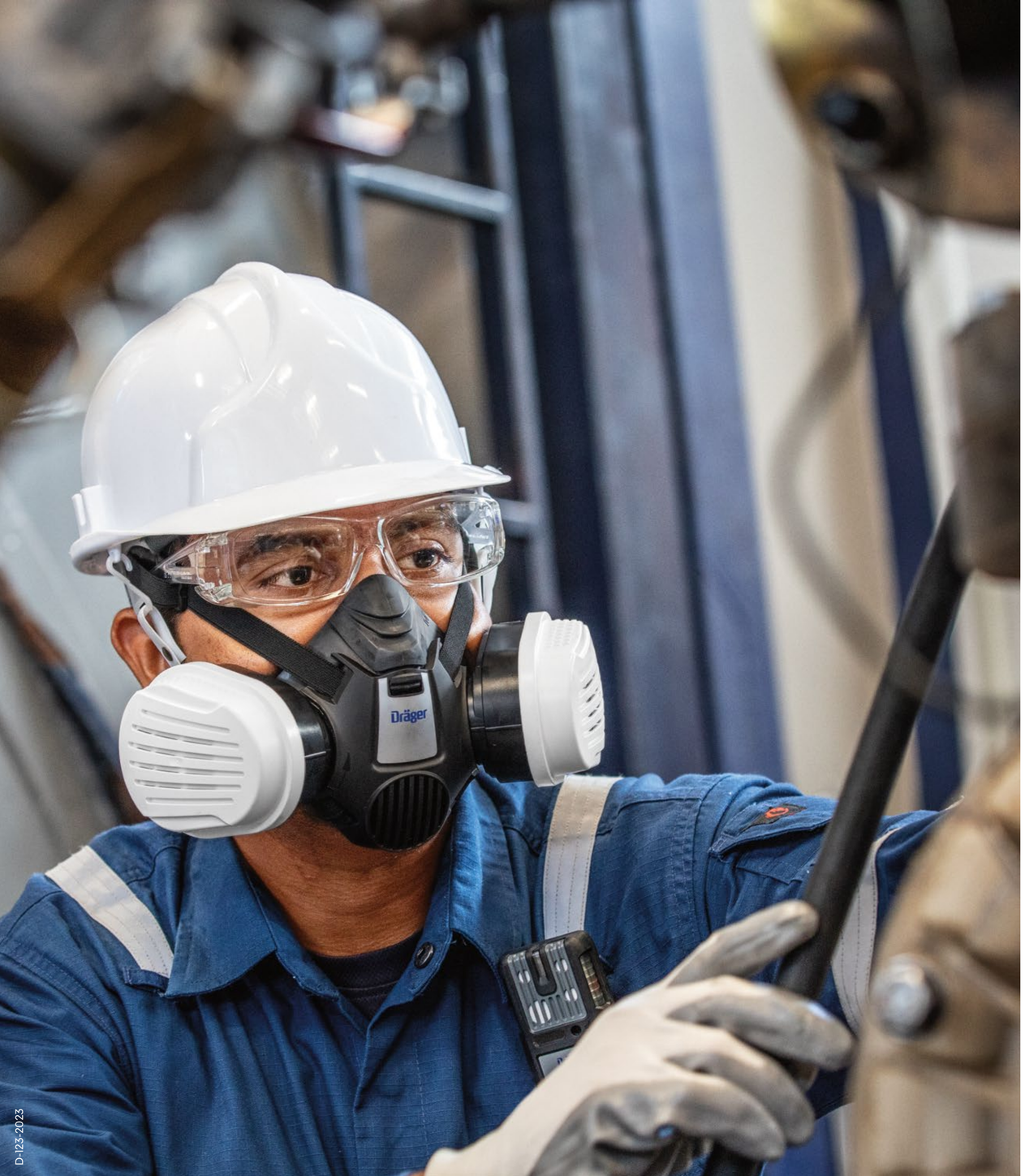
List of respiratory protection devices

Device	Description	NPF [1)]	APF DE	APF UK
Filtering half mask EN 149	FFP1 FFP2 FFP3	4 12 50	4 10 30	4 10 20
Half mask with filter EN 140	P1 P2 P3 GasX	4 12 48 50	4 10 30 30	4 10 20 10
Full-face mask with filter EN 136	P1 P2 P3 GasX	5 16 1,000 2,000	4 15 400 400	4 10 40 20
Air-purifying respirator with helmet or hood EN 12941	TH1 TH2 TH3	10 50 500	5 20 100	10 20 40
Air-purifying respirator with tight-fitting mask EN 12942	TM1 TM2 TM3	20 200 2,000	10 100 500	10 20 40

1) The values have been taken from the EN 529:2005. Other national or local guidelines must be followed. Please note that the performance indicated by the nominal protection factor can only be achieved with proper use and maintenance of the respirator in compliance with the instructions for use. The size must be suitable for your face, and the device may only be worn on clean-shaven faces, otherwise leaks can occur in the sealing line area.



Determining the required protection factor

Example: Lead dust is present as a contaminant in one of your applications. In order to determine the appropriate respiratory protection equipment and develop a protection concept, the corresponding protection factor must be calculated.

Determining the required protection factor	
Contaminant	Lead dust → particle protection required
Concentration at the workplace: Gases and vapours	3 mg/m³
Limit value (OEL)	0.1 mg/m³
Protection factor required	$\frac{\text{Concentration of contaminant}}{\text{OEL}} = \frac{3}{0.1} = 30$

So for this application with 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 m³ of ambient air) or in mg/m³ (= weight of a substance within 1 m³ of ambient air) and the concentration of particles (dust) only in mg/m³. As mg/m³ deals with weight and ppm with volume, mg/m³ cannot be directly converted into ppm. Higher concentrations are often given in % per volume, 10,000 ppm = 1 Vol%.

* The required filter and mask type may vary, depending on which national protection factor you use. For the example above the German APF of 30 was used.

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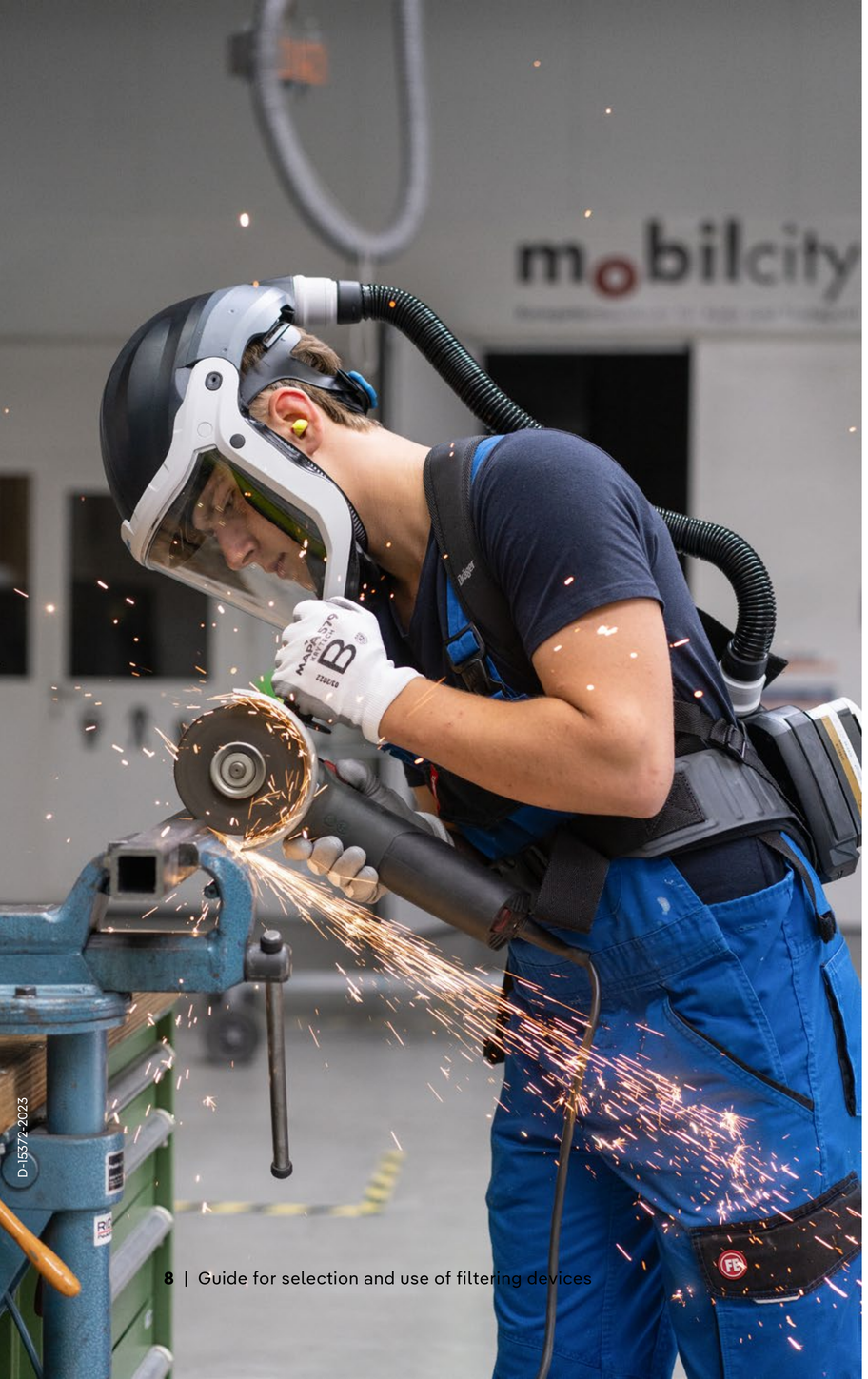

4. What is the maximum concentration of contaminants for which I can use the filter device?

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

Maximum permissible concentration = **Assigned Protection Factor (APF)** x **Occupational Exposure Limit (OEL)**

Example: Determining the maximum permissible concentration	
Contaminant	Mixture of potassium cyanide and hydrogen cyanide
Limit value (OEL)	0.9 ppm for hydrogen cyanide 1 mg/m³ for potassium cyanide
Respiratory protection:	Full-face mask with combination filter B P2
Factor × OEL =	Maximum permissible contaminant concentration
Factor for maximum permissible concentration of a full-face mask with gas filter:	400 x 0.9 ppm = 360 ppm Hydrogen cyanide
Factor for maximum permissible concentration of a full-face mask with particle filter:	15 x 1 mg/m³ = 15 mg/m³ Potassium cyanide

When using a combination filter, as in this case, two values for the maximum contaminant concentration are calculated: one value for use with gas filter, a second value for use with particle filter. It is necessary to take into account the lower value of both, i.e. the maximum contaminant concentration for potassium cyanide and hydrogen cyanide when using a full-face mask with combination filter B P2, as in our example, is 15 mg/m³ Potassium cyanide*.

* Values may vary, depending on which national protection factor you use. For the example above the German APF values were used.

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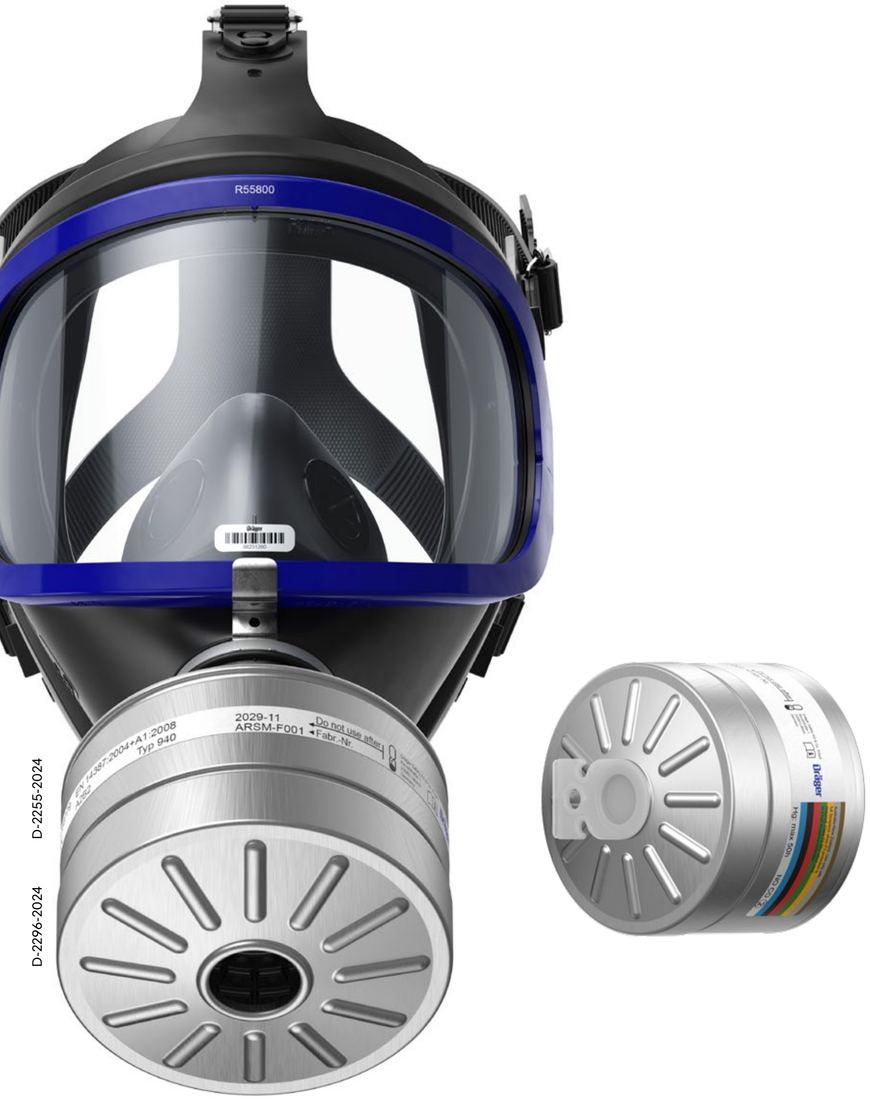


5. How do I select the right filter?

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

Filter colour codes

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.

Colour code	Filter type	Main application area
	AX[2)]	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[3)]	Carbon monoxide
	Hg[4)]	Mercury vapour
	NO[5)]	Nitrous gases including nitrogen monoxide
	Reactor[6)]	Radioactive iodine including radioactive methyl iodide
	P	Particles

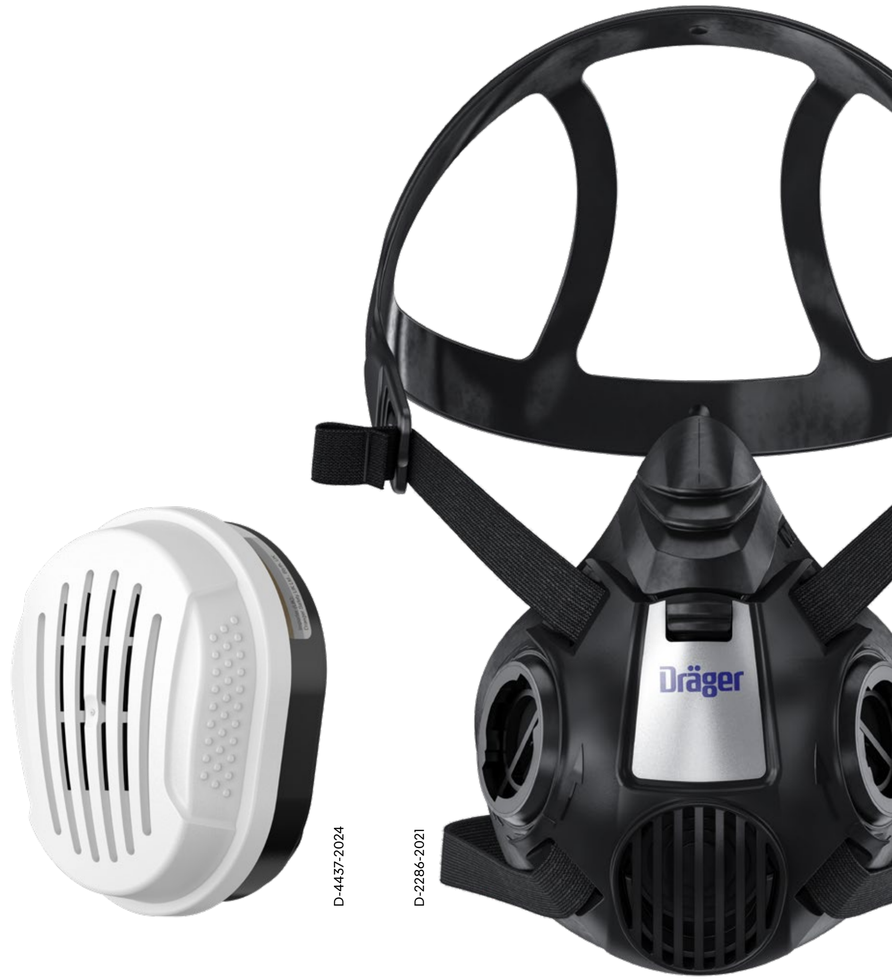
2) AX filters may only be used as supplied from the factory. Re-use and use against gas compounds is strictly forbidden.
3) CO filters may only be used once and are to be disposed of after use. Instructions based on local regulations apply.
4) Hg filters can only be used for a maximum of 50 hours in accordance with EN 14387.
5) NO filters may only be used once and are to be disposed of after use.
6) 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). 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%, class 2: 94%, class 3: 99.95%.

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[7], 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 x OEL[9]
	2	medium	10 × OEL with half-face masks / 15 × OEL with full-face masks[9]
	3	large	30 × OEL with half-face masks / 400 × OEL with full-face masks[9]
Combination filter		Gases, vapours and particles	
	1-P2 2-P2 1-P3 2-P3	Appropriate combination of gas and particle filters	Appropriate combination values

7) Based on the German protection factors. Other national or local guidelines must be followed.
8) Values taken from the European standard EN 14387
9) Values taken from the European standards EN 529:2005.



6. Strictly observe the following instructions when using filter devices:

Never use a filter device...

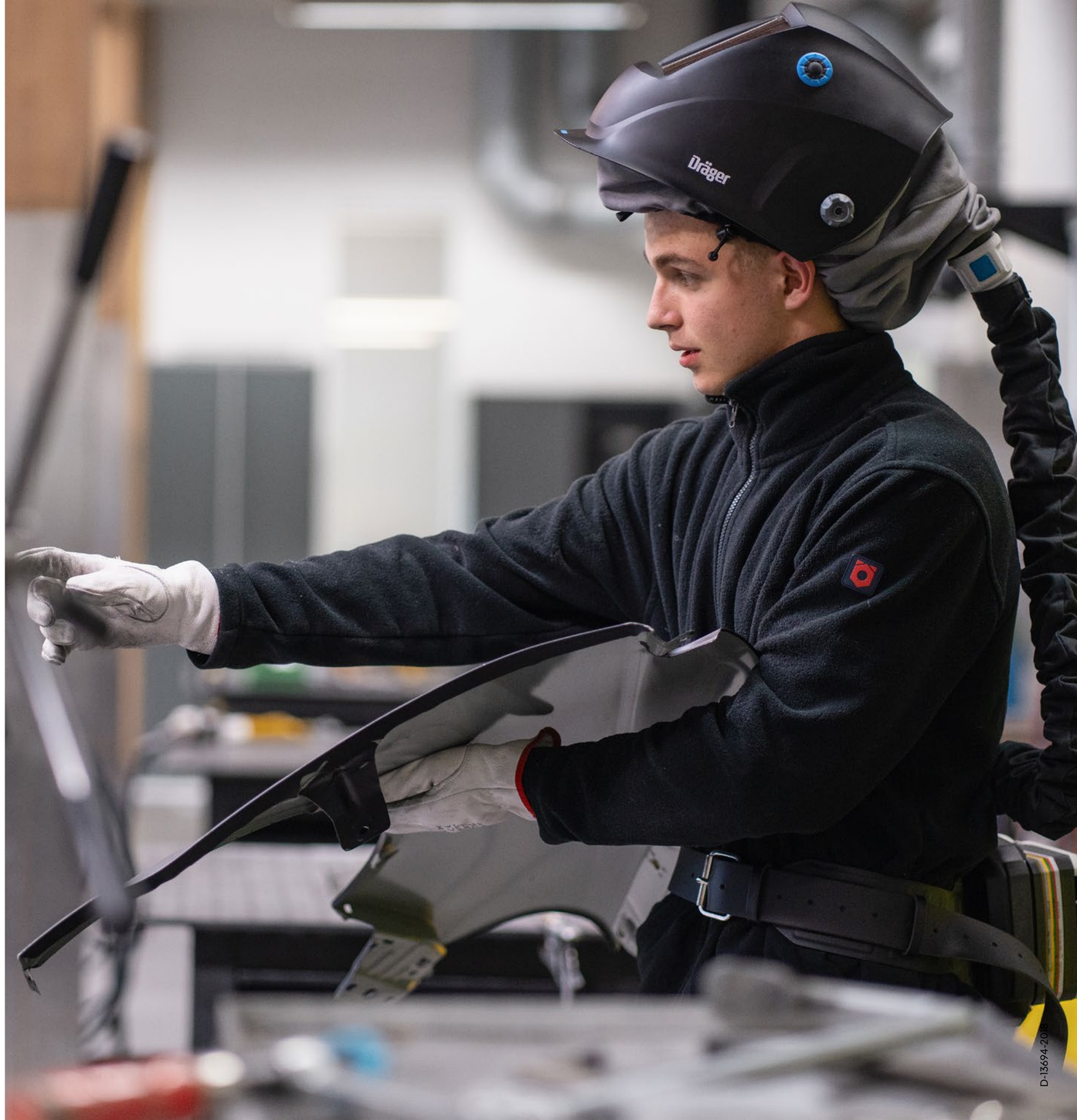
- in oxygen-deficient environments (observe your local regulations)
- in poorly ventilated areas or confined spaces such as containers, tanks, small rooms, tunnels and vessels
- in atmospheres where contaminant concentrations are unknown or are immediately dangerous to life or health (IDLH)
- if contaminant 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



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7. How long does a filter last?

The service life of a filter depends on its filter class and on the ambient conditions.

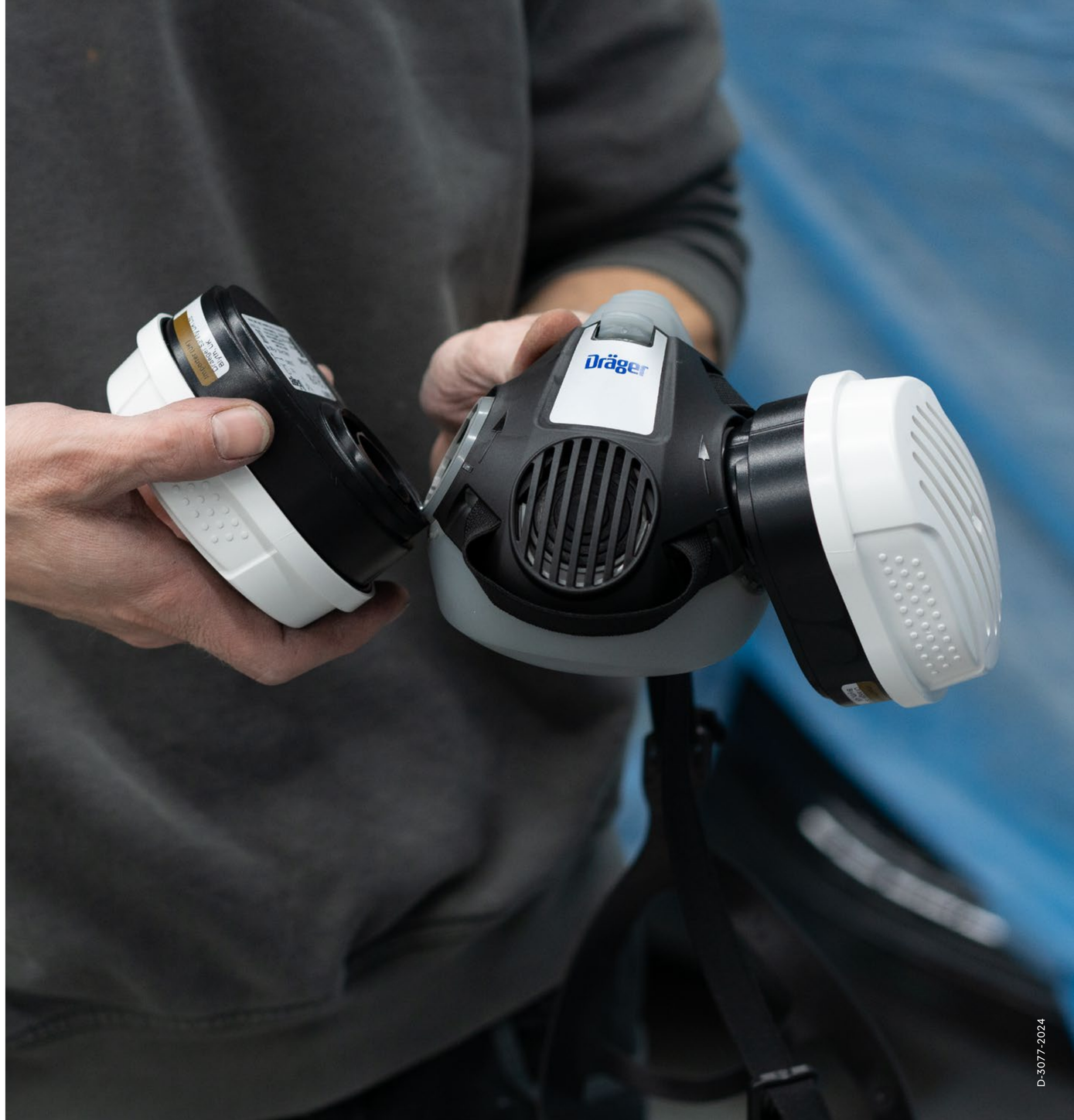
Factors affecting the service life are:

- 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



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8. Examples of contaminants, their OELs (here: AGWs, valid in Germany) and filter recommendations:

Contaminent	OEL ppm	OEL mg/m³	Filter type	Colour code
A				
Acetic acid	10	25	B [E] P2	
Acetone	500	1200	AX	
Ammonia	20	14	K	
Asbest	carcinogen (cat. 1)		P3	
B				
Benzene	0.06 - 0.6	–	A (P3)	
Buta-1,3-diene	0.2 - 2	–	AX (P3)	
C				
Chlorine	0.5	1.5	B (P3)	
Cyclohexane	200	700	A (P2)	
D				
DDT	–	–	A (P3)	
Dimethyl ether	1,000	1,900	AX (P3)	
E				
Ethanol	200	380	A (P2)	
F				
Formaldehyde	0.3	0.37	B (P3)	
G				
Glycerol	–	200 E	A P2	
H				
n-Hexane	50	180	A (P2)	
Hydrochloric acid	2	3	B [E] P2	
Hydrogen chloride	2	3	B [E] P2	
Hydrogen fluoride	1	0.83	B [E] P3	
Hydrogen peroxide	0.5	0.71	CO [NO] P3	
Hydrogen sulfide	5	7.1	B (P3)	
I				
Isooctan	300	1400	A (P2)	

Containment	OEL ppm	OEL mg/m³	Filter type	Colour code
L				
Lindane	–	0.1 E	A (P3)	
M				
Mercury vapour	–	–	Hg (P3)	
Methanol	100	130	AX (P3)	
4-Methyl-2-pentanone	20	83	A (P2)	
N				
Nitrouse fumes	–	–	NO (P3)	
O				
Ozone	carcinogen (cat. 3B)		NO (P3)	
P				
n-Pentane	1,000	3,000	AX (P3)	
Phosgene	0.1	0.41	B (P3)	
Prussic acid	0.9	1	B (P3)	
S				
Sulphur dioxide	1	0.7	E (P3)	
T				
Toluene	50	190	A (P2)	
V				
Vinyl chloride	1	2.6	AX (P3)	
X				
Xylene, all Isomers	50	220	A (P2)	

Please note:
e.g. A (P2): Gas filter is required (e.g. A); if the substance is also present in particulate matter or particles occur, a combined filter is required (e.g. A P2).
e.g. B [E] P2: B P2 filter is required; alternatively, an E filter can be used instead of the B filter.
No responsibility is taken for the correctness of this information.
Please check your local regulations.

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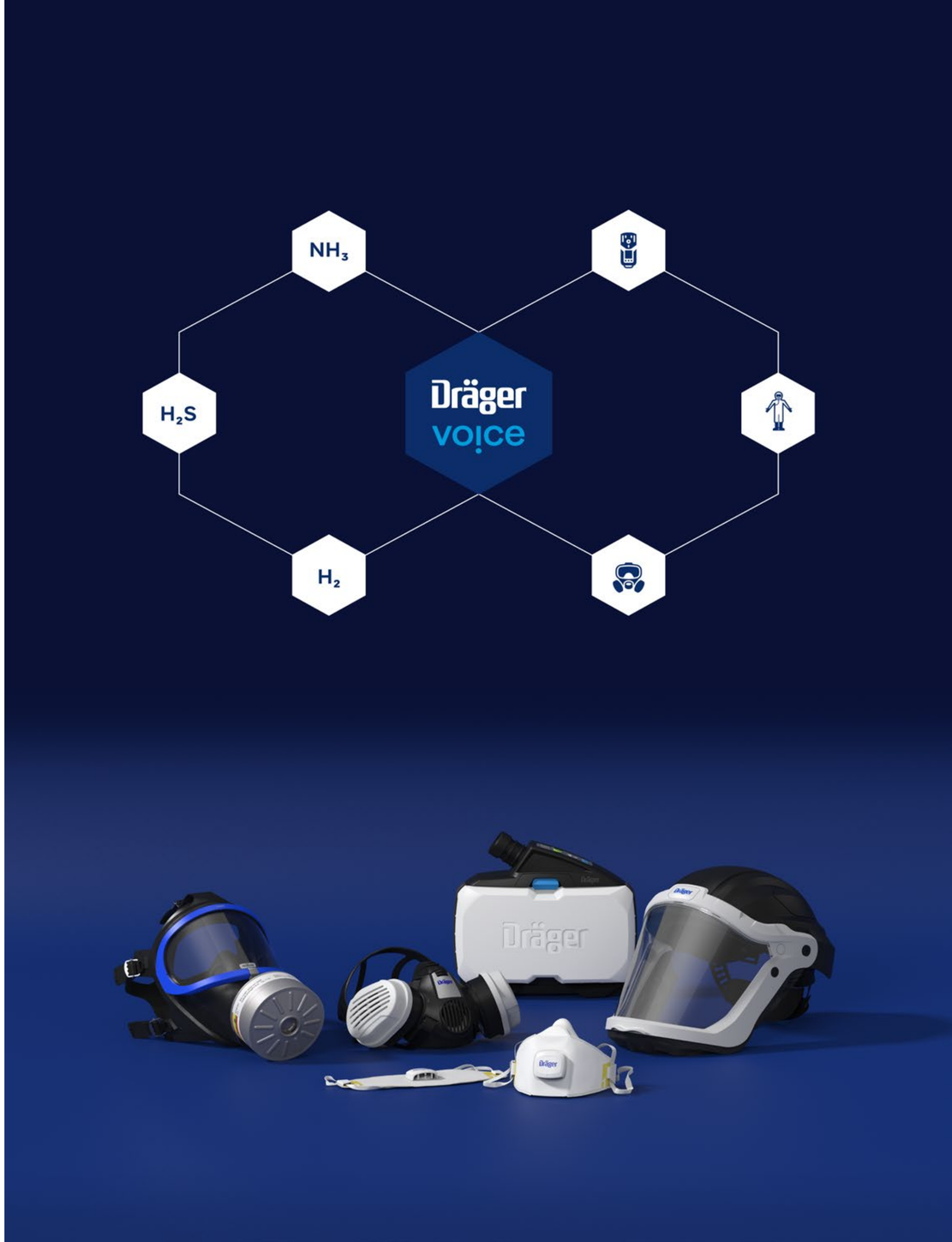

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