Guide for selection and use of filtering devices

D-8243-2018

Use of filtering devices

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, 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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FILTER DEVICES MAY BE SUFFICIENT WHEN:

- 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

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 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 devices

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?

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3. Which filter device do I need?

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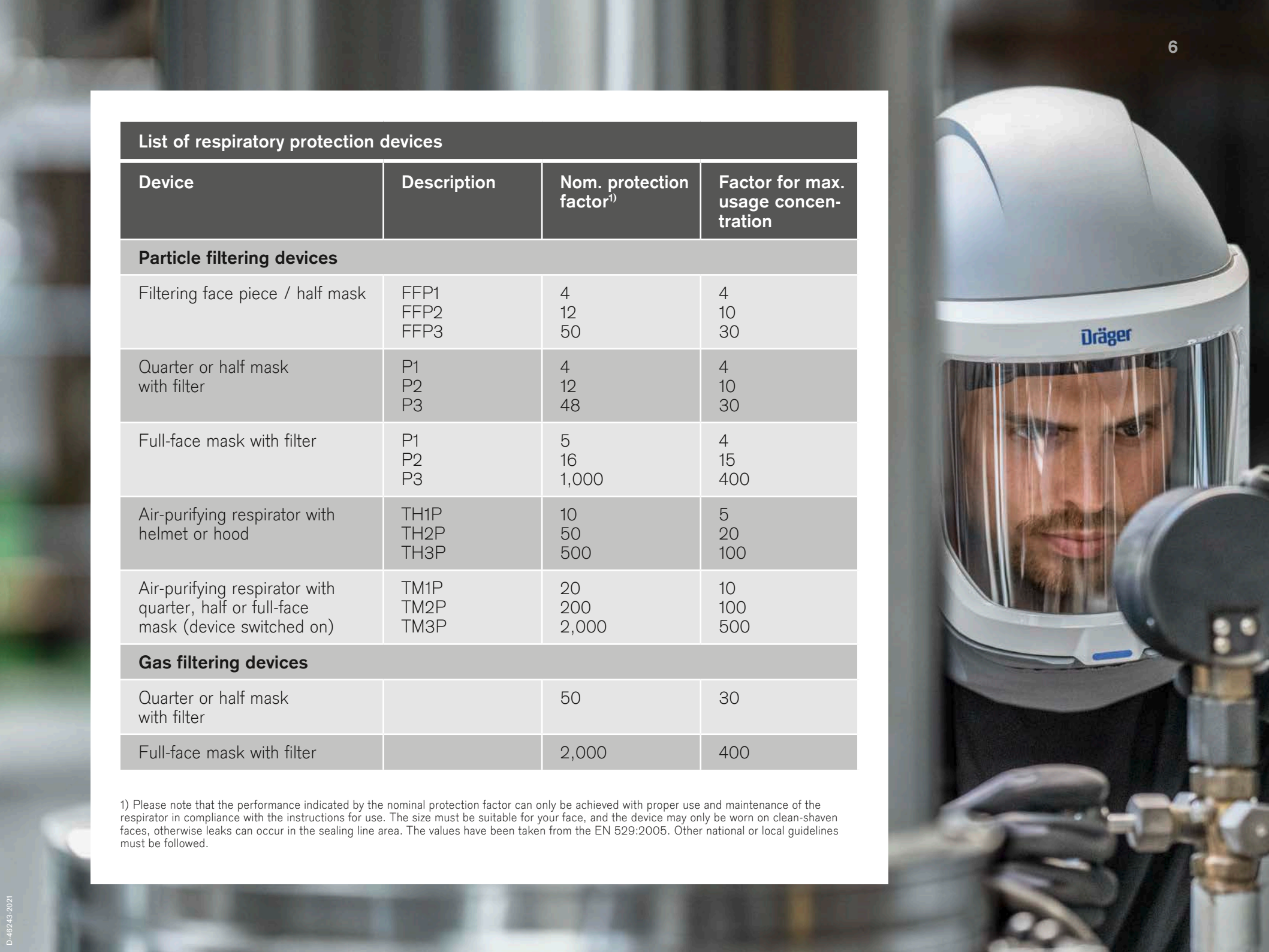
After answering all the previous questions, the protection factor must be determined. The following table gives you a brief overview of the nominal protection factors (NPFs) and the factors for the maximum usage concentration for each filter device. The NPF is derived from the highest permissible leakage 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 usage concentration is derived from the NPF. In order to determine the minimum protection factor the concentration and limit value of the contaminant are 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 one‘s health if exposed to it at that concentration on a daily basis.



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

1) 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. The values have been taken from the EN 529:2005. Other national or local guidelines must be followed.

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EXAMPLE: DETERMINING THE REQUIRED PROTECTION FACTOR

Contaminant	**Lead dust ➔ particle protection required**
Concentration at the workplace	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.

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 maximum usage concentration factor with the limit value (OEL) of the contaminant.

Maximum contaminant concentration	=	Maximum permissible concentration	x	OEL

EXAMPLE: DETERMINING THE MAXIMUM PERMISSIBLE CONTAMINANT CONCENTRATION

Contaminant	Chlorine dioxide
Limit value (OEL)	0.1 ppm
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 0.1 = 40 ppm Chlorine dioxide
Factor for maximum permissible concentration of a full-face mask with particle filter:	15 x 0.1 = 1.5 ppm Chlorine dioxide

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 chlorine dioxide when using a full-face mask with combination filter B P2, as in our example, is 1.5 ppm chlorine dioxide.

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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,however maximum:
	1	small	0.1 Vol.-% (1,000 ppm)[7)]
	2	medium	0.5 Vol.-% (5,000 ppm)[7)]
	3	large	1.0 Vol.-% (10,000 ppm)[7)]
Particle filter		Particle	
		Efficiency (separation ability):	
	1	small	4 x OEL[8)]
	2	medium	10 × OEL with half-face masks / 15 × OEL with full-face masks[8)]
	3	large	30 × OEL with half-face masks / 400 × OEL with full-face masks[8)]
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) Values taken from the European standard EN 14387
8) Values taken from the European standards EN 529:2005.
Other national or local guidelines must be followed.

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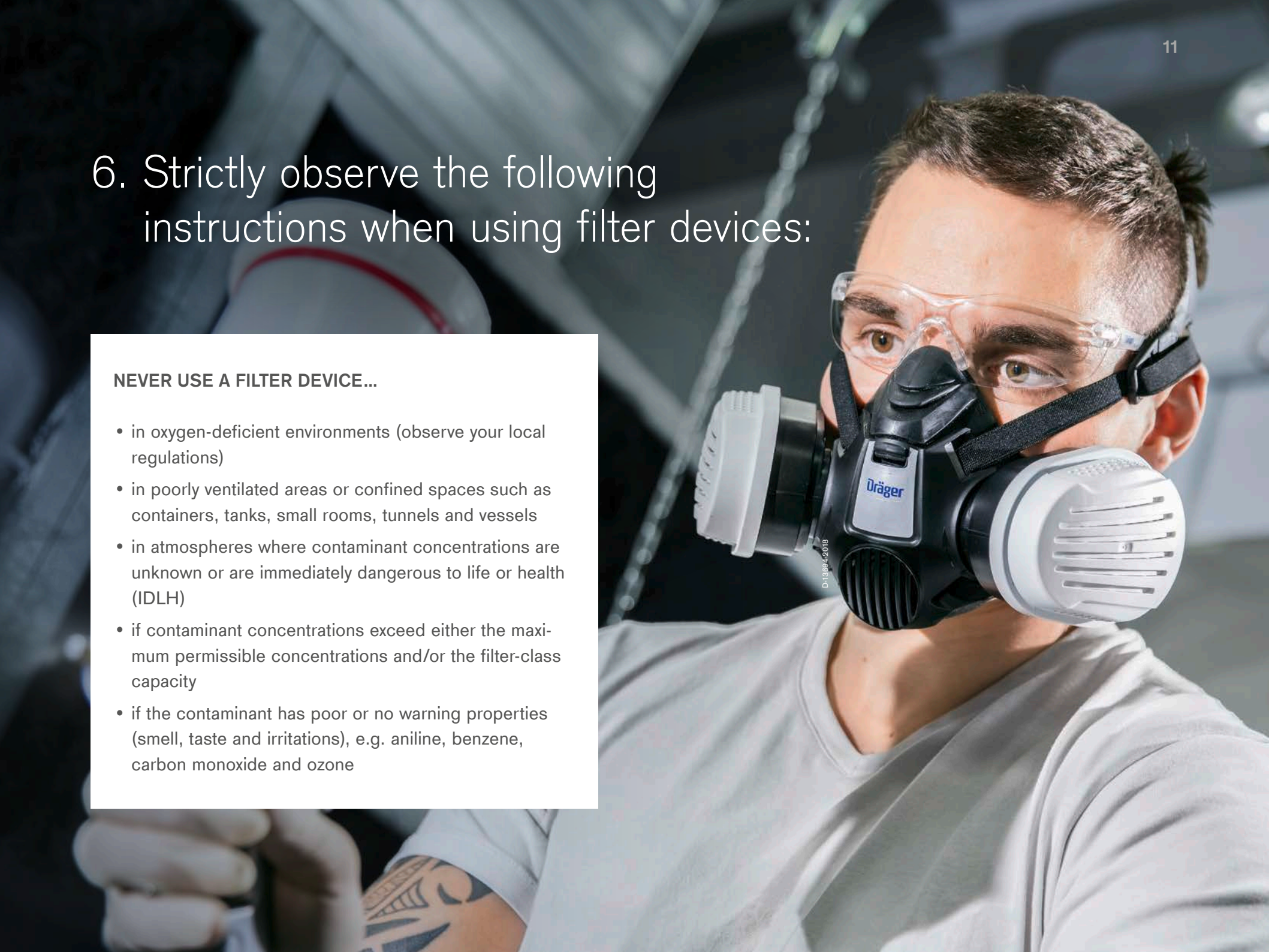
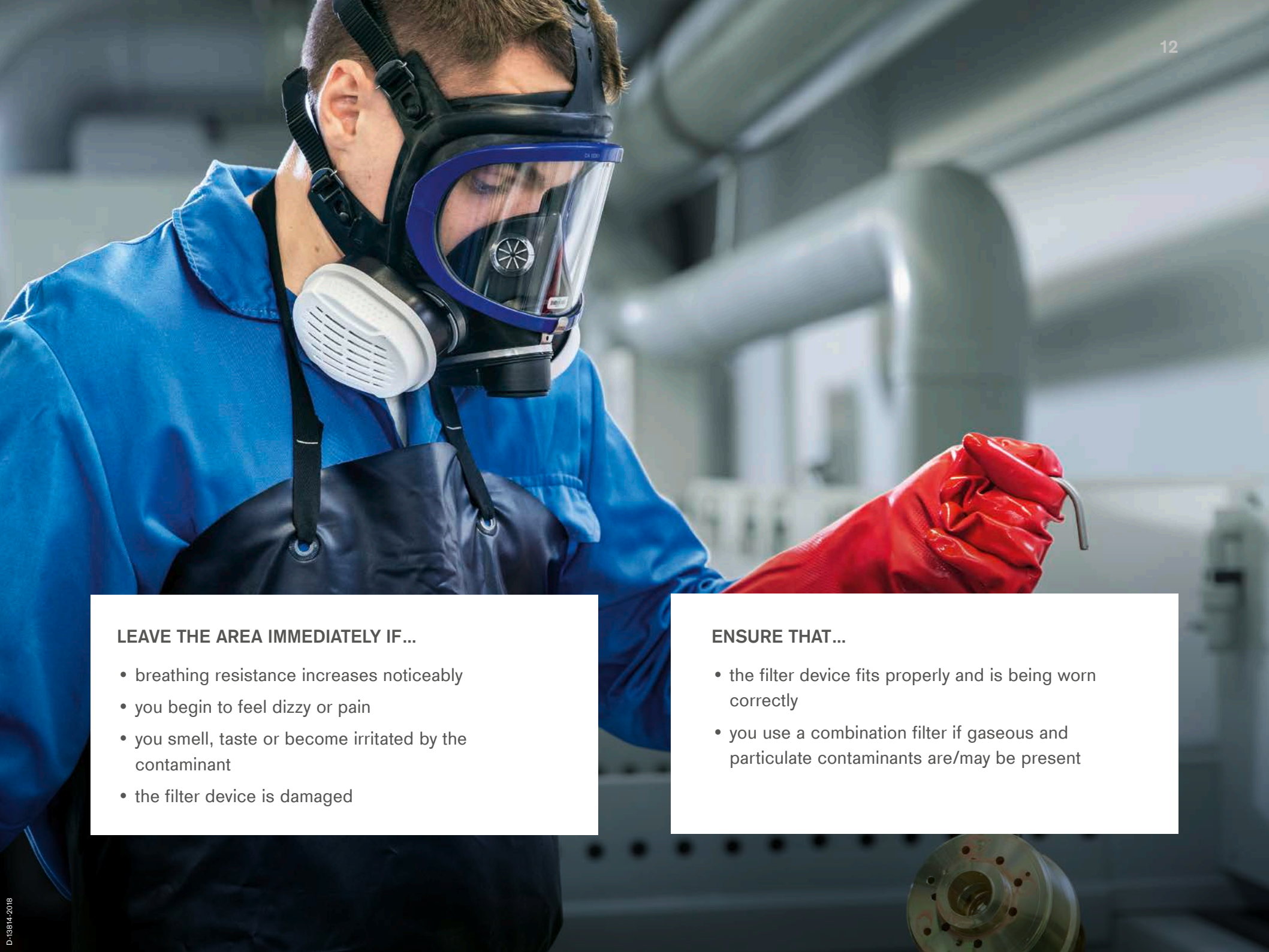
6. Strictly observe the following instructions when using filter devices:

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 lasts:

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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

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

Containment	OEL ppm	OEL mg/m³	Filter type	Color 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	Color 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.

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

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