



07/09/2002

The following table shows various application fields and the suitable mask-filter-combination recommended. Here you can find a detailed list of examples of applications. HM = half mask, FM = full face mask

Business field	Task	Application	Contaminant	Mask type*	Filter*
General	Handling	of chemical substances	particles and potentially identified substances	HM o. FM	ABEKHg-P3 1)
	Sampling		particles or/and potentially identified substances	HM	P3 / ABEKHg-P3 1)
	Inspection		particles and potentially identified substances	HM	ABEK-P3 or escape apparatus
	Measurement		particles or/and potentially identified substances	HM	P3 / ABEK-P3 1)
	Mixing	of epoxy resins and polyester resins	organic vapors	HM	A1
	Spraying/lubricating	of coolant mist	oil particles	HM / FFP2	P2
	Treatment	with preservatives	different	HM	ABEK-P2
	Transport	of dangerous goods	various	FM	ABEK2Hg-P3
	Cleaning	high pressure steam blasting	soap sud mist containing adhesions	HM / FFP1	P1
	Cleaning	degreasing	grease particles	HM / FFP2	P2
	Cleaning	disinfecting	organic vapors	HM	A1-P2
	Cleaning	disinfecting with agents containing aldehydes	organic and inorganic vapors	HM	AB-P2
	Cleaning	handling of petroleum ether or diluent for cellulose lacquers (solvent based)	solvent vapors	HM	A2
	Cleaning	with acids	acids	HM	ABE-P2
	Construction	Casting, die casting	of concrete, cement (foundations)	concrete dust	HM / FFP2
Asbestos removal		asbestos	asbestos fibers	HM / FFP3	P3
Grinding, cutting, drilling		on brickwork, concrete, stone and plaster	stone powder	HM / FFP1	P1 2)
Grinding, cutting, drilling		on brickwork, concrete, stone and plaster with a high share of quartz	stone powder	HM / FFP2	P2
Grinding, cutting, drilling		of cement	dust particles	HM / FFP1	P1
Grinding, cutting, drilling		of knifing filler of filling material	dust particles	HM / FFP1	P1 3)
Paving		tar	organic vapors, particles	HM	A1-P2 / A2-P2 4)
Finishing		processing of glass fiber and mineral fiber, e.g. roof insulation	dust particles and fibers	HM / FFP2	P2
Finishing		plastering	fine plaster dust	HM / FFP2	P2
Finishing		sealing	organic vapors	HM	A1-P2 / ABE1-P2
Finishing		clinkering (glue)	organic vapors	HM	A1-P2 5)
Finishing		roofing, tiling	tile and brick dust	HM / FFP2	P2
Preparation		excavation of contaminated soil	gases, solvents, dust particles	HM	ABE1-P2
Preparation		general demolition of brickwork, concrete, stone	dust particles	HM / FFP2	P2

Business field	Task	Application	Contaminant	Mask type*	Filter*	
Wood-working	Paint removal	flame cleaning of old coats of paint	gases, vapors, smoke, fine particles	HM o. FM	A1B1-P2	
	Paint removal	stripping of old coats of paint using solvent based agents	solvent vapors	HM	A1 / ABEK 6)	
	Paint removal	stripping of old coats of paint with substances containing ammonia	solvent vapors, ammonia	HM	ABEK	
	Paint removal	sanding, brushing off of old coats of paint, coatings	fine paint particles	HM / FFP2	P2	
	Paint removal	sanding, brushing off of old coats of paint, coatings containing chromium	fine paint particles	FM / FFP3	P3	
	Removal of adhesives	scraping off, sanding of adhesives such as polyester resin	fine particles	HM / FFP2	P2	
	Gluing	using solvent based substances	solvent vapors	HM	A2	
	Gluing	using solvent based substances (spray adhesives, e.g. polyester resin)	adhesive mist, solvent vapors	HM	A2-P2	
	Gluing	with strong epoxy resin adhesive	vapors	HM	A2-P2	
	Grinding, cutting, drilling	of wood	wood dust particles	HM / FFP2	P2	
	Grinding, cutting, drilling	of beech wood and oak wood	wood dust particles	HM / FFP3	P3	
	Metal working	Electroplating		possibly hydrocyanic acid	HM	AB-P2
		Soldering		smoke particles	HM / FFP2	P2
		Soldering	additionally with soldering paste	smoke particles, gases, possibly ammonia	HM	ABEK-P2
		Grinding, cutting, drilling	of rust	rust powder, metallic powder	HM / FFP1/2	P1 / P2
Grinding, cutting, drilling		of metals	metallic powder	HM / FFP2/3	P2 / P3	
Grinding, cutting, drilling		of iron	metallic powder	HM / FFP1	P1	
Grinding, cutting, drilling		of steel	metallic powder	HM / FFP1/2	P1 / P2	
Grinding, cutting, drilling		of stainless steel (high alloy)	metallic powder	HM / FFP2/3	P2 / P3	
Cutting		with laser beam	metallic powder	HM / FFP3	P3	
Welding		of aluminium	aluminium oxide smoke, ozone	HM / FFP3	P3 / A-P3 4)	
Welding		of motor vehicles	metallic smoke, ozone, NOx	HM	AB-P2	
Welding		manual arc welding using covered rod electrodes or laser beam welding	metallic powder, smoke	HM / FFP3	P3	
Welding / rivetting		of construction steel and zinc	metallic powder, welding smoke	HM / FFP2	P2 / ABE1-P2 4)	
Welding / rivetting		of stainless steel (Thorium electrode)	metallic powder, metallic oxide smoke	FM / FFP3	P3 / ABE1-P3 4)	
Paintwork		Grinding, cutting, drilling	of paint, lacquers and anticorrosion paint (containing chromium)	fine paint particles	HM / FFP2	P2
	Grinding, cutting, drilling	of paint, lacquers and anticorrosion paint (containing chromium)	fine paint particles	FM / FFP3	P3	
	Grinding, cutting, drilling	of anti-fouling lacquers	fine paint particles	HM	A1-P3	
	Spraying, varnishing	with water soluble paint	fine paint mist	HM	A1-P2	

Business field	Task	Application	Contaminant	Mask type*	Filter*		
Paintwork	Spraying, varnishing	with water soluble wood preservatives containing copper, chromium or arsenic	fine paint mist	FM / FFP3	P3		
	Spraying, varnishing	with solvent based paint, synthetic lacquer and bleaching agents	solvent vapors and mist	HM	A2-P2 5)		
	Spraying, varnishing	with latex paint	paint particles	HM / FFP2	P2		
	Spraying, varnishing	of latex paint with the presence of residual solvents or odors	solvent vapors and paint particles	HM	A2-P2		
	Spraying, varnishing	of isocyanates (solvent based)	solvent vapors and paint particles	HM	A2-P2		
	Spraying, varnishing	with lacquers and wood preservatives	organic vapors	HM	A1-P2/A2-P2 4)		
	Painting	with water soluble paint	big drops and spots of paint, vapors	HM	A1 / A1-P2		
	Painting	with solvent based paint, lacquers and wood preservatives	solvent vapors	HM	A1 / A1-P2 5)		
	Painting	with anti-fouling paint	solvent vapors	HM	A1 / A1-P3		
	Plastic manufacturing	Grinding, cutting, drilling	of plastics	plastic powder	HM / FFP2	P2 / AB-P2 7)	
		Waste management	Sweeping	dust	dust particles	HM / FFP3	P3
			General handling	waste sorting where odors, bacteria or spores are present	gases and dust particles	HM	A-P3
	General handling	contact with mold / fungus spores	fungus spores	HM / FM / FFP2	P2 8)		
	Power plant	Filter exchange and revision		contaminated dust particles	HM / FFP3	P3	
		Farming	General handling	handling of liquid manure	gases and vapors	HM	ABEK
Spraying			of pesticides (aqueous solutions)	insecticides / pesticides	HM / FFP2	P2	
Spraying			of pesticides (organic, evaporating)	insecticides / pesticides	HM	A1-P2	
Sweeping			of barn	dust particles	HM / FFP2 Odour P2		
Usage/cleaning	of animal feeding systems	dust particles	HM / FFP2 Odour P2				
Cleaning/drainage	of chicken / pigs farm manure pits	ammonia, H <sub>2</sub> S	HM	ABEK-P2 8)			
Medical science	General handling	contact with bacteria	bacteria	HM / FFP2	P2		
	General handling	contact with viruses	viruses	FM / FFP3	P3		
Swimming pools	Cleaning		bacteria	HM / FFP2	P2		
	Cleaning	additionally water treatment with chlorine	bacteria and gases	FM	AB2-P2		
Autobody	Repair	changing clutch and brake pads	fine dust, asbestos	HM / FFP3	P3		
	Contact	with diesel soot / smoke	sooty particles	HM / FFP2	P2		

1) observe exceptions  
 2) dependent on the concentration of gaseous substances  
 3) P2 if caustic  
 4) depending on the concentration  
 5) AX for low-boiling substances  
 6) VM depending on the concentration  
 7) AB, if gases might be produced  
 8) FFP2 Odour for gases below OEL

\* Remarks  
 This table is a guide to selecting the appropriate respiratory protection products. This guide does not release the user from the obligation to comply with national application regulations and laws and is not a substitute for adhering to and understanding the product instruction manuals.

## GUIDE FOR SELECTION AND USE OF FILTERING DEVICES

THIS BROCHURE WILL GIVE YOU A BRIEF OVERVIEW OF THE MOST IMPORTANT FACTORS TO CONSIDER WHEN CHOOSING FILTERING RESPIRATORY PROTECTION DEVICES. THIS INFORMATION CAN HELP YOU PROTECT YOURSELF AGAINST HARMFUL SUBSTANCES IN THE AIR BY SELECTING THE APPROPRIATE MASKS AND FILTERS.

### 1. What must I consider when choosing a respirator?

The hazards in your environment must be known, as well as the work requirements and the external conditions. Additionally you must take into consideration the protection level required by your respirator – as well as the type and protection level of the necessary filter.

### 2. Please check the following before using filtering respiratory protection:

- Is there enough oxygen in the ambient air? (see your local legislative requirements – in Germany a minimum of 17 vol. % is required)
- What contaminants are 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? (OEL)
- In addition to respiratory protection, is other personal protection equipment (e.g. eye or ear protection) required?

### 3. Which respirator should I choose?

It is necessary to answer all of the above questions (in 2.) to determine the needed protection factor. Table 1 gives you a brief overview of the nominal protection factors (NPF) for respiratory protective devices. The NPF is the highest permissible leakage level according to the approval requirements of the respective device. It indicates the mathematically calculated maximum protection performance. To evaluate the minimum required protection factor – you will need to know the concentration of the hazardous substance you are dealing with as well as the assigned Occupational Exposure Limit (OEL) of the substance. An OEL (like MAK, WEL or MAC) is the concentration of a

specific airborne substance – averaged over a reference period, which shows no evidence to be threatening to ones health if exposed to it, at that concentration, on a daily basis.

Table 1: List of respiratory protective devices

Device	Marking	Nominal protection factors <sup>1)</sup>
<b>Particle filtering devices</b>		
Filtering facepiece	FFP1	4
	FFP2	12
	FFP3	50
Quarter / Half mask	P1	4
	P2	12
	P3	50
Full face mask	P1	5
	P2	20
	P3	1000
PAPR with helmet or hood	TH1P	10
	TH2P	20
	TH3P	500
PAPR with quarter / half or full face mask (power on)	TM1P	20
	TM2P	100
	TM3P	2000
<b>Gas filtering devices</b>		
Quarter/half mask with filter		20
Full face mask with filter		2000

<sup>1)</sup> Values have been taken from the CEN Report 529. Additional national and local regulations must be followed. Keep in mind that the performance indicated by the nominal protection factor can only be achieved when the respiratory protective device is worn correctly and has been properly maintained. Make sure you choose the size that fits best for your face. Also, a respirator should only be worn on cleanly shaven faces, as facial hair in the sealing area causes leakage.

### Example: Determining the needed protection factor of your respirator

Contaminant:	Lead dust (particle protection is needed)	2000	x	0.5	1000 ppm or 0.1 vol. % Chlorine
Concentration at the workplace:	3 mg/m <sup>3</sup>				
OEL (Occupational Exposure Limit):	0.1 mg/m <sup>3</sup>				
Minimum protection factor =	$\frac{\text{concentration of hazardous substance}}{\text{OEL}} = \frac{3}{0.1} = 30$				

You can see in table 1 that with a needed minimum protection factor of 30 for lead dust, you will need to use a P3-filter – either in the form of an FFP (filtering facepiece), or together with a half mask, a full face mask, or PAPR.

In the case where the contaminants are present in both particle and gas form, the nominal protection factor must be established for each one separately. For the selection of filtering devices, 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<sup>3</sup> of air) or mg/m<sup>3</sup> (= weight of the substance within 1 m<sup>3</sup> of air) and the concentration of particles (dust) only in mg/m<sup>3</sup>. While mg/m<sup>3</sup> deals with weight and ppm with volume, there is no direct calculation for mg/m<sup>3</sup> to ppm. Higher concentrations are often indicated in % by volume, 10,000 ppm = 1 vol. %.

### 4. What is the maximum concentration of the contaminant for which I can use respiratory protection?

You can determine the maximum permissible concentration by multiplying the nominal protection factor (as found in table 1) by the Occupational Exposure Limit (OEL).

$$\text{Maximum permissible concentration} = \text{nominal protection factor} \times \text{OEL}$$

### Example: Determining the maximum permissible concentration<sup>2)</sup>

Contaminant:	Chlorine
OEL:	0.5 ppm (Occupational Exposure Limit)
Respirator :	Full Face Mask (Nominal protection factor of full face mask with gas cartridge: 2000)

$$\text{Nominal Protection Factor} \times \text{OEL} = \text{Maximum permissible concentration}$$

$$2000 \times 0.5 = 1000 \text{ ppm or } 0.1 \text{ vol. \% Chlorine}$$

As you see, the maximum permissible concentration for chlorine is 1000 ppm or 0.1 vol. %.

<sup>2)</sup> Values and terms of calculation have been taken from the CEN Report 529. Additional national and local regulations must be followed. Values of OEL base on MAK according to German regulations and thereof time-weighted average values over a reference period and not any short term exposure limits.











### 5. How to select the right filter?

Contaminants come in different forms – generally: aerosols (solids/particles) and gases (gases, vapours). You can choose between the filter types to protect against one of these forms or a combination of both of them.

Solids / particles:	Dusts, fibres, fumes, microorganisms (e.g. viruses, bacteria, fungi, spores) and mists
Gaseous substances:	Gases and vapours

The following table shows you the color coding of filters according to EN14387 – which helps you to determine which filter-type is needed for the contaminants you are dealing with.

Table 2: Colour-Coding for Filters

Colour code	Filter Type	Contaminants present
	AX <sup>3)</sup>	Gases and vapours of organic compounds with boiling point < 65 °C
	A	Gases and vapours of organic compounds with boiling point > 65 °C
	B	Inorganic gases and vapours, e.g. chlorine, hydrogen sulphide, hydrogen cyanide
	E	Sulphur dioxide, hydrogen chloride
	K	Ammonia and organic Ammonia derivatives
	CO <sup>4)</sup>	Carbon monoxide
	Hg <sup>5)</sup>	Mercury vapour
	NO <sup>6)</sup>	Nitrous gases including nitrogen monoxide
	Reactor <sup>7)</sup>	Radioactive iodine including radioactive methyl iodide
	P	Particles

<sup>3)</sup> AX filters may only be used as supplied from factory. Reuse and use against gas-compounds is absolutely impermissible.  
<sup>4)</sup> CO filters for one time use only. Must be disposed after use. Special guidelines according to local regulations apply.  
<sup>5)</sup> Hg Filters can only be used for a maximum of 50 hours according to EN 14387.  
<sup>6)</sup> NO filters for one time use only. Must be disposed after use.  
<sup>7)</sup> Reactor filters: special guidelines according to local regulations apply.


### Differentiation of filter types

Filters are split in different classes according to their capacity (gas filters) or their efficiency (particle filters), see table 3. Gas filters of class 2 may be used at higher concentrations or

for a longer time than class 1 filters. The class of a particle filter indicates how efficient the filter is in filtering out particles. (class 1: 80%, class 2: 94%, class 3: 99.95%).

Table 3: Differentiation of filter types

Filter type	Filter class	Protection against	Maximum permissible concentration of toxic substance
Gas filter		Gases and vapours	
		Capacity:	50 times the OEL with half masks / 2000 times the OEL with full face masks, but maximal:
	1	Small	0.1 vol. % (1000 ppm) <sup>8)</sup>
	2	Medium	0.5 vol. % (5000 ppm) <sup>8)</sup>
use with PAPR	1	Small	0.05 vol. % (500 ppm) <sup>8)</sup>
	2	Medium	0.1 vol. % (1000 ppm) <sup>8)</sup>
Particle filter		Particles	
		Efficiency (separation ability):	
	1	Small	4 times the OEL with half masks / 5 times the OEL with full face masks <sup>10)</sup>
	2	Medium	12 times the OEL with half masks / 16 times the OEL with full face masks <sup>10)</sup>
	3	Large	48 times the OEL with half masks / 1000 times the OEL with full face masks <sup>10)</sup>
		Example: Lead dust	OEL = 0,1 mg/m <sup>3</sup> 4 x 0,1 mg/m <sup>3</sup> = 0,4 mg/m <sup>3</sup> = maximum permissible concentration of lead dust for the usage of P1-filter with half masks.
Combined filter		Gases, vapours and particles	
	1-P2	Appropriate combined gas	Appropriate combined levels
	2-P2	combined gas	combined levels
	1-P3	and particulate	
	2-P3	filters	

**Example Filter Types:**  A2B2-P3

<sup>8)</sup> Values taken from the European Norm EN 14387  
<sup>9)</sup> Values taken from the European Norm EN 12941 and 12942  
<sup>10)</sup> Values taken from the CEN Report 529  
 Additional national and local regulations must be followed.

### Example Filter Types:

**A filter with the above mentioned colour code is suitable for**

### the following contaminants:

- A** gases and vapours of organic compounds with a boiling point beyond 65 °C up to concentrations covered by filter class 2 and
- B** inorganic gases and vapours, e.g. chlorine, hydrogen sulphide, hydrogen cyanide, up to concentrations covered by filter class 2 and
- P** particles up to concentrations covered by filter class 3.

### 6. When using filtering respiratory protection, always keep the following in mind: Never use any kind of filtering respiratory protection device . . .

- in oxygen deficient atmospheres (see local legislation for further guidelines e.g. Germany less than 17 vol. % O<sub>2</sub>)
- in poorly ventilated areas or confined spaces, such as tanks, small rooms, tunnels, or vessels
- in atmospheres where the concentrations of the toxic contaminants are unknown or are immediately dangerous to life or health (IDLH)
- when the concentration of a contaminant is higher than the maximum permissible concentration and / or the filter class capacity
- when the contaminant has poor or no warning properties (smell, taste or irritation), such as aniline, benzene, carbon monoxide, and ozone

### Immediately leave the area if . . .

- breathing resistance increases noticeably
- you began to feel dizzy
- you smell, taste, or become irritated by the contaminant
- your respirator is damaged

### Make sure that . . .

- the selected respirator fits properly
- if both gases and particles are present, that you use a combination filter, to filter out both gases and particles

### 7. How long does a filter last?

The service life of a respiratory filter depends on its size and on the conditions of use.

### Factors affecting service life:

- concentration of the contaminants

- combination of the contaminants
- air humidity
- temperature
- duration of use
- breathing rate of the user

Since the service life is influenced by so many different factors it is not possible to give an estimated service life. Important is:












- local / company regulations


### The end of service life is generally recognizable by:




















- in gas filters by a noticeable taste or smell of the contaminant
- in particle filters by an increased breathing resistance
- in combination filters a noticeable taste or smell and/or an increased breathing resistance

Table 4: Examples of contaminants, their OEL's (here: MAK's, valid for Germany) and filter recommendations

This is only a small choice of contaminants as example. For more information and a wide choice of contaminants please try our Dräger VOICE filter selection program on the internet (www.draeger.com/voice).

Contaminant	OEL ppm	OEL mg/m <sup>3</sup>	Filter type	Colour code
Acetic acid	10	25	B (P) <sup>11)</sup>	
Acetone	500	1200	AX	
Ammonia	50	35	K	
Asbestos	-	-	P3	
Benzene	1	3,2	A	
Buta-1,3-diene	5	11	AX-P3 <sup>12)</sup>	
Carbon monoxide	30	35	CO	
Chlorine	0,5	1,5	B	
Cyclohexane	200	700	A	
DDT	-	1	A-P3 <sup>12)</sup>	
Dimethyl ether	1000	1900	AX	
Ethanol	1000	1900	A	

Contaminant	OEL ppm	OEL mg/m <sup>3</sup>	Filter type	Colour code
Ethyl acetate	400	1500	A	

Formaldehyde	0,5	0,62	B2 (P3) <sup>11)</sup>	
n-Hexane	50	180	A	
Hydrochloric acid, fuming (37%)	-	-	E-P2 <sup>12)</sup>	
Hydrogen chloride	-	8	E (P2) <sup>11)</sup>	
Hydrogen cyanide	10	11	B	
Hydrogen fluoride	3	2,5	E (P3) <sup>11)</sup>	
Hydrogen peroxide	1	1,4	NO-P3 <sup>12)</sup>	
Hydrogen Sulfide	10	14	B	
Isobutane	1000	2400	AX	
Isooctane	-	-	A	
Lindane	-	0,5	A-P <sup>12)</sup>	
Mercury	0,01	0,1	Hg-P3 <sup>12)</sup>	
Methanol	200	270	AX	
4-Methyl-2-pentanone	20	83	A	
Mineral wool fibers	-	-	P2	
Nitrous fumes	-	-	NO-P3 <sup>12)</sup>	
Ozone	0,1	0,2	NO-P3 <sup>12)</sup>	
n-Pentane	1000	3000	AX	
Phosgene	0,02	0,082	B	
Sulfur dioxide	0,5	1,3	E	
Toluene	50	190	A	
Vinyl chloride	2	5	AX	
Xylene, all isomers	100	440	A	

<sup>11)</sup> Gas filter required; if the substance is also present in particulate matter or particles occur a combined filter is required, e.g. Formaldehyde: B2 (P3)  
<sup>12)</sup> Combined filter required, e.g. Lindane: A-P