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# Guide for selection and use of filtering devices

Dräger. Technology for Life®

## Application recommendations for masks and filters

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, VM = full face mask

| Business field | Task | Application | Containment | Mask type* | Filter* |
|---|---|---|---|---|---|
| General | Handling | of chemical substances | particles and potentially identified substances | HM o. FM | ABEK Hg P3 [1] |
|  | Sampling | | particles or/and potentially identified substances | HM | P3 / ABEK Hg P3 [1] |
| | Inspection | | particles and potentially identified substances | HM | ABEK P3 or escape device |
| | 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 | ABEK2 Hg 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 | AB 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 | P2 |
| | Asbestos removal | asbestos | asbestos fibers | HM | P3 |
|  | Grinding, cutting, drilling | on brickwork, concrete, stone and plaster | stone powder | HM / FFP2 | P2 [2] |
| | 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 / FFP3 | P3 |

| Business field | Task | Application | Containment | Mask type* | Filter* |
|---|---|---|---|---|---|
| Wood working | Paint removal | flame cleaning of old coats of paint | gases, vapors, smoke, fine particles | HM o. FM | ABEK P2 |
|  | Paint removal | stripping of old coats of paint using solvent based agents | solvent vapors | HM | ABEK P2 [5] |
| | Paint removal | stripping of old coats of paint with substances containing ammonia | solvent vapors, ammonia | HM | ABEK P2 |
| | 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 | VM / FFP3 [2] | 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 | VM / FFP3 | P3 / ABE1 P3 [4] |
| Paintwork | Grinding, cutting, drilling | of paint, lacquers and anticorrosion paint | fine paint particles | HM / FFP2 | P2 |
| | Grinding, cutting, drilling | of paint, lacquers and anticorrosion paint (containing chromium) | fine paint particles | VM / FFP3 [2] | P3 |

| Business field | Task | Application | Containment | Mask type* | Filter* |
|---|---|---|---|---|---|
| Paintwork | 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 |
| | Spraying, varnishing | with water soluble wood preservatives containing copper, chromium or arsenic | fine paint mist | VM / FFP3 [2] | 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, varnishin | gof 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 [5] |
| 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/draining | of chicken/pigs farm manure pits | ammonia, $H_2S$ | HM | ABE P2 [8] [9] |
| Medical science | General handling<br>General handling | contact with bacteria<br>contact with viruses | bacteria<br>viruses | HM / FFP2<br>FM / FFP3 | P2<br>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 | P3 |
| | Contact | with diesel soot/smoke | sooty particles | HM / FFP3 | P3 |

[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] FM depending on the concentration
[7] AB, if gases might be produced
[8] FFP2 Odour for gases below OEL
[9] Ensure sufficient ventilation in enclosed spaces!

* 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.

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, but this can differ in other countries)
- 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 (NFP) for respiratory protective devices. The NFP 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 [1] |
|---|---|---|
| **Particle filtering devices** | | |
| Filtering facepiece | FFP1 | 4 |
| | FFP2 | 12 |
| | FFP3 | 50 |
| Quarter / Half mask with filter | P1 | 4 |
| | P2 | 12 |
| | P3 | 48 |
| Full face mask with filter | P1 | 5 |
| | P2 | 16 |
| | P3 | 1,000 |
| PAPR with helmet or hood | TH1P | 10 |
| | TH2P | 50 |
| | TH3P | 500 |
| PAPR with quarter / half or full face mask (power on) | TM1P | 20 |
| | TM2P | 200 |
| | TM3P | 2,000 |
| **Gas filtering devices** | | |
| Quarter / half mask with filter | | 50 |
| Full face mask with filter | | 2,000 |

[1] 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 main-tained. 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 |
| Concentration at the workplace: | 3 mg/m³ |
| OEL (Occupational Exposure Limit): | 0,1 mg/m³ |

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 $m^3$ of air) or mg/$m^3$ (= weight of the substance within 1 $m^3$ of air) and the concentration of particles (dust) only in mg/$m^3$. While mg/$m^3$ deals with weight and ppm with volume, there is no direct calculation for mg/$m^3$ 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** [2)]

| | |
|---|---|
| Contaminent: | Chlorine |
| OEL: | 0.5 ppm (Occupational Exposure Limit) |
| Respirator: | Full Face Mask (Nominal protection factor of full face mask with gas cartridge: 2,000) |

Nominal Protection Factor × OEL = Maximum permissible concentration

2,000 × 0.5 = 1,000 ppm or 0,1 Vol.-% Chlorine

As you see, the maximum permissible concentration for chlorine is 1,000 ppm or 0.1 Vol.-%.

[2)] 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 [3)] | 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 derivates |
| | 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 factory. Reuse and use against gas-compounds is absolutely impermissible.

[4)] CO filters for one time use only. Must be disposed after use. Special guidelines according to local regulations apply.

[5)] Hg Filters can only be used for a maximum of 50 hours according to EN 14387.

[6)] NO filters for one time use only. Must be disposed after use.

[7)] 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<br>Capacity: | 50 times the OEL with half masks / 2,000 times the OEL with full face masks, but maximal: |
| | 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 | | Particles<br>Efficiency (separation ability): | |
| | 1 | Small | 4 times the OEL with half masks / 5 times the OEL with full face masks [10)] |
| | 2 | Medium | 12 times the OEL with half masks / 16 times the OEL with full face masks [10)] |
| | 3 | Large | 48 times the OEL with half masks / 1,000 times the OEL with ful face masks [10)] |
| | Example: Lead dust OEL = 0.1 mg/m³<br>4 × 0.1 mg/m³ = 0.4 mg/m³ = maximum permissible concentration of lead dust for the usage of P1-filter with half masks. | | |
| Combined filter | 1-P2<br>2-P2<br>1-P3<br>2-P3 | Gases, vapours and particles<br>Appropriate combined gas and particulate filters | Appropriate combined levels |

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

**Example Filter Types:**

A2B2 P3

**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, hydrogensulphide, 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. in Germany less than 17 Vol.-% $O_2$)
- 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: AGWs, 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).

| Containment | OEL | | Filter type | Colour code |
|---|---|---|---|---|
| | ppm | mg/m³ | | |
| **A** | | | | |
| Acetic acid | 10 | 25 | B [E] P2 | |
| Acetone | 500 | 1,200 | AX | |
| Ammonia | 50 | 35 | K | |
| Asbestos | carcinogen (cat. 1) | | P3 | |
| **B** | | | | |
| Benzene | carcinogen (cat. 1) | | A | |
| Buta-1,3-diene | carcinogen (cat. 1) | | AX (P3) | |
| **C** | | | | |
| Carbon monoxide | 30 | 35 | CO | |
| 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 | 1,000 | 1,900 | A (P2) | |
| Ethyl acetate | 400 | 1,500 | A (P2) | |
| **F** | | | | |
| Formaldehyde | 0.3 | 0.37 | B (P3) | |
| **H** | | | | |
| n-Hexane | 50 | 180 | A (P2) | |
| Hydrochloric acid, fuming (37 %) | – | – | B [E] P2 | |
| Hydrogen chloride | – | 8 | B [E] P2 | |
| Hydrogen cyanide | 10 | 11 | B (P3) | |
| Hydrogen fluoride | 3 | 2.5 | B [E] (P3) | |
| Hydrogen peroxide | 1 | 1.4 | CO[NO]P3 | |
| Hydrogen Sulfide | 10 | 14 | B (P3) | |
| **I** | | | | |
| Isooctane | – | – | A (P2) | |
| **L** | | | | |
| Lindane | – | 0.5 | A (P3) | |
| **M** | | | | |
| Mercury | 0.01 | 0.1 | Hg (P3) | |
| Methanol | 200 | 270 | AX (P3) | |
| 4-Methyl-2-pentanone | 20 | 83 | A (P2) | |
| Mineral wool fibers | – | – | P3 | |
| **N** | | | | |
| Nitrous fumes | - | - | NO (P3) | |
| **O** | | | | |
| Ozone | carcinogen (cat. 3B) | | NO (P3) | |
| **P** | | | | |
| n-Pentane | 1,000 | 3,000 | AX (P3) | |
| Phosgene | 0.02 | 0.08 | B (P3) | |
| **S** | | | | |
| Sulphur dioxide | 0.5 | 1.3 | E (P3) | |
| **T** | | | | |
| Toluene | 50 | 190 | A (P2) | |
| **V** | | | | |
| Vinyl chloride | 2 | 5 | AX (P3) | |
| **X** | | | | |
| Xylene, all isomers | 100 | 440 | 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.