



**Powerful. Reliable. Energy efficient.**  
Viledon® air filtration solutions for hospitals



Industrial Air Filtration | Healthcare

**Freudenberg  
Filtration Technologies**



## High standards of air filtration in hospitals



The requirements for air filtration in the hospital environment can be summarised in three key statements:

1. Protection of patients, visitors and staff against airborne contaminants
2. Protection against micro-organisms in buildings
3. Reliable filtering of non disease-causing particles, as these can also act as a vehicle for spreading bacteria

### The function of air filters in hospitals

Because many interior areas cannot be naturally ventilated, the majority of hospitals are air-conditioned. The increasing height of ward blocks also means that many windows can no longer be opened. In addition, to prevent microbial contamination, special areas such as operating theatres and isolation rooms are equipped with high-performance HEPA filters on the air intake and exhaust systems. In operating theatres, the aim is to prevent wound infection and to keep instruments sterilised. In the isolation rooms, to prevent the risk of infection spreading to other people in the hospital (airborne spread), also the exhaust air needs to be filtered through a HEPA filter.

Because air filters are built into the hospital's air conditioning (HVAC) equipment, the need to guard against particulate contamination of any sort is of paramount importance. HVAC systems are also a key focus of interest due to the fact that so-called "sick building syndrome" can be traced, among other reasons, to poorly maintained and hygienically substandard HVAC equipment. To properly protect people's health, increased demands need to be placed on the performance of air filtration units within HVAC systems. In this respect, compliance with appropriate standards and policies has a special significance. The installed filters need to guarantee that the proportion of dust particles, bacteria, fungi and organic elements in the air taken into the hospital – as well as the air emitted by the hospital into surrounding areas – does not exceed the limits specified by the regulations. For this reason, it must be ensured that the air filter itself is not, and cannot become, a source of hazardous or noxious air particles or constituents.

### Potential cost savings from air filtration

Rising energy prices and the need to reduce CO<sub>2</sub> emissions make the use of efficient air filters an attractive proposition, because this is an area that offers significant cost-saving potential. Fans in air conditioning systems account for around 10% of a hospital's total energy use. Of these costs, between 10% and 50% can be attributed to pressure drops in the HVAC system caused by the filters themselves. Reducing pressure losses in air filtration systems creates the ability to save energy, decrease costs and reduce CO<sub>2</sub> emissions.

### Conclusion

Operators of HVAC systems in hospitals face a twin challenge. On the one hand, they must comply with regulations and standards. On the other, they need to reduce energy use and its associated costs, while also reducing CO<sub>2</sub> emissions. Viledon® air filters are the ideal solution to this challenge.



### Standards and guidelines ensure security

The role of HVAC systems is to guarantee a consistently high and hygienic interior air quality. Various guidelines and standards help to ensure that these advanced hygiene requirements, which play a particularly important role in a hospital's air quality management function, are met at all times. The current standards include in particular Guideline VDI 6022 (in Germany) and the stand-

ards DIN 1946-4 and EN 13779. These regulations specifically define key criteria such as structural specifications, intake air quality, air filter quality, hygiene standards, maintenance checks, inspections and so on. Freudenberg Filtration Technologies solutions fully conform to the requirements of all currently applicable standards and guidelines.

#### VDI 6022

The VDI (Verein Deutscher Ingenieure) is the German Association of Engineers and one of Germany's most important regulatory bodies. Their Guideline 6022 (Sheet 1) sets out the requirements for HVAC systems and equipment with regard to planning, manufacture, construction, operation and maintenance, to ensure hygienic operation and adequate protection for people.



For more information, please see our customer information sheet "Important notes on VDI 6022".

#### DIN 1946-4

At the end of 2008, the Standards Committee for Heating and Air Conditioning Engineering (NHRS) published the DIN 1946-4:2008-12 regulations. These regulate the operation of HVAC systems in buildings and rooms within healthcare facilities and replace the previous DIN 4799 "Air flow systems for operating theatres". Section 6.5.7 of the regulations sets out the requirements for air filtration in hospitals.

#### EN 13779

The EN 13779:2007 standard provides for the ventilation of non-residential buildings and provides general conditions and requirements for ventilation, air conditioning and other cooling systems.

# Viledon® filtration solutions

top quality, energy efficient and service orientated

## Meeting all hygiene requirements

The hygiene regulations VDI 6022 formulated clear guidelines for HVAC systems in sensitive buildings like hospitals. The aim of these regulations is to guarantee the hygienic operation of HVAC systems and to protect the people who come into contact with them. Unlike the Viledon® air filtration solutions, conventional filters show significant shortcomings in relation to these regulations. Viledon® solutions fully conform to all the requirements of VDI 6022.

### Your benefits

- moisture resistant up to 100% relative humidity
- The materials used do not provide a breeding ground for bacteria and fungi
- Fully self-contained filter pockets – no contact with the often humid floor of the filter house
- No leakages
- No pocket filter fibre separation

+ No filter material fibres extracted on the clean air side

+ Glass fibre-free pocket filters

## Viledon® reduces energy costs

Due to their excellent physical properties, Viledon® filters reduce pressure drop in air filtration systems, thus saving energy and operating costs and reducing CO<sub>2</sub> emissions.

### Your benefits

- Class-leading energy efficiency properties
- Long service life with low increase of pressure drop
- Low initial pressure difference
- Easy disposal (made entirely of synthetic materials, so capable of full incineration)

## Energy efficiency classification: the user-orientated filter comparison

The European energy efficiency classification system EUROVENT 4/11 enables you to judge how good a filter is in terms of operating costs. Co-developed by Freudenberg, this system allows users to quickly and easily identify energy-efficient filters. For the energy-optimized operation of HVAC systems we recommend air filters of energy efficiency grades A to C. Using the system, target filters can be selected according to high dust-holding capacity and very slow increase in pressure drop. Choosing the most energy-efficient filters makes a valuable contribution to energy savings while also protecting the climate and the environment. Examples of highly energy-efficient filters are the Viledon® compact pocket filter and MaxiPleat cassette filter.



We will be pleased to send you our latest case studies.



energy efficiency  
performance

### With Viledon® 4.4 tons less CO<sub>2</sub> emissions per year

1<sup>st</sup> filter stage: 9 x conventional M6 pocket filter  
2<sup>nd</sup> filter stage: 9 x conventional F9 cassette filter  
Volume flow: 30,000 m<sup>3</sup>/h

1<sup>st</sup> filter stage: 9 x M6 Viledon® compact pocket filter T60  
2<sup>nd</sup> filter stage: 9 x F9 Viledon® MaxiPleat cassette filter MX98  
Volume flow: 30,000 m<sup>3</sup>/h

#### Conventional filtration

Power consumption  
27,820 kWh/year

Electricity costs\*  
(27,820 kWh x 0.10 €/kWh)

**2,782 €**

CO<sub>2</sub> emissions\*\*  
(27,820 kWh x 0.559 kg/kWh)

**≈ 15,551 kg/year**

#### Viledon® System

Power consumption  
19,930 kWh/year

Electricity costs\*  
(19,930 kWh x 0.10 €/kWh)

**1,993 €**

CO<sub>2</sub> emissions\*\*  
(19,930 kWh x 0.559 kg/kWh)

**≈ 11,140 kg/year**

**789 €/year**  
Cost savings  
with Viledon®

**≈ 4.4 t/year**  
CO<sub>2</sub> reduction with  
Viledon®

\* Electricity costs for industry (0.10 €/kWh),  
Source: BDEW Bundesverband der Energie- und  
Wasserwirtschaft e.V., correct as of 2011

\*\* Specific carbon dioxide emissions of the German  
electricity mix in 2011 (0.559 kg/kWh of CO<sub>2</sub>  
emission factor), Source: German National  
Environment Office, FG/2.5., correct as of April 2009



Nano jetSpin – the unmistakable “Embossed-Plus”  
in pocket filters of filter classes F7 and F8.



The built-in spacers ensure optimal  
pocket form during operation.



The bags are leak-free welded.



The bags are securely foamed  
into the PUR front frame.



### Viledon® service

Specifically for hospitals, we offer:

- Hygiene inspections and hygiene checks in accordance with VDI 6022, using trained personnel
- Filter change, cleaning and disposal, including particle capture measurement
- Filter monitoring
- Filter procurement, storage and scheduling
- Filter comparison measurements
- Energy efficiency measurements
- On-site filter training, including the thematic modules installation / filter change; handling; storage; principles of filtration; filter classification and more ...
- State-of-the-art test laboratory
- Personal customer support
- Complete range of filters

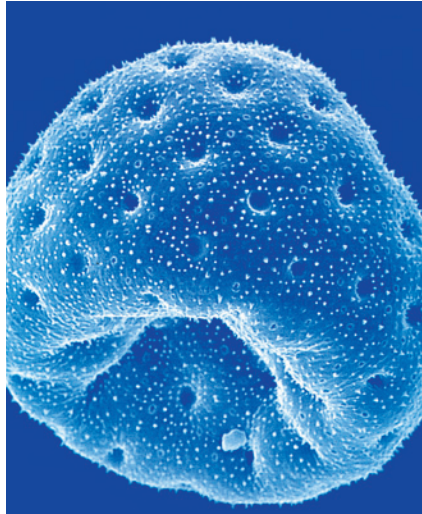
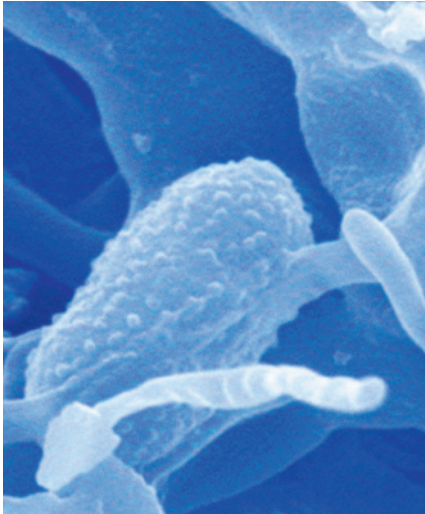
### Viledon® filterCair: the complete service package

To ensure that you are able to exploit the high quality of our filters to maximum effect within your complex HVAC plant, we have developed a unique and extensive Filter Management System: Viledon® filterCair. This is a custom-made bundled package, consisting of a comprehensive range of filters plus servicing and warranties.

### Conclusion

Viledon® air filters fully meet all the demands of the VDI 6022 hygiene guidelines for HVAC systems and all other relevant standards. They also significantly reduce energy costs compared to conventional filters, as demonstrated in numerous tests. Our comprehensive Viledon® service offering completes the package, ensuring optimal filtration in all respects.

# The potential dangers and risks of faulty filters



*Fungal spores and pollen  
under the electron microscope*

## Typical impurities in the air

### Atmospheric dust

Atmospheric dust is composed, among other things, of road dust, soot and organic deposits. Dust particles themselves are not usually pathogenic, but may carry micro-organisms.

### Pollen

Pollen is part of the reproductive cells of plants. Although they are not pathogens, they can cause allergic reactions and asthma. Because pollen is larger than 15 microns, it can be effectively removed from the air using high-quality filters.

### Fungal spores

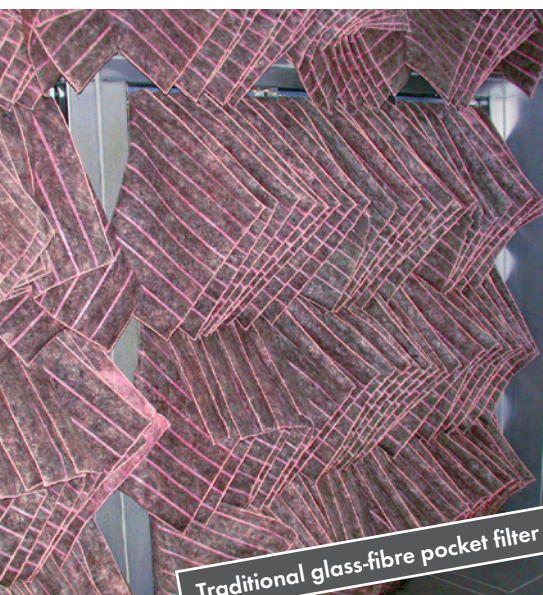
Fungi contain many hundreds of different micro-organisms that help to decompose plants. Most can cause allergies and a rare few can even cause serious infections. Fungi produce spores that can be transmitted through the air.

### Bacteria

A bacterium is a kind of protozoa without nucleus, usually 2 to 3 microns in size. The multiplication of bacteria is carried out by cell division. In air circulation systems, the filters need to remove the bacteria to prevent them from re-entering the hospital buildings. Bacteria can cause serious illnesses such as cholera, diphtheria, whooping cough, tuberculosis or typhoid.

### Viruses

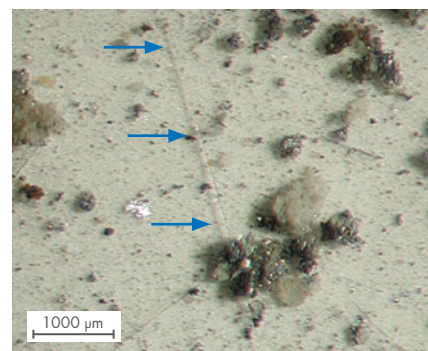
Viruses are the smallest of all parasites (15 to 400 nm) and depend entirely on cells for propagation. They are made up of an outer shell (composed of proteins and sometimes lipoids) and a nucleic acid core (RNA or DNA). In most cases, this core penetrates a vulnerable cell and so initiates the infection. Viruses cause, among other things, Ebola, influenza, measles, colds or chicken pox.



Traditional glass-fibre pocket filter



Viledon® Compact pocket filter



(above) Floor dust sample showing glass fibres and particles on the clean air side

(left) Conventional glass-fibre pocket filter

(right) Viledon® Compact pocket filter made from synthetic-organic fibres

### Risks posed by loose glass-fibre particles

Glass fibres are among the man-made mineral fibres, whose toxicity to humans is the subject of numerous investigations. From a strictly scientific point of view, based on existing epidemiological studies, a carcinogenic effect of glass fibres has neither been conclusively proved nor definitively ruled out. However, breathable glass fibre particles continue to be suspected of causing cancer.

The hygiene guidelines VDI 6022 clearly stipulate that no fibres extracted from the filter material should be allowed to enter the clean air environment. Conventional filters, using glass fibre non-woven materials, are susceptible to releasing glass fibre particles that then enter the theoretically 'cleaned' air of the hospital buildings. That is why you are safer using Viledon®, because all Viledon® pocket filters are entirely free of glass fibres.

### Problems with glass-fibre filters

- Poor moisture resistance resulting in caking /clumping of the fibres
- Low tearing resistance
- Multiple weaknesses in the seams (e.g., holes)
- Flammable compound (spun-weave / glue); combustible adhesive
- Cannot be incinerated
- Non-homogeneous density of the medium
- Unstable pockets
- Lack of rigidity of the material



(left) Frontal view: damage to filter material due to handling errors during filter installation (slight tear); uneven and not completely open filter pockets.

(right) Frontal view: secure-mounting synthetic filter material; rigid spacers to optimise pressure difference & energy saving.

# Viledon® multi-stage filter concept in a hospital



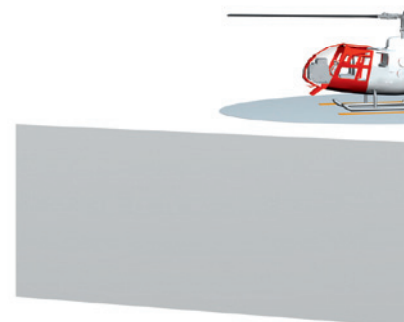
## Everything relies on the right filter system

In order to achieve the required level of indoor air quality, we combine different classes and types of filters into multi-stage systems. Generally, a 2-stage filtration system serves to capture both coarse and fine particles. In operating theatres or isolation rooms, terminal filters remove even finer particles from the air.

These sensitive areas are subject to particularly stringent requirements. To ensure the highest standards of clean air in this environment, the air is circulated using low turbulence displacement. In the adjacent areas, the hourly rate of air exchange within the room, the people present and any equipment should be coordinated. The supply of a sensitive area

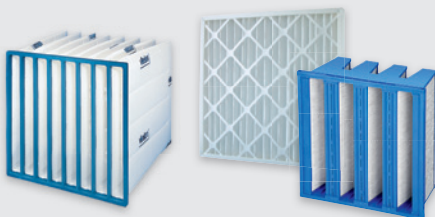
with filtered air must be designed so that effective ventilation is achieved under all operating conditions, while the risk of excessive pressure from adjacent areas is minimised. An ideal solution for a hospital can be seen in the illustration (right).

The absolute reliability of the filters in terms of filtration performance, freedom from leaks and secure mounting in the frame is a crucial prerequisite for use in clean rooms. The choice of an appropriately high-quality filtration system clearly demonstrates its value in the validation and monitoring of protected areas.



Example layout

- 1** Compact pocket filter G3 - F7,  
Filter cell or DuoPleat F7  
(according to DIN 1946-4: M5 - F7)

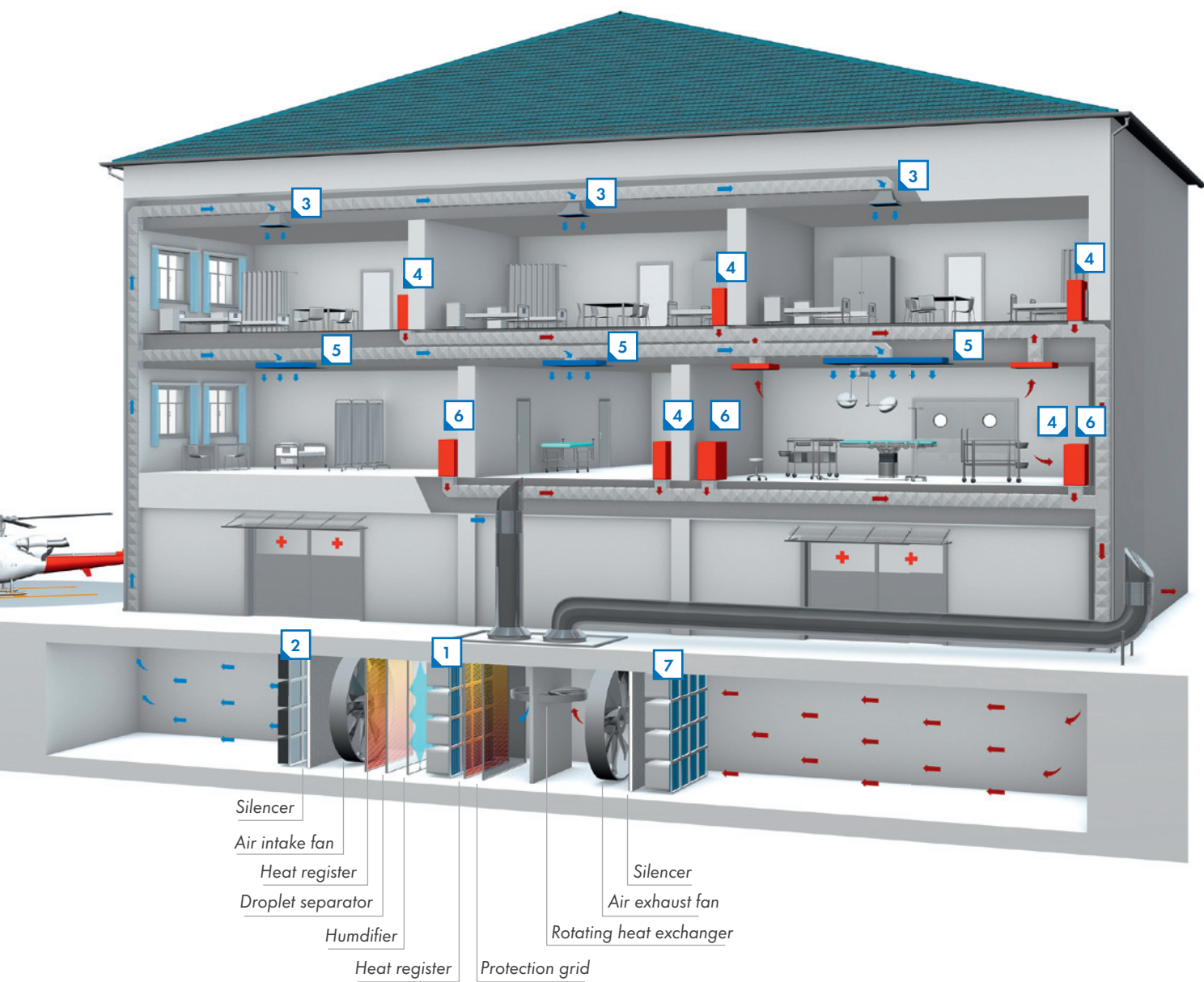


- 2** Compact pocket filter F7 - F9 or  
Cassette filter F7 - F9  
(according to DIN 1946-4: F9)



- 3** Terminal housing





**4** Filter mat or filter cell  
G3 - G4



**5** HEPA filter  
H13 - H14



**6** High-volume flow HEPA filter  
H13 - H14



**7** Compact pocket filter  
minimum M5



# The complete Viledon® filter range for all hospital applications

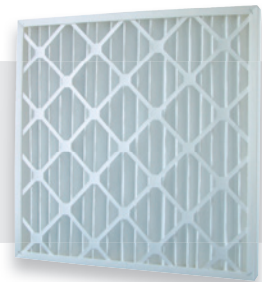
## Filter mats

| Filter class<br>(EN 779) | Average arrestance | Type        |              |
|--------------------------|--------------------|-------------|--------------|
|                          |                    | PES media   | PP media     |
| G2                       | 65 – 80 %          | PSB / 145 S | P 15 / 150 S |
| G3                       | 80 – 90 %          | PSB / 275 S | P 15 / 350 S |
| G4                       | > 90 %             | PSB / 290 S | P 15 / 500 S |
|                          | Average efficiency |             |              |
| M5                       | 40 – 60 %          | A3 / 300 S  |              |



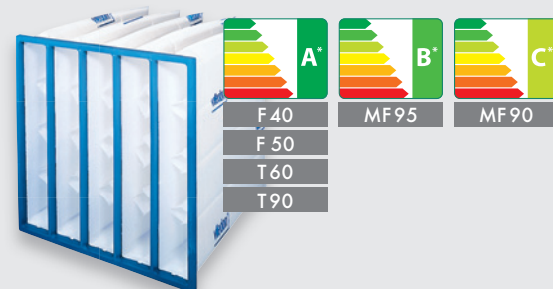
## Filter cells

| Filter class<br>(EN 779) | Average arrestance | Nominal<br>volume flow rate | Filter type     |
|--------------------------|--------------------|-----------------------------|-----------------|
| G3                       | 80 – 90 %          | 4,250 m³/h                  | MP 45 / MP 45 K |
| G4                       | > 90 %             | 3,400 m³/h                  | MP 45 / MP 45 K |



## Compact pocket filters

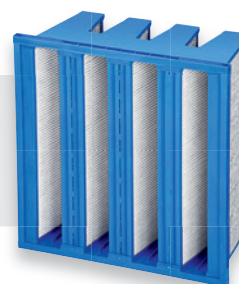
| Filter class<br>(EN 779) | Average arrestance | Filter type |        |
|--------------------------|--------------------|-------------|--------|
| G3                       | 80 – 90 %          | G 35 SL     | G 35 S |
| G4                       | > 90 %             | F 40        | F 45 S |
|                          | Average efficiency |             |        |
| M5                       | 40 – 60 %          | F 50        |        |
| M6                       | 60 – 80 %          | T 60        |        |
| F7                       | 80 – 90 %          | MF 90       | T 90   |
| F8                       | 90 – 95 %          | MF 95       |        |



\* According to Eurovent 4/11, rated at 3,400 m³/h

### DuoPleat combination filters – particle filter plus activated carbon filter

| Filter class (EN 779) | Average efficiency | Filter type |
|-----------------------|--------------------|-------------|
| F7                    | 80 – 90 %          | DP 85       |



### NanoPleat cassette filters

| Filter class (EN 779) | Average efficiency | Filter type |
|-----------------------|--------------------|-------------|
| M6                    | 60 – 80 %          | MV 75 HSN   |
| F7                    | 80 – 90 %          | MV 85 HSN   |
| F8                    | 90 – 95 %          | MV 95 HSN   |



\* According to Eurovent 4/11, rated at 3,400 m³/h

### MaxiPleat cassette filters

| Filter class (EN 779) | Average efficiency | Filter type |
|-----------------------|--------------------|-------------|
| M6                    | 60 – 80 %          | MX 75       |
| F7                    | 80 – 90 %          | MX 85       |
| F8                    | 90 – 95 %          | MX 95       |
| F9                    | > 95 %             | MX 98       |



\* According to Eurovent 4/11, rated at 3,400 m³/h

### High-volume flow EPA / HEPA filters with galvanized steel or stainless steel frame

Frame depth: 292 mm

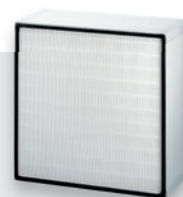
| Filter class (EN 1822) | Arrestance MPPS** |
|------------------------|-------------------|
| E11                    | ≥ 95 %            |
| H13                    | ≥ 99.95 %         |
| H14                    | ≥ 99.995 %        |



### EPA / HEPA filters with plastic frame

Frame depth: 78 mm, 150 mm, 292 mm

| Filter class (EN 1822) | Arrestance MPPS** |
|------------------------|-------------------|
| E11                    | ≥ 95 %            |
| H13                    | ≥ 99.95 %         |
| H14                    | ≥ 99.995 %        |

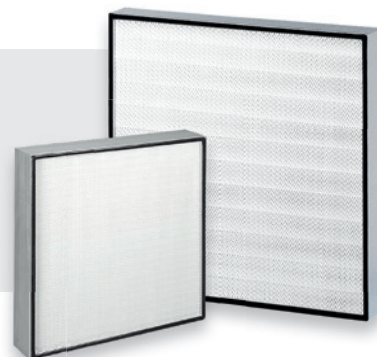


### HEPA filters with aluminium frame

Frame depth: 68 mm, 78 mm, 88 mm with PUR semicircular profile gasket  
80 mm, 102 mm with Silgel sealing

| Filter class (EN 1822) | Arrestance MPPS** |
|------------------------|-------------------|
| H13                    | ≥ 99.95 %         |
| H14                    | ≥ 99.995 %        |

\*\* MPPS = Most Penetrating Particle Size



### Also available:

- Terminal housings
- Terminal HEPA Filter / Hood Modules
- Fan filter units
- Safe-change housings (contamination-free filter changing)
- Accessories



Terminal housing



Terminal HEPA Filter / Hood Module

# Viledon®

## Excellence in filtration

With Viledon®, Freudenberg Filtration Technologies offers hospitals a complete, top-quality range of filters from Class G 3 to H 14 for room ventilation and clean room technology. All our filters meet the highest standards of efficiency and operational safety, and all filters from Class M 5 to F 9 (EN 779) are EUROVENT certified.

Our quality and management systems are certified under the current regulations of DIN EN ISO 9001, DIN EN ISO 14001 and OHSAS 18001.



Viledon® filters have demonstrated proven success in many applications, providing reliable, efficient and cost-saving air filtration. We will be happy to send you our latest case studies and references.



## Freudenberg Filtration Technologies

A partner you can rely on



Freudenberg Filtration Technologies develops and produces superior filtration solutions worldwide. Our solutions make industrial processes more economic, save resources, protect the environment and enhance quality of life. Our filters are successfully used for air intake, air exhaust and air circulation systems in many industrial applications. These include general HVAC and clean room system, turbo machinery, surface technologies and emission control. Also in liquid filtration we provide a strong portfolio. As a development and manufacturing partner of the automotive industry, Freudenberg Filtration Technologies develops automotive

interior filters and engine air intake filters. In the area of health protection, we produce filter solutions for applications in the office and in the home, as well as for many more technically demanding speciality applications. Our product portfolio is complemented by comprehensive system solutions and services. Worldwide, around 1,700 employees across 30 locations actively contribute to the success of our company.

For more information, visit  
[www.freudenberg-filter.com](http://www.freudenberg-filter.com)

Freudenberg Filtration Technologies is a supporting member of the German Association of Hospital Technology (Fachvereinigung Krankenhaustechnik e.V. – FKT).



You can find out more about Freudenberg Filtration Technologies from our company brochure.



**Freudenberg Filtration Technologies SE & Co. KG**

69465 Weinheim / Germany

Phone +49 (0) 6201 80-6264 | Fax +49 (0) 6201 88-6299

viledon@freudenberg-filter.com | www.freudenberg-filter.com