Viledon HEPA and ULPA Filters – The Patented Solution for Sterile Air and Clean Rooms

viledon®

Product Overview

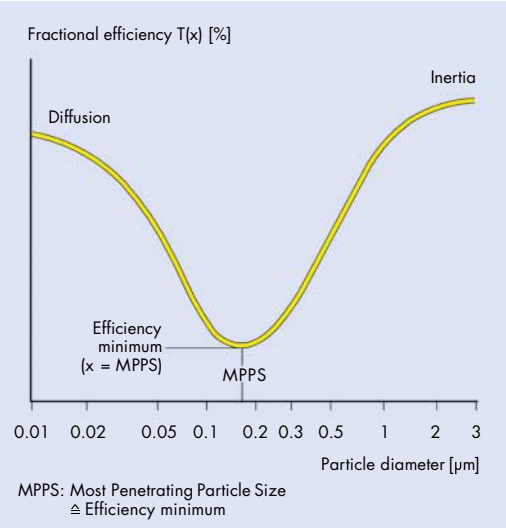
Freudenberg

In a class of their own for technology and performance

While the performance qualities of air filters in Classes F 5 to F 9 are assessed in terms of the efficiency for the particle size 0.4 µm, averaged over the dust loading, to EN 779, HEPA and ULPA filters from Class H10 upwards are classified in terms of their particle-size-referenced minimum efficiency in new condition as laid down by EN 1822. This classification by minimum collection efficiencies is based on minimum curves describing the arrestance characteristics of HEPA and ULPA filter media with defined particle sizes at nominal media velocity.

The particle size at which the medium exhibits the lowest collection efficiency is called the Most Penetrating Particle Size (MPPS). The typical parabolic shape of these minimum curves shows that particles both larger and smaller than the MPPS are arrested more effectively (see graph on the right).

The European standard EN 1822 replaces various national standards like DIN 24183, DIN 24184, BS 3928 and AFNOR 44013: when EN 1822 was drawn up, it was based on DIN 24183, and is largely identical to it.
EN 1822 distinguishes between HEPA filters (High-Efficiency Particulate Air Filters) up to Class H14, and ULPA filters (Ultra Low Penetration Air Filters), from Class U 15 upwards. The table below shows previous classification systems for HEPA and ULPA filters in comparison with the new EN 1822 and the US Military Standard.

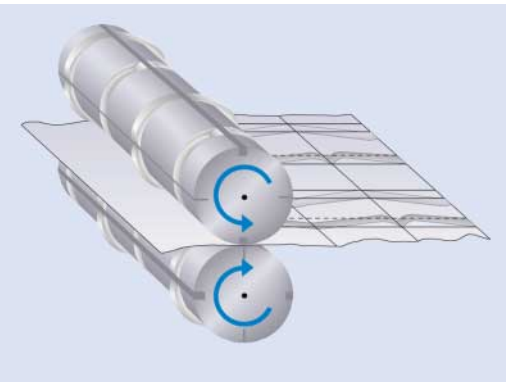


Minimum curve for an H13 filter medium

Unique down to the very last detail ...
Viledon HEPA and ULPA filters are manufactured using a patented thermal embossing process. A complementary pair of cylinders simultaneously embosses conical dimples and the subsequent pleat tips into a heated micro-glassfiber paper containing a thermoplastic bonder (see illustration below).
This extremely delicate processing of the filter medium means that, in contrast to conventional HEPA/ULPA filters, the risk of creating cracks or pin-holes on the media is practically eliminated.

Integral efficiency* for MPPS	Filter Class to EN 1822	DIN 24183	DIN 24184	BS 3928	US Mil. Std. 292
≥ 85 %	H 10	EU 10	Q	EU 10	–
≥ 95 %	H 11	EU 11	R	EU 11	≥ 95 %
≥ 99.5 %	H 12	EU 12	–	EU 12	≥ 99.97 %
≥ 99.95 %	H 13	EU 13	S	EU 13	≥ 99.99 %
≥ 99.995 %	H 14	EU 14	–	EU 14	≥ 99.999 %
≥ 99.9995 %	U 15	EU 15	–	–	–
≥ 99.99995 %	U 16	EU 16	–	–	–
≥ 99.999995 %	U 17	EU 17	–	–	–

*** The integral efficiency is the mean value of all local efficiencies measured over the filter's face area.**

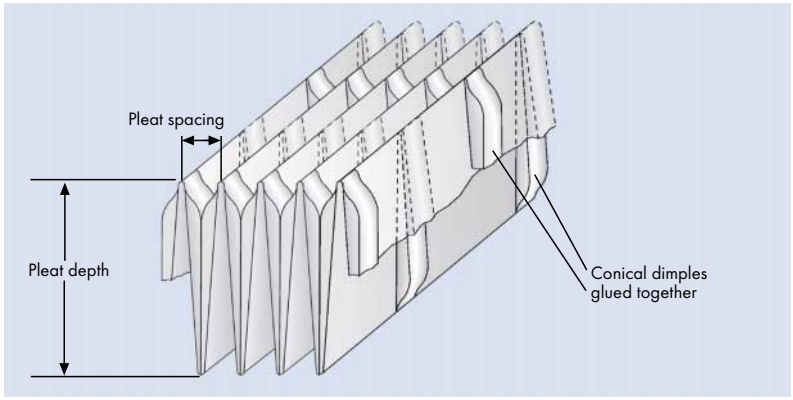


Thermal embossing process

The embossed dimples mean that after pleating the filter medium spaces itself, so that no additional spacer materials need be used (see illustration on the right).

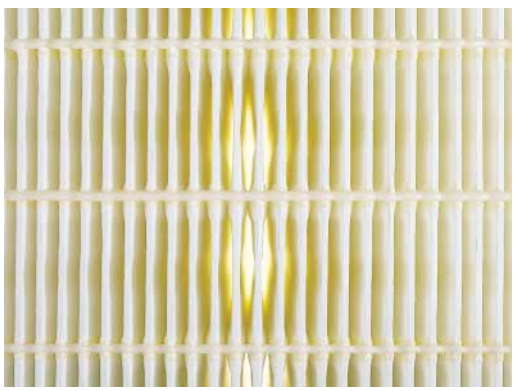
The unusually high stability of the pleat packs (which can be as much as 1220 mm wide) is reinforced by applying a fine adhesive onto the backs of the dimples and a plastic thread running over the pleat tips. So compared to other manufacturing techniques, the use of sealing and pleat-fixing agents is reduced.

This patented thermal embossing technique creates equidistant pleats, whose precise V-shape geometry ensures optimum air flow through the pleat pack. At the same time, the embossing process gives the filter medium an inherent rigidity, enabling pleat depths of 280 mm to be achieved for the first time ever. Since the pleats are exactly equidistant, there is minimized turbulence in the downstream air flow, a crucial factor in laminar flow applications.



Thermal embossing process: pleating without any spacer materials

Cross-section through a 280 mm deep pleat pack



V-shaped pleats, back-lit

... and unequalled in practice

Viledon HEPA and ULPA filters constitute an innovative milestone in terms of cost-efficiency and operational reliability – a truly up-to-the-future performance:

- Exceptionally reliable and cost-efficient operation, providing very low pressure drops even at high volume flows
- Homogeneous flow characteristics, resulting from the optimized pleat geometry
- Low-turbulence downstream air flow, thanks to equidistant, geometrically precise pleats
- Lightweight filter elements for easy handling
- Secure and leak-free installation with continuous, homogeneously foamed-on polyurethane seal
- Additional security against leaks, since no sharp-edged metal separators are used
- Full incinerability for the filter elements in the plastic-framed version.

A product range that thinks of everything

Viledon HEPA/ULPA filters are available up to Class U17, with models of Classes H11, H13 and H14 constituting the basic range.

The filter elements up to Class H13 are manufactured with plastic frames in the standard version. The patented frame design combines crucial product advantages: Plastic-framed HEPA filters are not only very stable, microbiologically safe, non-corroding, moisture-resistant and lightweight, but also fully incinerable. They meet the hygiene requirements for HVAC systems, offering maximized security against the growth of bacteria and moulds. The suitability for cleanrooms up to Cleanliness Class 2 according to ISO 14644-1 (Class 0.1 to US Fed. Std. 209) has been certified by the German Fraunhofer Institute for Manufacturing Engineering and Automation, IPA.
From Class H14, either plastic or anodized extruded aluminium is the standard frame variant. For specialized applications there are also options for frame materials like galvanized steel or stainless steel sheeting.

Protection grids on both sides offer additional security against mechanical damage to the filter medium during handling. Plastic-framed filter elements can be supplied with flow-straightening plastic protection grids. Metal-framed models can on request be fitted with protection grids made of painted steel mesh or aluminium mesh. Filters from Class H14 and/or with a pleat depth of 280 mm are fitted with protection grids on both sides as a standard feature.
Handles fitted on request to the side of the frame make it easier to replace and dispose of filters contaminated with hazardous dusts.

The tight fit of the filter elements in the mounting system is achieved by continuous, homogeneously foamed-on PU semicircular profile gaskets. The filters with plastic or sheet-metal frames can on request also be supplied with flat gaskets. A PU gasket variant with an integrated test channel for plastic-framed elements allows the leakage test often specified to be conducted.

For the fluid sealing systems frequently used in cleanroom applications, filter frames both with fluid gel and with a knife-edge can be supplied.

Filter elements intended for single-flow configurations feature a metal hood cast for airtight sealing. In addition to the standard spigot diameter of 250 mm, customized versions are also available.

When the requirements for laminar flow are extremely stringent, the filter elements can additionally be fitted with a laminarizing medium on the clean-air side.

Filter/hood module for single-flow configuration

Testing times for quality products

Reg. No. 1420
Freudenberg Vliesstoffe KG
Filter Division
Weinheim/Germany

At Freudenberg, quality is an across-the-board commitment, which starts off with full comprehension of the customer's requirements, before translating these into products, processes and services. A modern Quality Management System to ISO 9001 monitors all operations, from the very beginning of development work and application-engineering consultancy all the way through to delivery of the finished product.

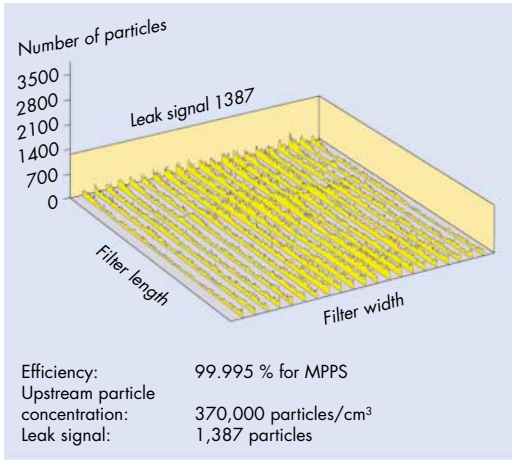
Scan test rig for individual (filter) testing of filters from Class H13

Consistently high quality of the filter media used is essential if the completed filter elements are to perform properly. For quality assurance of the HEPA/ULPA filters, the filter media involved are tested for pressure drop and collection efficiency, determining the specific minimum curve with the MPPS (Most Penetrating Particle Size / efficiency minimum) of the medium under test. The MPPS concerned will later serve as the test particle size for scan-testing the finished filter elements during final inspection.

For individual testing of all HEPA/ULPA filters from Class H13 in conformity with EN 1822, Freudenberg uses one of the world's most sophisticated scanning test rigs. The fully automated filter scanning system determines, at nominal volume flow rate, the pressure drop, the collection efficiency for MPPS and any leaks as well.
To ascertain the local collection efficiencies, the filter element is tested with an aerosol whose particle size has been set to the MPPS value previously determined. The particle number concentration on the raw-air side is measured continuously during the filter scan by means of a CNC (condensation nucleus counter).
On the clean-air side, a pair of sensors, connected to two CNCs, scans the entire surface of the filter, and measures the local particle concentrations. If one of these local concentrations exceeds a predefined limit value, this point is detected as a leak.

In conclusion, the local penetration values, the overall collection efficiency calculated from this, and the pressure drop, together with all relevant test parameters, are recorded in graphical form in a test certificate, provided with each filter element. These individual test reports are an important constituent of the qualification and validation documents for submission to the regulatory authorities.

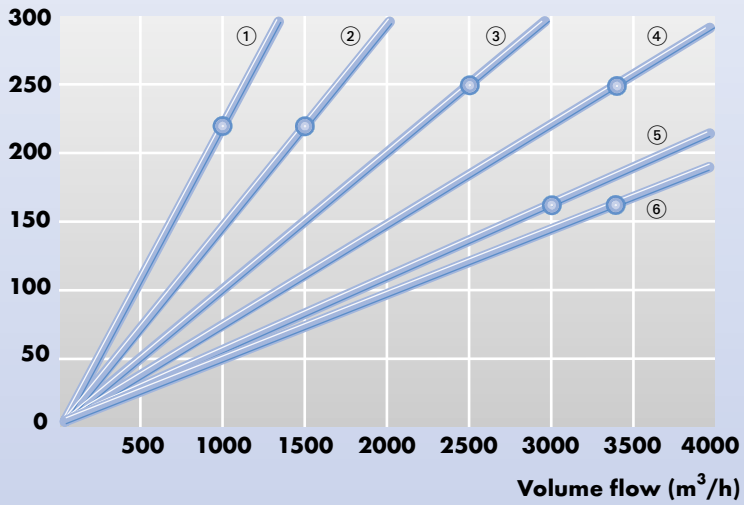
Following the scan test, there is an option for determining a velocity profile of the downstream air flow at freely selectable positions, using hot-wire anemometry, and recording it in a separate test report.



Scan test report for a H14 filter

Maximum air volume in minimum space: Viledon HEPA filters, Classes H10 to H13

Pressure drop (Pa)
for 610 x 610 mm² filter elements / Classes H 11 and H 13



① H 13 / Frame depth 78 mm / Pleat depth 50 mm
② H 13 / Frame depth 150 mm / Pleat depth 100 mm
③ H 13 / Frame depth 292 mm / Pleat depth 200 mm
④ H 13 / Frame depth 292 mm / Pleat depth 280 mm
⑤ H 11 / Frame depth 292 mm / Pleat depth 200 mm
⑥ H 11 / Frame depth 292 mm / Pleat depth 280 mm

Nominal volume flow

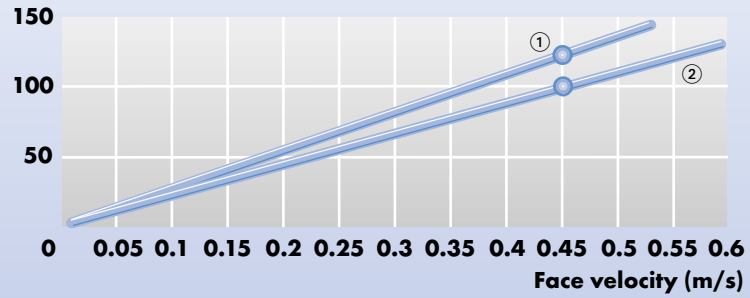
Viledon HEPA filters in Classes H10 to H13 are used for supply, exhaust and recirculated-air filtration in ventilation systems with very stringent requirements for clean-air quality and sterility, e.g.

- in operating theatres and intensive-care units at hospitals
- in cleanrooms
- in highly sensitive industrial processes like electronics, pharmaceuticals, chemicals, cosmetics, optics, foodstuffs, precision engineering
- in handling hazardous substances like carcinogenic dusts, asbestos disposal, heavy metals
- in the nuclear industry and its research facilities

Viledon HEPA filters can handle very large volumes of air at a specified pressure drop, or achieve very low pressure drops for a specified volume flow. So you can either get big performance in a small space, or cut your energy costs, whichever you like.

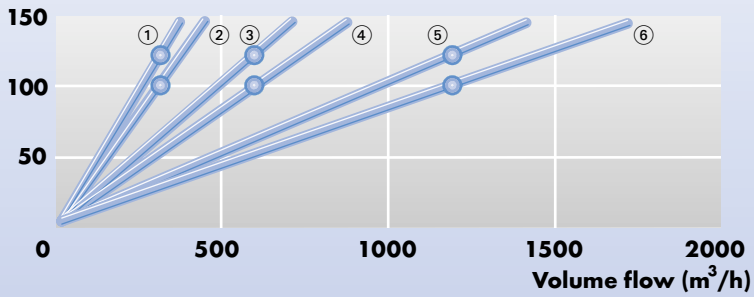
Laminar flow with minimum pressure drop: Viledon HEPA and ULPA filters, Classes H14 to U17

Pressure drop (Pa) for Class H 14



① H 14: Frame depth 71 mm or 78 mm / Pleat depth 50 mm
② H 14: Frame depth 92 mm / Pleat depth 70 mm

Pressure drop (Pa) for Class H 14



① 305 x 610 mm / Frame depth 71/78 mm
② 305 x 610 mm / Frame depth 92 mm
③ 610 x 610 mm / Frame depth 71/78 mm
④ 610 x 610 mm / Frame depth 92 mm
⑤ 610 x 1220 mm / Frame depth 71/78 mm
⑥ 610 x 1220 mm / Frame depth 92 mm
Pleat depth 50 mm
Pleat depth 70 mm

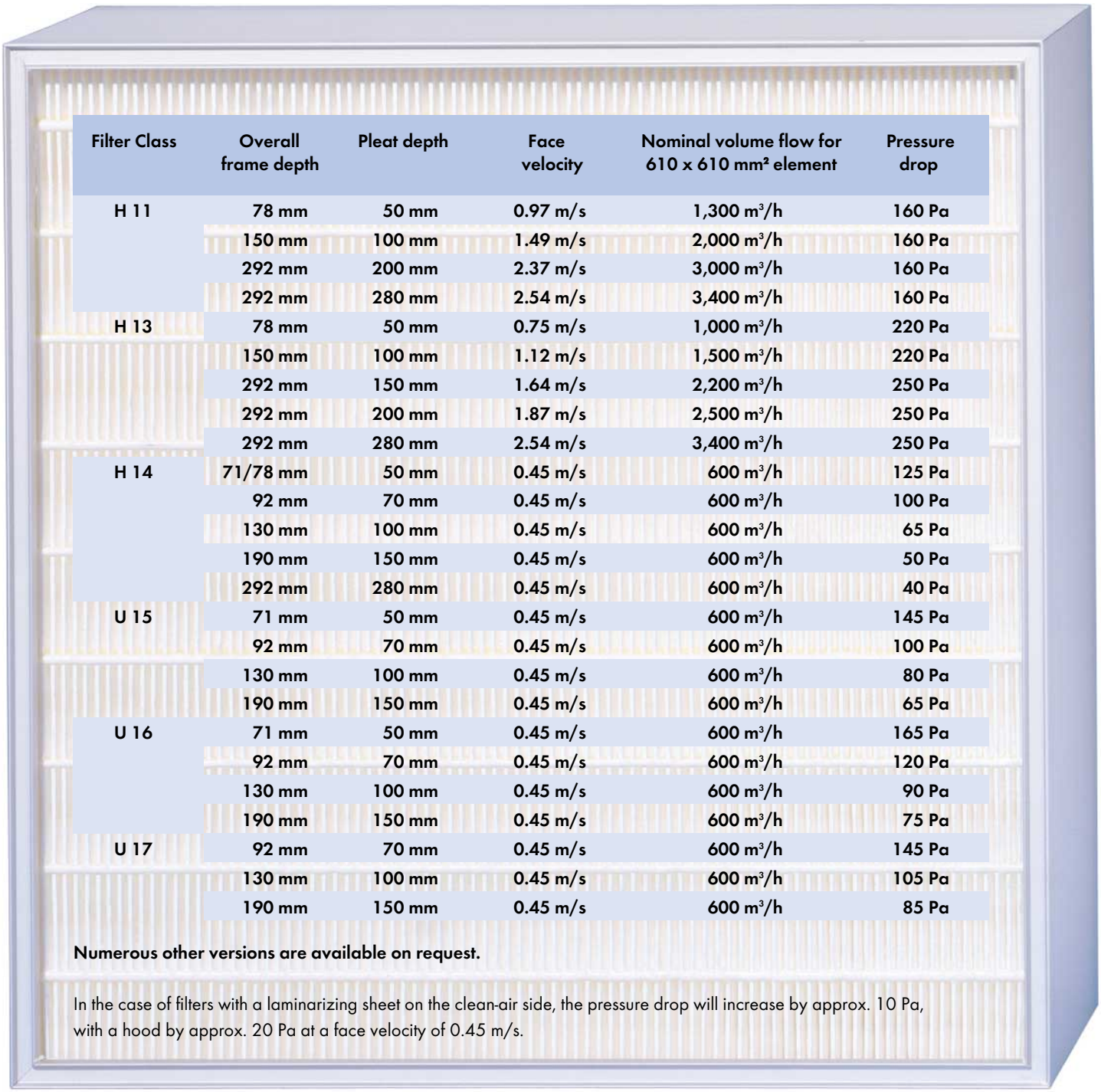
Viledon HEPA and ULPA filters in Classes H14 to U17 are used for supply, exhaust and recirculated-air filtration in ventilation systems with extremely stringent requirements for clean-air quality and sterility, e.g.

- in laminar flow boxes
- in laminar-flow areas in pharmaceutical processes, operating theatres, etc.
- in micro-electronics (e.g. semiconductor manufacturing)
- in ceiling outlets and modules for flexible cleanroom systems (filter-fan modules)

The particularly large quantities of air which have to be recirculated continuously in laminar-flow applications entail correspondingly high energy costs. So every Pascal of pressure drop at the filters installed shows up only too clearly in the system operating costs.

Viledon cleanroom filters, with pleat depths of up to 280 mm, enable substantial cost savings to be achieved here.

Viledon HEPA and ULPA filters – Top of the class every time



Filter Class	Overall frame depth	Pleat depth	Face velocity	Nominal volume flow for 610 x 610 mm² element	Pressure drop
H 11	78 mm	50 mm	0.97 m/s	1,300 m³/h	160 Pa
	150 mm	100 mm	1.49 m/s	2,000 m³/h	160 Pa
	292 mm	200 mm	2.37 m/s	3,000 m³/h	160 Pa
	292 mm	280 mm	2.54 m/s	3,400 m³/h	160 Pa
H 13	78 mm	50 mm	0.75 m/s	1,000 m³/h	220 Pa
	150 mm	100 mm	1.12 m/s	1,500 m³/h	220 Pa
	292 mm	150 mm	1.64 m/s	2,200 m³/h	250 Pa
	292 mm	200 mm	1.87 m/s	2,500 m³/h	250 Pa
	292 mm	280 mm	2.54 m/s	3,400 m³/h	250 Pa
H 14	71/78 mm	50 mm	0.45 m/s	600 m³/h	125 Pa
	92 mm	70 mm	0.45 m/s	600 m³/h	100 Pa
	130 mm	100 mm	0.45 m/s	600 m³/h	65 Pa
	190 mm	150 mm	0.45 m/s	600 m³/h	50 Pa
	292 mm	280 mm	0.45 m/s	600 m³/h	40 Pa
U 15	71 mm	50 mm	0.45 m/s	600 m³/h	145 Pa
	92 mm	70 mm	0.45 m/s	600 m³/h	100 Pa
	130 mm	100 mm	0.45 m/s	600 m³/h	80 Pa
	190 mm	150 mm	0.45 m/s	600 m³/h	65 Pa
U 16	71 mm	50 mm	0.45 m/s	600 m³/h	165 Pa
	92 mm	70 mm	0.45 m/s	600 m³/h	120 Pa
	130 mm	100 mm	0.45 m/s	600 m³/h	90 Pa
	190 mm	150 mm	0.45 m/s	600 m³/h	75 Pa
U 17	92 mm	70 mm	0.45 m/s	600 m³/h	145 Pa
	130 mm	100 mm	0.45 m/s	600 m³/h	105 Pa
	190 mm	150 mm	0.45 m/s	600 m³/h	85 Pa

Numerous other versions are available on request.

In the case of filters with a laminarizing sheet on the clean-air side, the pressure drop will increase by approx. 10 Pa, with a hood by approx. 20 Pa at a face velocity of 0.45 m/s.

The figures given are mean values subject to tolerances due to the normal production fluctuations. Our explicit written confirmation is always required for the correctness and applicability of the information involved in any particular case.

You will find instructions on how to handle and dispose of loaded filters in our information on product safety and eco-compatibility.

Freudenberg Vliesstoffe KG · Filter Division
D - 69465 Weinheim
Tel. +49 (0) 62 01/80-62 64 · Fax +49 (0) 62 01/88-62 99
Email: filter-service@freudenberg-nw.com · www.viledon-filter.com

Freudenberg

LRO 060 June 2004 · Replaces all previous issues of this brochure · Printed on paper bleached without chlorine.