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Aldes ME Flash

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Technical Information

Air Filtration

Why filtration ?

Filtration decreases the concentration of particles in the air.

There are 3 important goals :
- Preserve **the indoor air quality** (IAQ) in each indoor and environment (home, offices, residential and commercial premises, factory…) from the pollutants contained in **the outdoor air.**
- Protect **outdoor environment** from the pollutants carried out by the rejected indoor air (chemicals, biological products…).
- Protect **ductwork components** (motor, exchanger,…).

If the air is not filtrated, the pollutants are stagnating and proliferating in the ductwork. The exchangers or others elements are getting clogged and this lead to risk of bacteria development and pollutants transfer.

Pollution is a complex phenomenon which results of the presence of noxious elements in the atmosphere. There are two types of pollutants. The physical one, which consists in discerning gaseous pollutants and solid pollutants (dust and particles). The second one distinguishes the origin of pollutants (primary and secondary pollutants).

1- **Solid pollutants:**
They are **thin particles** which can **transport** some other substances**,** such as for example carcinogenic aromatic hydrocarbons. Those substances can go into the pulmonary cells and even into the blood.

2- **Primary pollutants :**
These substances are located **in the atmosphere** with **no chemical transformation**. Among these pollutants, some of them are important :
• **sulfur dioxide (SO2)** produced by industrial activities. This pollutant is transformed into sulfur acid (H2S04) in the atmosphere which is mainly responsible for acid rains.
• **Nitrogen oxide (NOX)** produced by fossil fuel combustion which contributes to the creation of ozone in the atmosphere.
• **Volatile organic compounds (VOC)** which correspond mainly to hydrocarbons but also to methane (responsible for greenhouse gas emissions).

3-Secondary pollutants:
Those substances are the result of **primary pollutants chemical transformation** (ozone, sulfure acid, nitric acid).

Filtration is a common way to struggle against solid pollutants. However some filters with high efficiency are designed for gaseous pollutants.

Filter classification according to the efficiency

Filters are classified in 4 types :

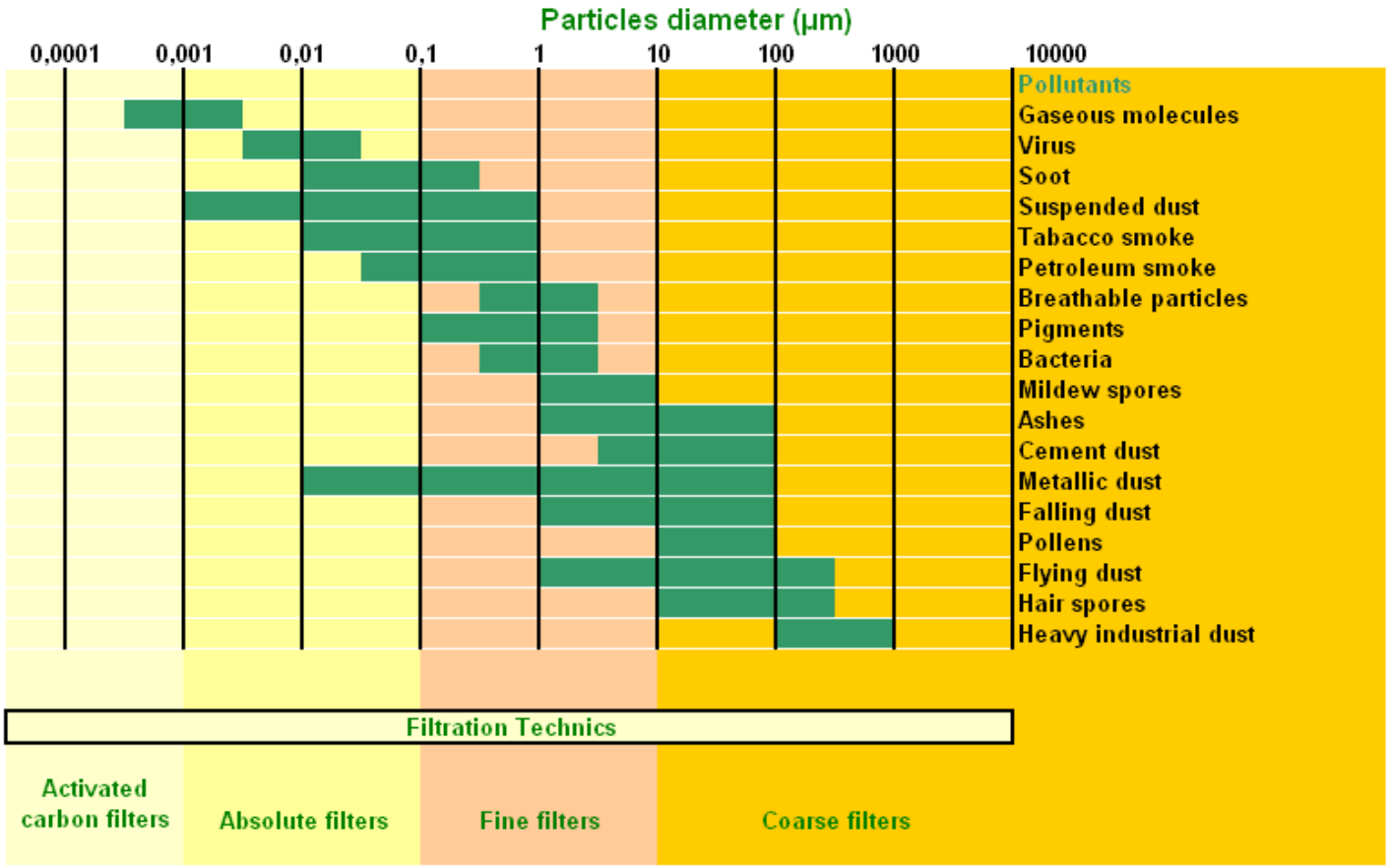
1- Coarse filters or formerly called gravimetric filters:
The first goal of this filter is to **stop the biggest particles** but can also be used as a filter **protection** with higher efficiency downstream. They stand for the letter G.
(Filtration until 10µm – example : pollen)

2- Fine filters or formerly called opacimetric filters:
They can be used as a first stage of **filtration**. The main goal is the air treatment in commercial buildings but they can also protect absolute filters for high protection application. They stand for the letter F.
(Filtration until 0.1µm – example : spores, bacteria)

3- Absolute filters:
They are essentially used for sensible applications (hospitals, pharmaceutical, industries). They **limit** the gas or virus **propagation**. They stand for the letter H (for HEPA - High Efficiency Particulate Air) or U (for ULPA - Ultra Low Penetration Air).
(Filtration until 0.001µm – example : bacteria, smoke).

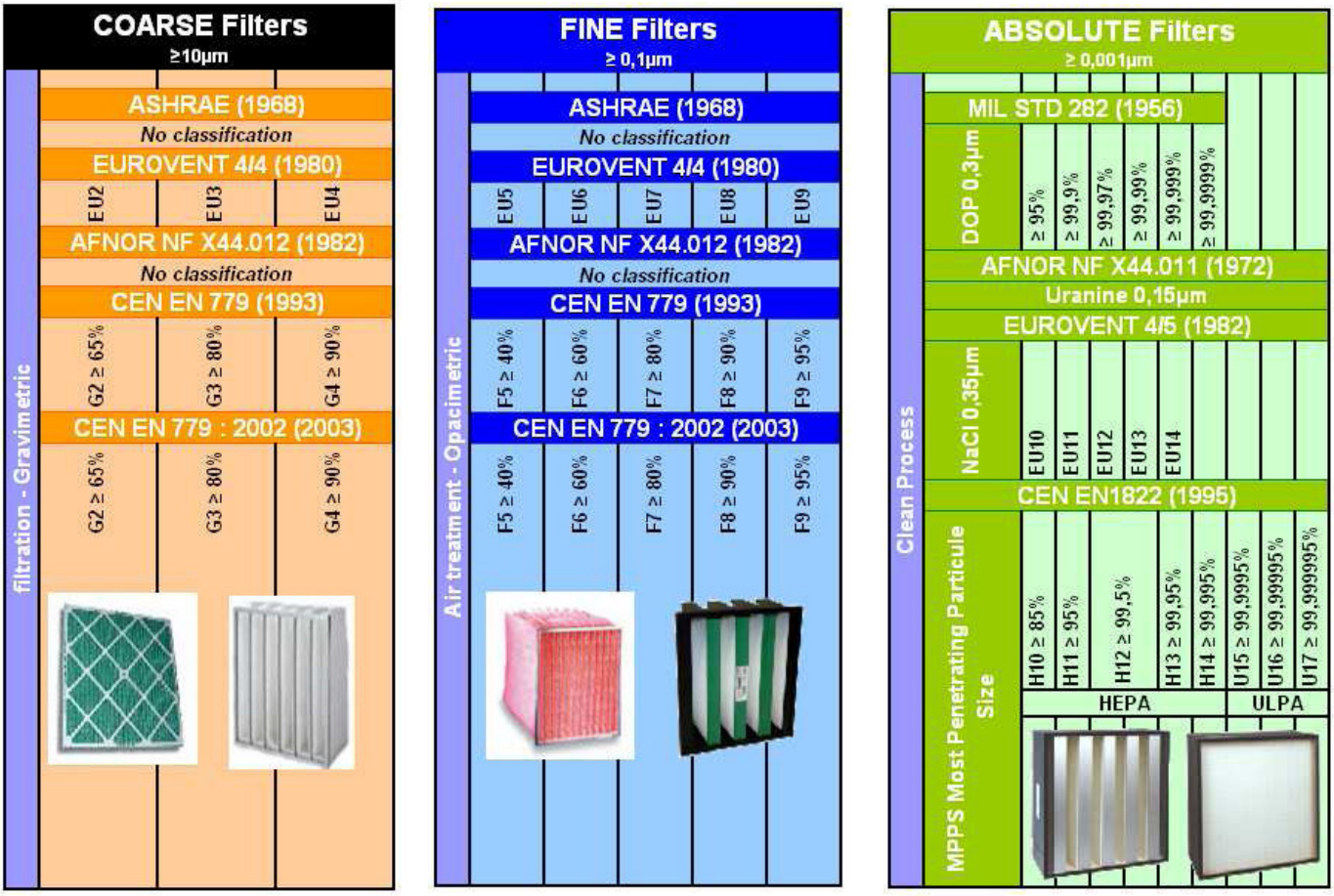
4- Activated carbon filters:
They are used for **stopping the contaminants** on molecular level, neutralizing the smells (in kitchen for instance) and ensuring the security for nuclear installations. They must always be protected by a filter with minimum F7 efficiency filter.
(Filtration until 0.1nm ie 0.0001µm – example : pet shop\odor).
This type of filtration won't be introduced in this technical letter

The table below gives the fitted filtration - for some pollutants.



The following table introduces the chronology of different standards and filter tests applied, from 1956 to nowadays. Each step brought improvements in the efficiency determination methods. The equivalence between different classifications is hard to determinate (for instance EUROVENT filter: 4/5 and EN1822).

Up to this day, the European standard is the most recent and the most used by the majority of filter manufacturers.



The filtration percentage indicated in this table corresponds with the percentage of particles (with the associated diameter) stopped by the filter. For example, a filter H10 can stop more than 85% of particles, with a diameter bigger than 0.001µm.

AFNOR	*French association of normalization*
ASHRAE	*American Society of Heating, Refrigerating and Air-conditionning Engineers (USA)*
EUROVENT	*European committee for constructors of aeraulic material*
CEN	*European committee of normalization*
HEPA	*High Efficiecy Particulate Air (filter)*
ULPA	*Ultra Low Penetration Air (filter)*
MIL STD	*Military Standard for USA*
DOP	*Di-Octyl-Phtalate : measurement of the filter efficiency as pourcentage of stopped DOP particles sized at 0,3µm*

The EN779 standard changed in 2003. In fact, some types of filters depend on the electrostatic effect to get higher efficiency (see page 6 of this Aldes ME Flash). The new method of the EN779:2002 standard can now assess the level of the performance deterioration due to the decrease of the electrostatic effect.

Tables below gives some possible applications for each kind of filters.

COARSE FILTERS			
	EUROVENT 4/5	EN 779	
First filtration - Gravimetric	EU2	G2 ≥ 65%	□ Against insects
	EU3	G3 ≥ 80%	□ Fan coils / □ fat captation / □ Pollen protection
	EU4	G4 ≥ 90%	□ painting or glazing cabinets / □ climatisation cabinet / □ 1st minimum level in air handling unit

FINE FILTERS			
	EUROVENT 4/5	EN 779	
Opacimetric	EU5	F5 ≥ 40%	□ Wharehouse, lobby ventilation
			□ minimum filtration for the air recycling from the room without specific pollution
	EU6	F6 ≥ 60%	□ Adapted for oil an soots fogs
	EU7	F7 ≥ 80%	□ mimium first filration for an activated carbon filter
			□ 1st level advised level for air handling unit
			□ phone call centers, offices, auditoriums
	EU8	F8 ≥ 90%	□ Adapted against bacteria
	EU9	F9 ≥ 95%	□ Computer rooms /□ steril room access

ABSOLUTE FILTERS				
	EUROVENT 4/4	MIL STD 282	EN1822	
Clean process	EU10	≥ 95%	H10 ≥ 85%	□ Final filtration for non sensible zone in hospitals
	EU11	≥ 99,9%	H11 ≥ 95%	
	EU12	≥ 99,97%	H12 ≥ 99,5%	□ photographic industry
	EU13	≥ 99,99%		
	EU14	≥ 99,999%	H13 ≥ 99,95%	□ pharmaceutical industry / □ food-processing industry
		≥ 99,9999%	H14 ≥ 99,995%	□ Sensible surgery room
				□ Exhaut from the production of toxic products and isotopic laboratories (P3), □ military and nuclear sites
				□ laminar flow /□ Micro & electronic mechanics
			U15 ≥ 99,9995%	□ Clean rooms in microelectronic
			U16 ≥ 99,99995%	□ specific laminar flow hood
			U17 ≥ 99,999995%	□ Exhaut from the production of toxic products and isotopic laboratories (P4)

Filter classification according to their geometry

Filters can be classified according to their geometrical structure :

- Metallic filters: in aluminum, galvanized or stainless steel. Adapted for a cleaning application or corrosion resistance : oil fog, professional cookerhood (type G2, G3). Mounted on frame or slides.

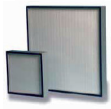
- Pleated filters: pleated structure on steel frame or cardboard. Compact size and minimum pressure drop (type G3, G4). Also available for higher efficiency (from F5 to F7). Mounted on frame or slides.

- Plan filters: plan structure on a metal frame or cardboard (from G2 to G4). Mounted on frame or slides.

- Flexible bag filters: with metallic or plastic frame. The depth can vary between 195 mm to 635 mm (from G4 to F9). Mounted on frame or slides.

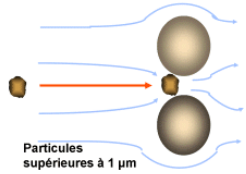
- Dihedral filters or rigid bags filters: fine fibre on rigid frame. High filtration area. Mounted on both side (F6 to H10), on frame or slides.

- Multi-dihedral filters for HEPA (from H10 to H14). Mounted with compression screw.



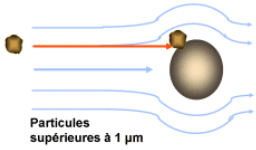
- Filtrating panels: for HEPA et ULPA filters. In final position - in specific casing or in the ceiling inside the diffuser. Mounted with compression screw

Filtration mechanisms

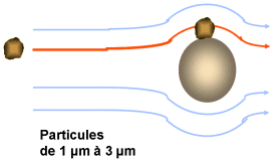


Airflow with particles arrives on the filter's fibres. Air direction is then deflected and particles in the air are going to be stopped by fibres - according to 4 different physical mechanisms :

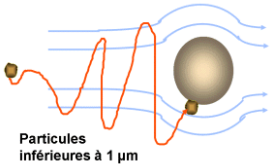
- **Sieving :** particles with diameter higher than the distance between 2 fibres are blocked.



- **Inertia :** the biggest particles have a too high inertia to follow the airflow direction changes. These particles do not deflect and are stopped by fibre.



- **Interception :** the smallest and lightest particles follow the airflow. The ones close to the fibre are stopped.



- **Diffusion :** Particles <1µm have an anarchical trajectory and do not follow the airflow. As soon as their trajectory meets the fibre, these particles are going to be stopped.

Composition & structure of the filter

For the choice of the filter, other physical elements are taken into account :

- **fibre structure:** 2 types of fibres exist :

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• **synthetic fibre:** the efficiency is linked to the capacity of the fibre to keep the electrostatic effect as long as possible. Indeed, some filters have an electrostatic charge which can be natural or given through the manufacturing process (called « electret filters »). Such filters can have a high efficiency when they are clean to the electrostatic effect between particles and fibres. But this efficiency decreases after a while. The minimum efficiency is reached after few weeks (between 7 and 10). The efficiency decreases but knows a small rise when the filter starts to be clogged.

• **fibreglass:** this filter does not need electrostatic effect in order to stop particles. Additionally, the cloggest they are, the more efficient they get – up to a limit (see next part « pressure drop»). These fibres are used essentially for F, H and U filters.

- **Diameter and density of the fibre:**

↗ Ø Fibres => ↘ Efficiency

↗ Fibres density => ↗ Efficiency

- **Mounting :** mounting types can be different according to the kind of filter and its application (mounting on slides, on frame, with compressive screws…).

Pressure Drop

Filter pressure drop corresponds to the filter's aeraulic resistance to the airflow. Some factors determine the pressure drop: the nature of the filter, its structure, and also clogging. The filter lifetime is linked to the evolution of pressure drop. The filter clogging leads to the pressure drop increase of the whole installation (increase around 100 to 200 pa).

The filters replacement is recommended when the pressure drop reaches a maximum value - given by the manufacturer. This value is the limit from which the manufacturer won't guarantee the filter performance and/or its mechanical resistance.

Cleaning a filter is not recommended (except for metallic ones). The contact with water or a mix of liquids can damage and lower the filter efficiency. The loss is estimated to almost 50% (at each cleaning).

The clogging control is handled with leant tube pressure gauge or pointer pressure gauge. The user measures the pressure thanks to pressure connections, upstream and downstream of the filter. An alarm could activate when the fixed maximum pressure, determined by the user, is reached, which means that the filter should be replaced.

To design the pressure drop of the filter in an aeraulic system, the usual parameter is the average clogging. This parameter is obtained by an average between final pressure drop of the clogged filter and initial pressure drop of the clean filter – such as following:

$$\Delta Pmoyen = \frac{(\Delta Pfinal - \Delta Pinitial)}{2}$$

Aldes Range – which filters in our products?

The table sums up the different filters in Aldes products.

		Supply air / Exhaust air	
Commercial Premises Ventilation	VEKITA	Pleated filter	G4
		Pleated filter	F5
	VIK	Pleated filter	G4
		Pleated filter	F5
	TVEC GII	Bag filter	G4
		Bag filter	F5
	TVEC GII - valve filter	Pleated filter	G4
	DFE - HRV unit	Pleated filter / Pleated filter	G4 / G4
	DFE + micro-watt	Pleated filter / Pleated filter	F7/ G4
Grilles and Diffusers	AC 161 - 163	Plan filter	G3