Air filters for ventilation installations

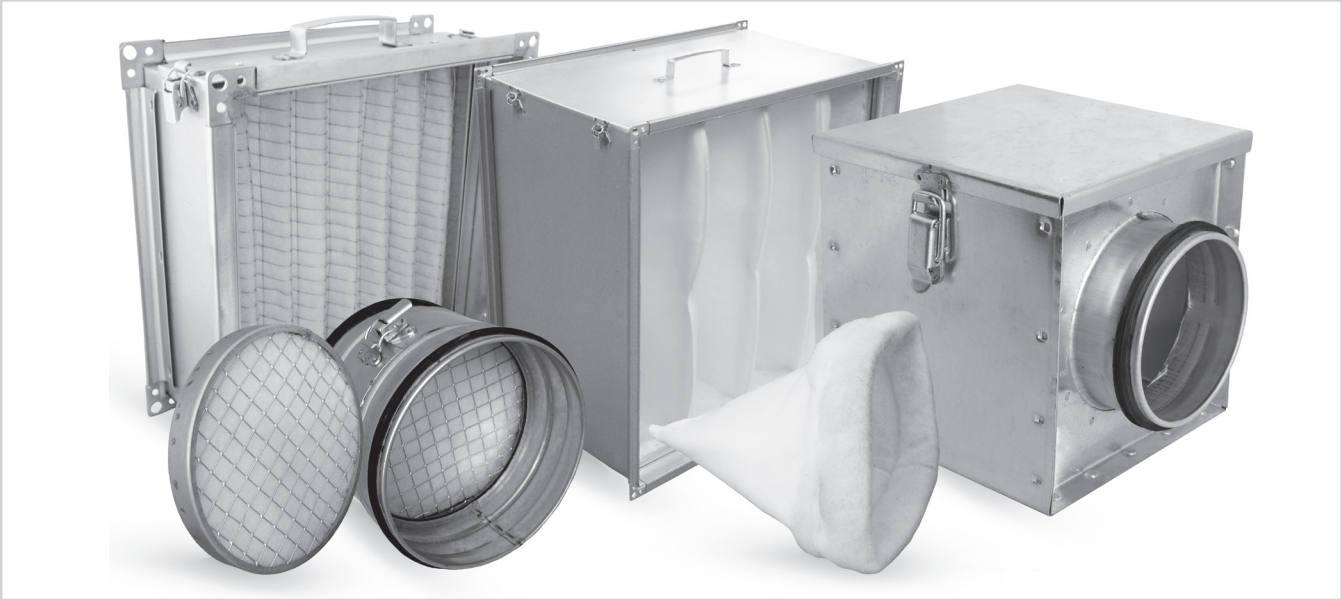

Illustration no. 1
Air filters available in Alnor product offer

Filters are used in ventilation systems for protection against impurities which may cause irregular operation of the entire system or damage its individual components.

Air filters are used to ensure adequate indoor air quality for users in rooms fitted with the ventilation system.

The main parameter of air filters is impurity control efficiency with as low as possible obstruction to the air flow.

The filtration process itself is defined as removing foreign particles from liquid or gas, whereas an air filter stands for a device used to remove particles from liquid or gas.

Physical phenomena which are used to arrest the particles within the filter or on its surface are called filtration mechanisms. The mechanism which separates air particles in the filtration layer by single strand depends, among others, on the strand diameter, particle diameter, flow speed and particle distribution upstream from the strand.

Most basic filtration mechanisms include:

- molecular diffusion
- direct adsorption,
- inertial deposition,
- blocking (interception),
- electrostatic phenomena.

The most important parameters to describe the filtration process are:

- filtration efficiency,
- air flow resistance,
- dust absorption
- air flow speed,
- air stream volume,
- filtration surface area.

Illustration no. 2
Duct filter
UFI cassette filter

Filtration devices have a specific dust capacity. It stands for the maximum weight of the dust particles separated by the filter per unit of filtration surface area at which the so called full dirtying of the filter occurs. This asks for regular maintenance of the installation and replacing air filters.

Filters are used in ventilation both in air supply and exhaust systems .

Filters in air exhaust installations

Arresting impurities with varied particle types to supply clean air to the facilities calls for a multi-stage filtration system.

Illustration no. 3
Duct filter insert
class EU3, EU4, EU5

To this end, filters made of fibrous materials are used the most often.

For exhaust installations, the filters are most often used as dust collectors. Moreover, they separate impurities such as: microorganisms, including germ microbes and chemicals from the air. Filters are also employed to a different - no less important - end, to protect ***heat recovery systems*** from impurities from indoor air which may deceptively seem to be clean.

Ventilation filters remove impurities from air, however the actual scope of application for a specific filter type depends entirely on its capacity to arrest particles. The capacity to arrest specific types and fractions of impurities is equally important. To allow for easy selection of the right filter for the right application, they were divided into classes.

During use, filters slowly accumulate impurities which means the filter itself in time may start to emit impurities, including microbiological ones. If proper conditions are met, fungi may

Table no. 1
Filter types according to different classifications

	Germany	European Standards
Basis for the classification	**DIN 24184**	**PN-EN 779**
	DIN24185	**-**
Pre-filters (rough)	EU1	G1
	EU2	G2
	EU3	G3
	EU4	G4
Nominal grade filters	EU5	G5
	EU6	G6
	EU7	G7
	EU8	G8
	EU9	G9
Absolute filters (High-efficiency) HEPA		H10
	EU10	H11
		H12
	EU12	H13
	EU13	H14
Absolute filters (High-efficiency) ULPA		U15
		U16
		U17

germinate to the other side of the filter, reducing the air purity within the facility. Filter impurities also cause increased air flow obstruction, this limits the amount of fresh air supplied to the rooms. This necessitates that filters are replaced periodically.

For facilities with elevated hygiene requirements, it is recommended to employ a multi-stage filtration system which utilizes a sequence of filters with gradually increasing filtration efficiency.

Multi-stage filtration systems most often utilize:

- pre-filters (also known as rough filters) - Ist stage
- nominal filters -IInd stage,
- absolute filters -IIIrd stage,

Irregularities in the filtration system may cause irregular operation of the ventilating unit and a decrease in air quality.

Causes for irregularity in air filter operation are:

- improper filters used in the particular installation,
- improper filter installation,
- leaks in the filtration system,
- mechanical filter damage,
- too much dirt accumulated on the filter surface.

Illustration no. 4
FSCQ cassette duct filter class EU3, EU4, EU5

Dirty filters effectively limit the air flow and may act as a secondary source of impurities.

Exhaust system filters also collect indoor impurities. Pre-filter dirtying may also cause increased noise in the clean room due to the increased positive pressure inside the ventilated room compared to adjacent rooms.

Improper fastening and insulation of the filter, or damage to the filter surface causes impurities to enter downstream components in the system, this may result in the contamination of, e.g. heat exchanger active surface, or the ventilator fan, which in turn causes irregular operation of the system.

Depending on actual requirements, pre-filters or even absolute grade filters may be used for exhaust-side installations.

Illustration no. 5
Conical UFI duct filter, class EU3, EU4, EU5

Projected lifetime of exhaust filters depends on the intended use of the installation as well as outside air purity, it usually spans from 0,5 to 2 years.

Ventilation filters for air supply systems.

Pre-filters are used to remove comparatively large-sized particles from the air. Higher grade filters are used to separate sub-micron particles.

Pre-filters are placed at the very start of the installation system - near the actual air intake, to prevent dusting and to remove larger particles which may damage the ventilation system components or the recuperator unit.

In ventilating units, the delicate surfaces of the heat exchanger are especially susceptible to contamination.

Pre-filters should be replaced periodically, between 3 and 6 months of operation, depending of external air quality. In any case, the filter should not be replaced less frequently than once per year.

Illustration no. 6
FSQ duct cassette filter
class EU3, EU4, EU5

Nominal grade filters are usually used at the second filtration stage. Higher filtration efficiency compared to pre-filters allows to separate most of the dust and microbiological impurities. These filters protect the ***ventilation ducts, silencers***, and end-filters from quick accumulation of dirt.

Impurities collected by the filters make for a good environment for microorganisms to develop. Moreover, highly contaminated filters block the air flow in the installation to the extent that it causes an increase of temperature by several degrees in the downstream duct after the ventilator.

Filters should be replaced in the period between 5 to 9 months. Due to the risk of fungus developing in the nominal filters, their lifetime should no exceed 12 months, even in highly favourable conditions.

Illustration no. 7
Duct filter cartridge
with round duct connection

Nominal grade filters should be installed on the delivery side, downstream from the devices such as ***the ventilator*** or air humidifier which can create aerosols. It is recommended to install pocket filters so that the individual pockets are arranged vertically.

End filters - absolute grade for the ventilation systems are mostly used in clean rooms. They act as the final barrier for impurities coming from the installation itself and usually act as the IIrd stage of the filtration.

Typically, the lifetime of absolute filters in clean rooms is 6 to 18 months.

Absolute grade filters should be tightly fixed in place, well-insulated and located as close to the room as possible, ideally directly within the supply ventilator.

Filter replacement

The capacity of the clean filter is initially less than nominal, and increases as the impurities are collected on the filtering surface. The dust layer in the pockets of the filter creates a so called secondary filtration layer. On the other hand, at the same time the air flow obstruction increases. It is the result of large amount of dust deposited on the filtration layer.

Illustration no. 9
Duct filter inserts, class EU3, EU4, EU5

At the moment when the critical mass of the buildup is reached, filter efficiency diminishes. Reduced filtration capacity is a direct result of the reduced or blocked air flow in the filter.

Selecting and purchasing a proper filter type calls for the specification of several material and construction requirements such as: dimensions and expansion, insulation type, number and arrangement of filtration pockets, damage protection for the filtering materials, required mounts, etc.

A practical solution is to purchase duct filters, cassette and pocket filters fitted in special cartridges which can be easily opened to replace the filter insert.

Pocket and cassette filters feature:

- easy installation,
- quick replacement,
- long lifetime,
- good filtration efficiency,

Air filtering serves to protect the ventilating unit from contamination and increases the lifetime of the entire ventilation system. Hence, to ensure comfortable conditions in ventilated facilities and to protect the ventilating units from damage, filters should be replaced at the right time.

For more information on filters, see the website: *www.ventilation-alnor.co.uk*.