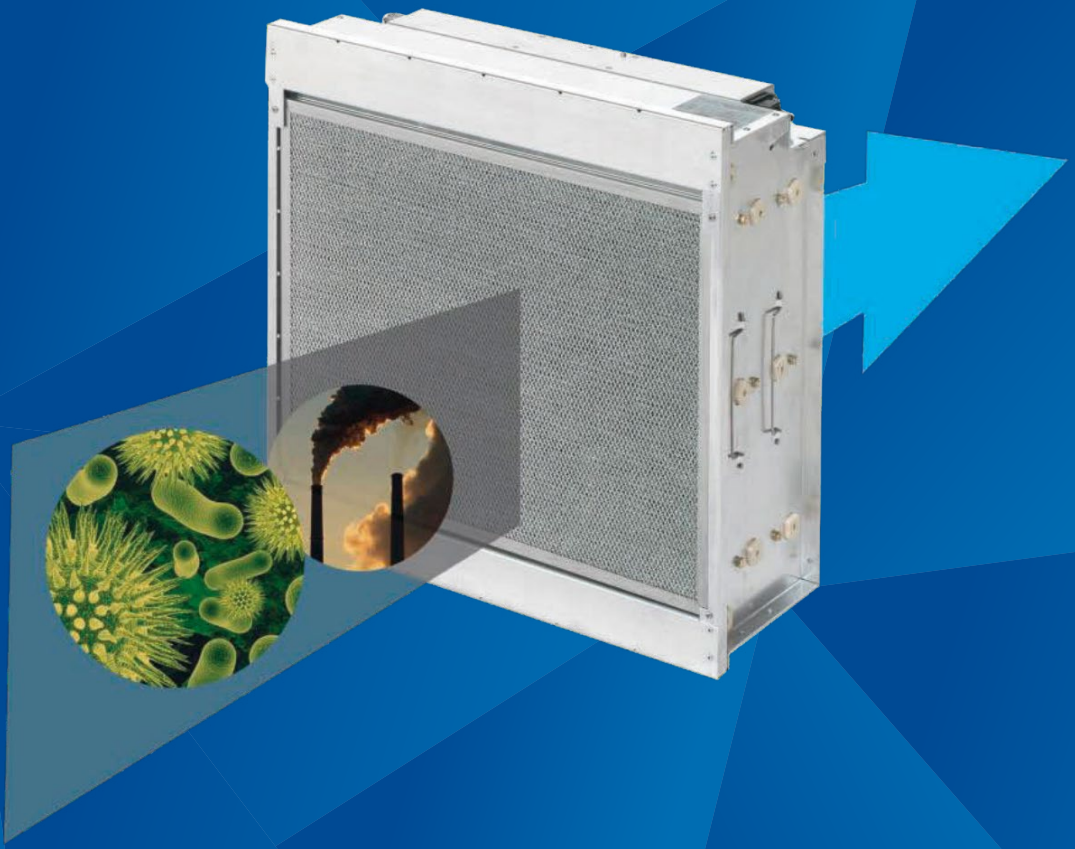
TECHNICAL FOCUS

# FE SYSTEM ELECTROSTATIC FILTER

## HIGH TECH SOLUTION FOR AIR PURIFICATION



expansion® electronic

BETTER AIR FOR A BETTER QUALITY OF LIFE

# SUMMARY

# DETAILS

The use of static air filtration dates back to the early 1900s, when a newly patented device in the United States was employed for the abatement of fumes which came from a sulfuric acid synthesis system.

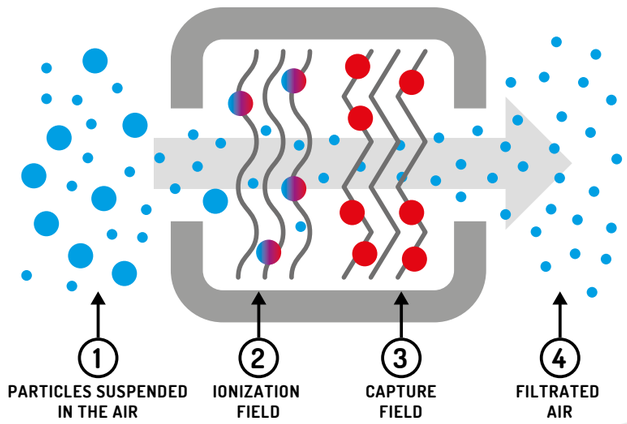
Thanks to the specialization in different applications and to the evolution of materials and control systems, this principle is now available in many constructive variants of different complexity, which are intended for specific applications such as air treatment and air conditioning (shopping centers, hospitals, offices), or in the food, textile, mechanical or electronic industries.

## OPERATION PRINCIPLE

The operation principle of the electrostatic or electronic filter is based on the electrostatic precipitation process, the effect of which is comparable to the attraction of iron objects to a magnetic field.
The flow of air passing through the electrostatic filter when it comes into contact with the filter is affected by two main phases:

1. the transfer of an electric charge to the particles (ionization) phase n°2,

2. capture of the particles (capture) phase n°3.




## MAIN CONSTRUCTIVE FEATURES

The FE SYSTEM series consists of a new range of active electrostatic filters, very practical and usable in substitution or in addition to traditional mechanical filters (bag and pocket filters), in new and /or existing installations without adaptation costs.

FE SYSTEM electrostatic filters are made up of a metallic aluminum body, which, during the filtration process, intercepts the pollutant by accumulating it on the capture blades.

Its adoption in ventilation systems and in particular in the air conditioning industry does not require changes in the structural and dimensional characteristics of the plant.

Standardized dimensions according to EN 15805: 2008.

# MAIN CONSTRUCTIVE FEATURES

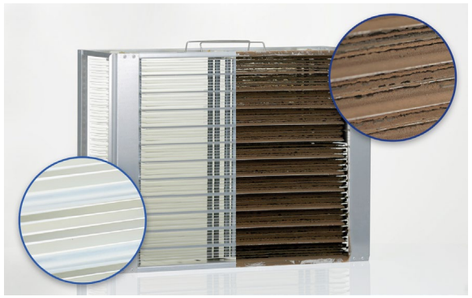
## 1 - ADAPTABLE

One of the main features of the FE SYSTEM Filters is the applicability in a variety of industries thanks to the standard sizes compatible with the pocket filters.
**AIR CONDITIONING:** Installation inside conditioning units for residential, tertiary and industrial sectors.
**INDUSTRIAL:** Filtration of micro dusts, rubber and plastic fumes, fumes in general, welding fumes (such as ferrous metals, precious metals, control panels) with a maximum concentration of 20 mg/m.
**HOSPITAL:** Control of aerodynamic contamination for hospital rooms, white rooms, outpatient clinics, waiting rooms.
**FOOD SOLUTIONS:** Control of air contamination during food processing.

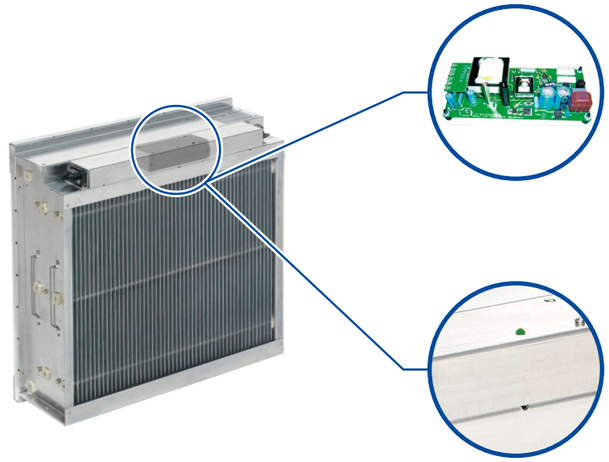
## 2 - RENEWABLE BY WASHING

FE SYSTEM filter is made up of a metallic alluminium body, which gets dirty by accumulating the filtered pollutant on the inner plates.

When the filter is saturated, the LED starts blinking. It is enough to wash with water and a little alkaline detergent to remove dirt and regenerate the filter. This operation does not damage the filter electronics, protected by waterproof resin.



## 3 - INCORPORATED ELECTRONIC



**Circuit**
A feature that distinguishes the FE SYSTEM Filters is the built-in electronics that generates the high voltage needed for the operation of the filter.

**Led**
Multi-pole connectors can be used to connect multiple filters with one power line (230V to 50Hz) and provide the alarm signal.
Integrated electrostatic circuit with complete watertightness.

## 4 - CERTIFICATED EFFICIENCY

The FE SYSTEM filters have been tested by independent and international organizations, which have issued the following certifications:

| | |
|---|---|
| **UNI 11254 : 2007** | It classifies FE SYSTEM Filters in Four Degrees of Filtering (A, B, C, D) Italian Certification |
| **EN 1822 : 2005** | It classifies FE SYSTEM Filters as Absolute Filters (E10-E11 Class) International Certification |
| **EN 779 : 2012** | It classifies the FE SYSTEM Filters as Fine Filter (F7-F9 class) International Certification |

# FILTRATION EFFICIENCY

The “dual-voltage” electrostatic filters have very high filtration efficiency, also linked to the crossing speed as shown in the following figure.

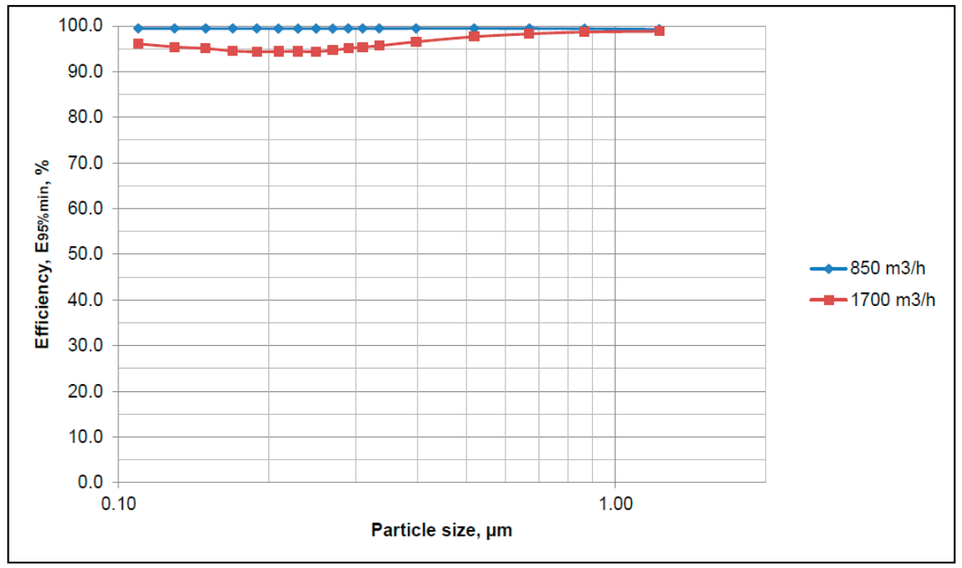



**Table 1:** Filtration efficiency 1m/s and 2m/s FE600

The filtration efficiency is therefore **not less than E10 (ex H10)**, that is the class identified as absolute filter when faced with frontal crossing speeds up to 2 m/s.

This performance is obtained with **almost no pressure drop**, given by constructive geometry and linked to the presence of a metal pre-filter placed upstream of the electrostatic filter, with the function of retaining the coarsest particles and distributing airflow uniformly.

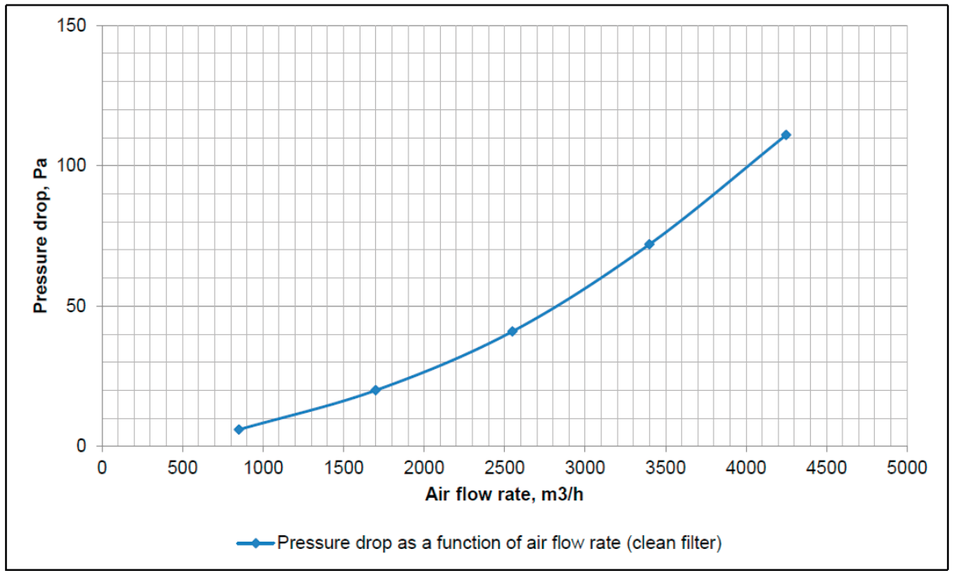


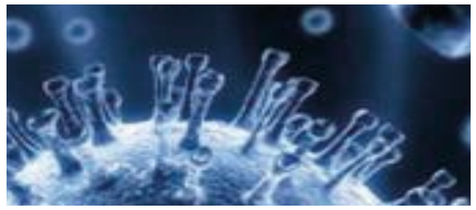

**Table 2:** Pressure drop FE600

The use of electrostatic filters therefore **does not increase the power of the ventilation section**, as it is necessarily done with the presence of rigid pockets or flushes of the traditional type to cope with the increased pressure drop of the filtration seals. Since ventilation is active throughout the entire operating range of the unit, so as to account for about half the electrical consumption and therefore operating costs, energy and environmental savings are absolutely significant.

# ABATEMENT MICRO-ORGANISMS

Electrostatic filters are active on pollen, fine dust, toner, mold, smog, viruses, bacteria and tobacco smoke.
As documented in the technical literature and on the basis of specific tests and laboratory tests (ILH Berlin and San Matteo di Pavia), electrostatic filtration systems are able to electrostatic filtration systems are able to eliminate from the airflow, with a typical **efficiency ranging from 98.5% to 99.9%**, also microorganisms such as:

- airborne bacteria, such as Micrococcus luteu,
- yeast, such as Rhodotorula rubra,
- Bacillus Anthracis
- molds and germs present in the natural spectrum of air.



# ENERGY CONSUMPTION

The filter is powered through the integrated electronic board (see p.5). The electronic circuit is integrated with complete watertightness. Network power supply (230V -50/60 Hz).
**The electric absorption of the filters**, even at full load, has a **negligible effect (less than 1%)** on the overall behavior of the treatment unit. The absorbed electric power is 0,016 W for large size filters and 0,09 W for smaller size filters.

# ECONOMIC ANALYSIS

High performances of electrostatic filters are accompanied by important benefits mainly due to:

- **Pressure drop on the airflow side is absolutely modest**, determined almost exclusively by the metal prefilters G2 or G4. This results in a significant reduction in the energy consumption for ventilation, with the filtration efficiency that stays constant throughout the operating cycle;
- **The life cycle of the filters is equal to the life of the machine itself (15-20 years)**: the soiling of the electrostatic filter is signaled by a sensor that allows to program its periodic maintenance, that the user can easily do by himself, without any need to replace the filtering septum as is the case with traditional cells.

Below is a **detailed analysis** of a typical mid-size rooftop unit with reversible air-to-air heat pump equipped with 2-dielectric or electrostatic rigid pocket-type filtration stage, equal to the remaining functional characteristics and performance.

Considering the operating and maintenance profile for the typical use ‘Shopping center’, the annual cost of ownership for both versions is estimated for:

- consuming fan delivery section (linear model);
- maintenance filter section F7;
- Return on initial investment.

**Table 3:** Pay back air treatment unit with use of electrostatic filters

| FEATURES OF UNIT | | | |
|---|---|---|---|
| **Rooftop air-to-air heat pump** | | | |
| Heat recovery of thermodynamic type | as standard | | |
| Freecooling | as standard | | |
| Air flow inlet/recovery | 13.600 m3/h | | |
| Effective prevalence of inlet | Pa | 250 | |
| Effective prevalence of recovery | Pa | 100 | |
| **OPERATION PROFILE** | | | |
| Hours/day of operation | 16 | | |
| Working days per week | 7 | | |
| Weeks/year of operation | 52 | | |
| Total annual hours | 5824 | | |
| **MAINTENANCE PROFILE** | | | |
| Average electricity price | €/KWh | € 0,15 | |
| Price/labor for filter maintenance | €/h | € 30,00 | |
| **PAYBACK CALCULATION** | | | |
| Efficiency of main filtration stage | | G4 | G4 |
| Efficiency of second stage filtration | | F7 | FE electrostatic |
| Surplus unit price with electrostatic filter option | € | - | € 4.000,00 |
| **SUPPLY FAN SECTION CONSUMPTION** | | | |
| High efficiency filter pressure drop(1) | Pa | 145 | 28 |
| Total profit prevalence | Pa | 495 | 378 |
| Supply fan, installed electric power | kW | 5,8 | 5,8 |
| Supply fan, absorbed electric power | kW | 3,6 | 2,9 |
| Electrostatic filter, absorbed power | kW | 0 | 0,1 |
| Energy absorbed by the delivery fan in 1 year | kW/h | 20966,40 | 17472,00 |
| Ventilation cost in 1 year | € | 3.144,96 | 2.620,80 |
| **MAINTENANCE** | | | |
| Frequency of filter maintenance (service/year) | N° | 3 | 1 |
| Replacement parts price (F7 filters or electrostatic detergents)(2) | € | 520,00 | 20,00 |
| Work time filter maintenance | t/hours | 1 | 1,5 |
| Labor filter maintenance cost | € | 30,00 | 30,00 |
| F7 filter disposal cost | €/kg € 0,50 | 30,00 | 0 |
| Maintenance cost filters in 1 year | € | 1.680,00 | 65,00 |
| **CONDUCTION ANNUAL COST** | | | |
| Conduction annual cost (consumption + maintenance) | € | 4.824,96 | 2.685,80 |
| Different maintenance cost per year compared to G4 + F7 | € | - | - 2.139,16 |
| **PAY-BACK** | | | |
| Pay Back | years | 1,87 | |
| Pay Back | months | 22,44 | |

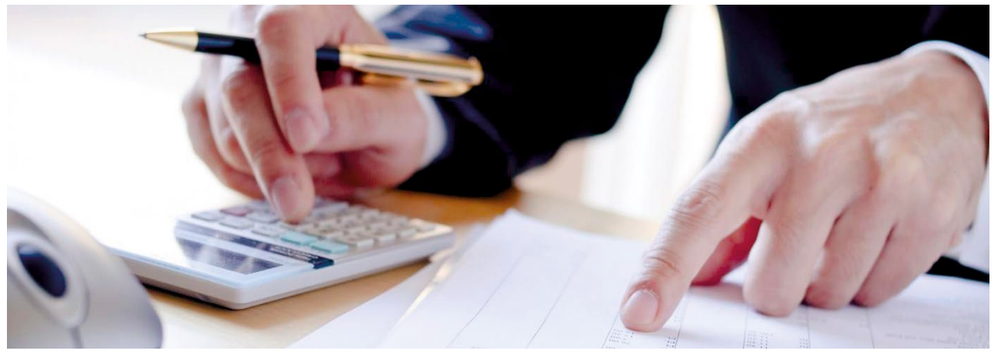
(1) Highly efficient dirty filter
(2) Price list 5L tank: 110,00 €

# CONCLUSIONS

Electrostatic filtration systems are already widely used and tested in civil and industrial environments. Based on the phenomenon of electrostatic precipitation, this type of filtration is characterized by:

1. Very high filtration efficiency, with yields greater than 99%.
2. Contemporary abatement of microorganisms such as bacteria, yeasts, molds and germs.
3. Reliable pressure drop through the filter.
4. The life cycle of the filters is equal to the useful life of the entire unit, with minimal maintenance requirements.
5. Very high level of product reliability.

This allows for a quick recovery of the higher initial investment compared to a traditional filtration system, such as the pocket type, thanks to the reduction in electric consumption of the ventilation sections, as the pressure drop is very low and **maintenance costs extremely low** since it is not necessary to periodically replace the filters.
Practical cases show how the **return on investment** typically takes place **in a few months**.



# FREQUENT QUESTIONS

**Compared to traditional high efficiency F7-F9 filter, on which further pollutants are effective Electrostatic Filters?**
Electrostatic filters are particularly suitable for the reduction of fine dust and nanopowder, oily vapors, pollen, bacteria, viruses, mushrooms, spores, toners, tobacco smoke.

**What is the metal prefilter for?**
The metal prefilter distributes the air flow across the entire section in a homogeneous manner, contributes to the maintenance of the electrostatic field generated by the electrostatic filter and creates one mechanical barrier that prevents contact with live organs.

**Electrostatic filters heat the treated air?**
Electrostatic filters do not change the air temperature that passes through them.

**Electrostatic filters create ionization phenomena?**
The amount of ozone produced by the electrostatic filters falls considerably below the maximum values, as evidenced by surveys carried out by independent laboratories according to the procedures prescribed in the sectoral regulations (Ozono SP Sweden Certification).

**Is high voltage in electrostatic filters safe?**
Electrostatic filters are safe. Exactly as in the cathode tubes of televisions in all houses, at a voltage of about 15 kV corresponds very low currents. In addition, the electrostatic filters contain all the necessary safety devices such as the grounding of the outer casing, the access panel equipped with a safety switch that removes the filter voltage and the internal impedance for quick discharge of the residual voltage.

**Extremely humid air can cause short circuit problems?**
In the presence of high humidity, the formation of electric shocks to the ground is induced by the microdusts depositing on the insulator of the electrical contacts. For this reason, in areas with mists or high humidity it is recommended to have a higher frequency in the periodic checking of the filters and especially in their cleaning.

**Electrostatic filters are suitable for health and food applications?**
Electrostatic filters are suitable for hospital and food applications. This technology is already applied to pre-filtration in operating rooms, as a filtration system in hemodialysis rooms, and as a system for filtration in hospital rooms and visiting surgeries.

**What certifications do electrostatic filters have?**
The Italian UNI 11254: 2007 legislation determines the performance of electrostatic filters. ILH (Berlin Institute of Hygiene) and Policlinico S. Matteo of Pavia certified the filters to demonstrate the bactericidal and microbicidal effect present in the air and what deposited on the filters.
The SP Sweden Research Center (Eurovent Certification Body) has certified the filters according to European standards EN 1822 and EN 779.

**Are the pollutants taken away from the plates when the unit is switched off?**
The adhesion of the pollutants to the plate is of a molecular type, and their removal can therefore only take place by mechanical action or by washing. Naturally the air passage at normal speeds does not cause any detachment of the dirt from the filters.
(Certificate of Lucern University)

**Is washing possible to damage electronic and power components?**
Electrostatic filters are specially designed to be cleaned by washing. Multi-pole connections and integrated control panel are watertight. The rest of the filter is made up of aluminum alloy wires and plates. Just clean the filter thoroughly before re-inserting it into the unit.

**What could be the cause of malfunction for an electrostatic filter?**
Possible anomalies for an electrostatic filter are often due to its incorrect maintenance. The damage of ionizing wires may occur due to impacts during incorrect removal of electrostatic filters from their seat, or as a result of inadequate cleaning that results in early wear. Ceramic insulator breakage can be caused by the deformation of the blades due to incorrect handling. However spare parts available, allow for quick repair by maintenance personnel electromechanical.

**Where and how are electrostatic filters installed?**
The FE SYSTEM electrostatic filters are installed inside air treatment units, rooftop or ventilation plants. They can be installed in the same “U” guides of classic pocket filters without modifying the way of internal construction of the unit.
You can also perform a retrofit, replacing filters with rigid pockets or flosses with electrostatics, without intervening on inner structure and filter frames / guides.

**How are electrostatic filters connected?**
Electrostatic filters are provided with connection multipole for power supply (230V - 50 / 60Hz) and for serial connection. The indication of the filter status can be viewed on the filter by built-in led and externally thanks to the derivation box. If the air handling unit is supplied with integrated controls, you can interface clean contact in exchange on supervisory system.

BETTER AIR FOR A BETTER QUALITY OF LIFE

**EXPANSION ELECTRONIC SRL**
Via delle Industrie, 18
36050 Cartigliano (VI) • ITALY
T +39 0424 592400 • +39 0424 827058
F +39 0424 827061
www.expansion-electronic.com
info@expansion-electronic.com