Engineering

INER-ST

Inertia filters

SagiCofim

Ecoefficiency for Indoor Air Quality

INER-ST

Inertial separation is an excellent pre-filtration system, particularly suitable in environments with high dust concentration as desert areas, mines, steel and foundry factories, cement industries.

This filtration system is based on the principle of conservation of kinetic energy by the airborne dust particles. Thanks to a series of quick changes in direction, while the clean airflow is being employed in the process, through inertia the particles continue moving in a straight line till they eventually reach the unloading hopper. There, thanks to a small volume of air handled by a bleed fan (around 10% of the total inlet air volume), the particles are exhausted outside.

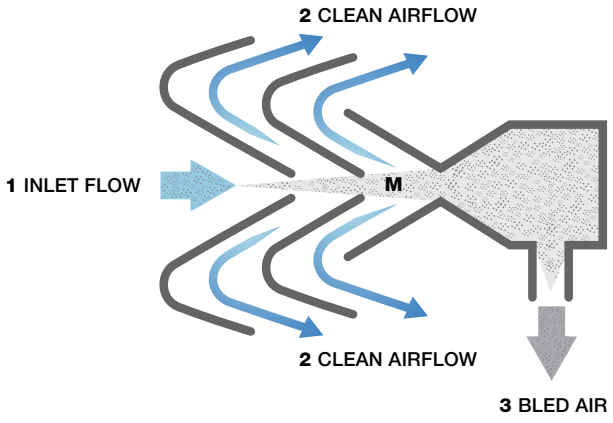
Obviously, the higher the mass of the particles handled and the speed through which they are transported, the higher the efficiency of an inertia filter.
In any case the filtering system efficiency is based on the bleed fan correct operation.

Developments

Since the development of the first multivane inertia cells, many refinements have been made to the shape of the vane, for instance higher exit velocities on the clean side to prevent clogging. Vane spacing has been varied by continuous testing to give optimum efficiency over a wide range of particle sizes and to increase efficiency, while reducing pressure loss characteristics. It has now been proven that inertia cells attain their highest efficiency with a pressure drop in the region of 200/300 Pa (0,8/1.0" w.g.), but it is still possible to achieve reasonable collection efficiencies with pressure drops in the region of 150/200 Pa (0.4/0,6" w.g.) by increasing the percentage of air evacuated through the bleed system.

The principles of separation are shown in Fig. 1.
Separation relies upon the ability of air to follow the path through the separator vanes from area (1) to area (2), while the bulk of the dust is precipitated along path M due to its kinetic energy. This effect is enhanced by suction in area (3) by the use of a scavenge or bleed fan.

Fig. 1



Performance Testing

Testing inertia filters requires the use of considerable test facilities. For these tests was employed an EN 779:2002 rig using ISO 12103 A2 Fine & A4 Coarse test dusts.

ISO 12103 A2 Fine Test Dust is siliceous with a size spectrum from 0.6 microns to 85 microns while A4 Coarse Test Dust has a wider spectrum from 2 microns to 200 microns.

Efficiency at standard rating against test dusts

Dust	Efficiency at:	
	200 Pa	250 Pa
ISO 12103.1 A2 FINE	82,2 %	82,2 %
ISO 12103.1 A4 COARSE	94,6 %	95,0 %

INER-ST

How an inertia cell works
An inertia cell is made up of a pair of V-arranged panels, on whose surface are pressed slots through which the air flow makes the quick changes of direction described above.
A central straightening vane is installed to reduce the air turbulences.
The two V's converge at the bottom of the filter leaving an opening which is proportional to the air inlet opening, so to maintain the air flow speed constant inside the filter.

Being self-cleaning, inertia filters have unlimited service life.

Material of Construction
Inertia filters are naturally and continuously subject to abrasion by the airborne dust particles, so that any protective coating (such as painting, galvanization, etc.) would be quickly removed by the passage of dusts.
This problem is solved by employing the appropriate constructive material.
Weathering steel, best-known under the trademark COR-TEN steel, is a steel alloy which was developed to eliminate the need for painting, since it forms a stable rust-like appearance when exposed to the weather for some time.

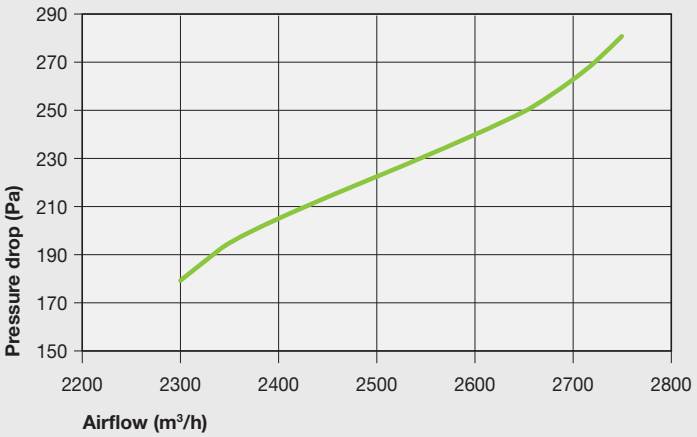
"Weathering" means that, due to its chemical composition, said steel exhibits increased resistance to atmospheric corrosion if compared to other steels. This is because it forms a protective layer on its surface under the influence of the weather.
The corrosion-retarding effect of the protective layer is due to the peculiar distribution and concentration of alloying elements in it.
The layer protecting the surface develops and regenerates continuously when subject to the influence of the weather.

In other words, the steel is allowed to rust in order to form the 'protective' coating.
Inertia filters in COR-TEN are covered with a special wax coating only to the purpose of protecting the surfaces during manufacturing, handling and transportation.

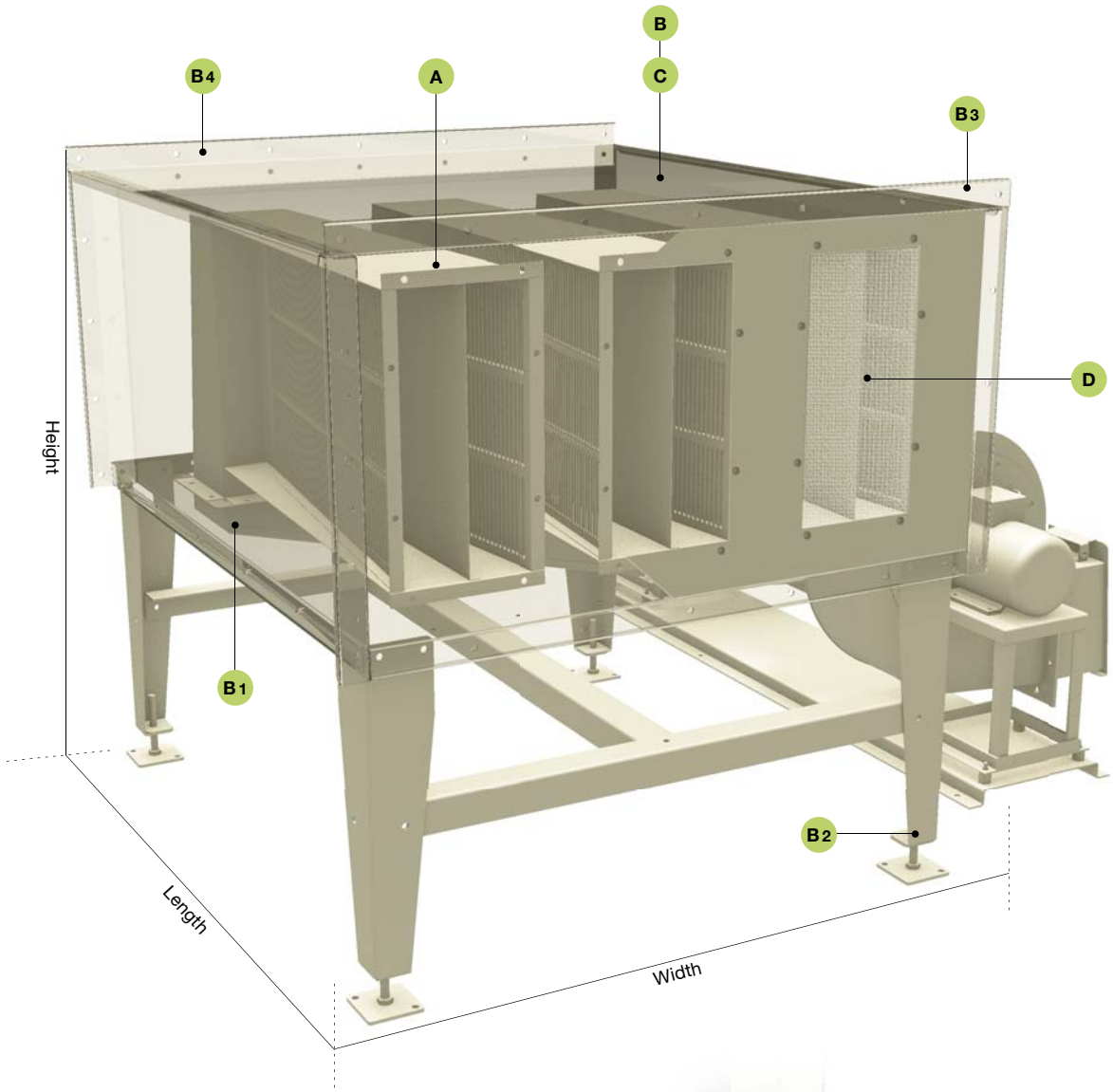
A good, yet more expensive alternative, is Stainless steel type AISI 316.

The tests have been carried out in a third party's laboratory at the University of Turin, Italy.
The test protocol and rig are as described in EN 779 : 2002 "Particulate air filters for general ventilation - Determination of filtration performance". We tested the filter at two pressure drop levels: 200 Pa and 250 Pa.

The results we obtained show that our inertia filters installed as prefilters in a HVAC system give considerable protection to the following filtering stages.
The extended life of the filter banks downstream the inertia units represents a considerable saving in life cycle costs.



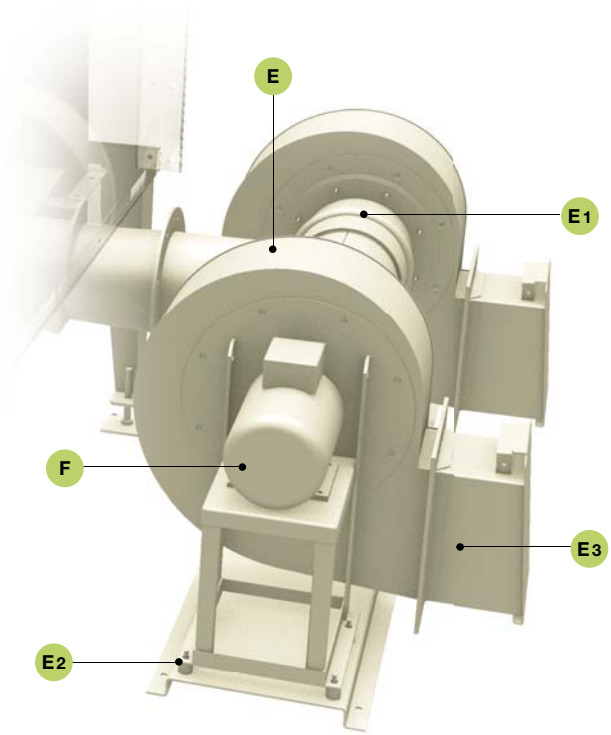
INER-ST



Supply configuration
Inertia filters can be housed in a galvanized steel housing, properly stiffened and painted with specific coating suitable for aggressive environment, consisting in a primer coat and a final enamel coat. The standard steel thickness is 2 mm., but different thicknesses are available. For critical applications, special paints or stainless steel can be used. The air intake can be provided with an air inlet grid (insect screen) and duct connection flange.
A maintenance door, support legs, lifting lugs, flanged connection to the main fan complete the supply.

The filter units located outside can be protected against sunshine by a roof panel fixed to the filter top.
Filter and bleed fan are connected through a vibration joint.

Bleed Fan Operation
The bleed or scavenge fan is the only component subject to failure in inertial filter installations. We recommend to associate a warning light or alarm signal with bleed fan operation.



INER-ST

Product specific features			
	Equipment	**Features**	**Material options**
A	**Filter cells**	Accurately moulded panels, 1 mm th. assembled in easily removable cells	COR-TEN steel
			INOX 316L st. steel
B	**Filter housing**	Stout contruction, bolted and welded, complete with: **(B1)** discharge hopper, **(B2)** adjustable support legs, **(B3)** inlet connection flange, **(B4)** outlet connection flange	S 235 Carbon steel
			Galvanized steel
			AISI 304 st. steel
			INOX 316L st. steel
C	**Housing coating**	Several options availble for any environment	Only galvanized
			Galvanized + coated
			Degreasing + primer + enamel
			Customized coating
D	**Insect screen**	Fixed on the air inlet, a 12 x 12 mm whire mesh	Galvanized
			AISI 304 st. steel
E	**Bleed fan**	Centrifugal fan, direct driven, suitable for dust evacuation, complete with: **(E1)** flexible joint, **(E2)** elastic supports	Std. Mfr. Painted Carbon steel
			AISI 316 st. steel
F	**Electric motor**	Built by the major world manufacturers, EN or NEMA type, TEFC, IP 55 Class F, high efficiency	Standard manufacturer, safe area
			Explosion proof
			Custom defined

Options		
	Orientation	Right or Left fan position
	Redundancy	Single or double bleed fan
	Safety switch	Pressure switch with box
	Connection	Motor teminal box
	(E3) Overpressure damper	Bleed fan non-return damper

Airflow rates (m^3/h) with 250 Pa pressure drop

Length (mm)		Height (mm)		Width (mm)	560	700	1.000	1.300	1.600	1.900	2.200	2.500	2.800	3.100
				Model	**1 cell**	**2 cells**	**3 cells**	**4 cells**	**5 cells**	**6 cells**	**7 cells**	**8 cells**	**9 cells**	**10 cells**
	1.100		**1.005**	**H1**	2.650	5.300	7.950	10.600	13.250	15.900	18.550	21.200	23.850	26.500
	1.150		**1.500**	**H2**	5.300	10.600	15.900	21.200	26.500	31.800	37.100	42.400	47.700	53.000
	1.250		**1.900**	**H3**	7.950	15.900	23.850	31.800	39.750	47.700	55.650	63.600	71.550	79.500
	1.300		**2.300**	**H4**	10.600	21.200	31.800	42.400	53.000	63.600	74.200	84.800	95.400	106.000
	1.400		**2.700**	**H5**	13.250	26.500	39.750	53.000	66.250	79.500	92.750	106.000	119.250	132.500

How to compose a system: a 40.000 m^3/h system = H3/5 cells or H5/3 cells

INER-ST

Options
Usually no instruments are required for inertia filters operation.
The following devices can be supplied on request:

High Pressure Alarm
Differential pressure switches can be supplied to provide alarm in case of pressure loss beyond normal limits. The indication can be local or remote.

Manometer
Differential manometers can be provided to monitor the pressure drop of the installation.

Control panel / Junction box
The bleed fan is usually supplied unwired and shall be connected in situ.

On request, it is possible to provide a local control panel or a JB suitable to switch off power supply during maintenance operations.

INER-ST

Maintenance instructions

The inertial filter is a self-cleaning device with no consumable parts, therefore it requires no ordinary maintenance.
However, a periodic check of the unit is recommended:
remove any foreign body which may obstruct the filter blades with a metal brush and/or compressed air.
Then check the dust discharge duct and remove any deposit.
Beat the vertical ducts of the inertial filters by means of a wooden mallet in order to remove any residue inside them.
Check accurately the proper conditions of inlets which may be obstructed, that the motor wiring connection is watertight, the correct mechanical connection of bleed fan and of flexible joint with the filter and the direction of the impeller rotation.

Overview

In inertia filters the sand/dust is separated from the airflow by the effect of inertia.
Inertia filters are composed by one or more filter cells, a bleed fan to discharge the separated dusts, a housing flanged to connect the filter to the AHU.
The bleed-fan is sized so to have minimum 10% of the total intake air discharged outdoor, with a static pressure capable of overcoming the filter and ducts pressure drop.
If requested, the option with 2 bleed fans (one in stand-by, complete with return damper) is allowable.
A wire mesh screen is factory-mounted at the air intake.
The filter cells, provided with an accurate setting of blades to guarantee a high efficiency rate, are of a stout construction, made of low-alloy corrosion resistant "Cor-Ten" steel sheet.
Cor-Ten (known also as weathering steel), was developed to eliminate the need for painting: it forms a stable rust-like protective layer on its surface for several years. AISI 316 stainless steel is a valid alternative for very aggressive environments.
The certified separation efficiency is 82% on ISO 12103-1 A2 and 95% on ISO 12103-1 A4 dusts, with 250 Pa pressure drop .

Main references

Saudi Aramco KSA
Rabigh Developement Pr.

Saudi Aramco KSA/Tecnimont
Manifa Pr.

Saudi Aramco KSA/Technip
Jubail export refinery Pr.

Sonatrach Algeria/Saipem
Menzel Pr.

Sonatrach Algeria/Saipem
Arzew Chem. Pr.

Sonatrach Algeria/JGC
GNL 3 Pr.

Sonatrach Algeria/JGC
Bir Seba Pr.

Gasco UAE/Fluor
Habsan Pr.

Gasco UAE/Tecnimont
Habsan 5 PE

Gasco UAE/Hyundai
Habsan 5 U&O

Saipem Italy

Tecnimont Italy

SNC Lallin Canada
Qatalum Pr.

Bechtel USA
Suez Oil Pr.

General Electric USA
Tiga Malaysia

Fluor USA/Tecnimont
Tasnee PE Pr.

SagiCofim spa
Comfort Filtration Engineering

via Firenze 1
20063 Cernusco sul Naviglio
Milan Italy
tel +39 02 929021 r.a.
fax +39 02 92902300
info@sagicofim.com
www.sagicofim.com

SE.2013.11_INER ST_T