

Air is an ingredient in your food.
Let Camfil show you how to
maintain clean indoor air quality.

CLEAN AIR SOLUTIONS



AIR IS AN INGREDIENT IN YOUR FOOD

Food Safety is a Team Effort

Food safety requires a team of dedicated people working to ensure what we eat and drink is safe. This team, following HACCP guidelines and principles, will inevitably identify hazards from the necessary airflow in a processing facility. Many of these hazards can be controlled through an analysis of the HVAC system which includes careful evaluation of the air filters.

An air filter is a single component within a larger and more complex HVAC system. This system delivers conditioned air at specific temperature, humidity and pressurization levels to ensure a safe working environment and a safe product. The performance of an air filter directly impacts those responsible for food safety within a facility. Failure to do the necessary research to understand the performance capabilities of the filter has ramifications beyond food safety. Energy, labor, equipment and landfill costs can all increase dramatically due to poor filter selection.

Each person involved in food safety utilizes their expertise to ensure quality air is maintained within the processing facility.	
Quality Control / Process Authority	Determines what level of air quality maximizes food safety, product taste, shelf life.
Engineering	Evaluates air filters and identifies the products that will deliver required air quality and maintain adequate air flow.
Procurement	Sources filters that match engineering specifications from reputable sources who offer in situ validation, life cycle cost modeling software and service life guarantees.
Maintenance	Establishes filter service schedules that take full advantage of the air filter's performance capabilities and service life to maximizes cost savings.
Sustainability	Evaluates the environmental impact of the filter selected by using source reduction principals, lessening stress on overcrowded landfills and also reviews the filter manufacturer's long-term commitment to sustainability.
Energy	The single highest component cost of an air filtration program is not the filter itself, it is the cost of energy to move air. The filter that maintains a low average pressure drop over its service life will require 30% - 40% less energy to operate.



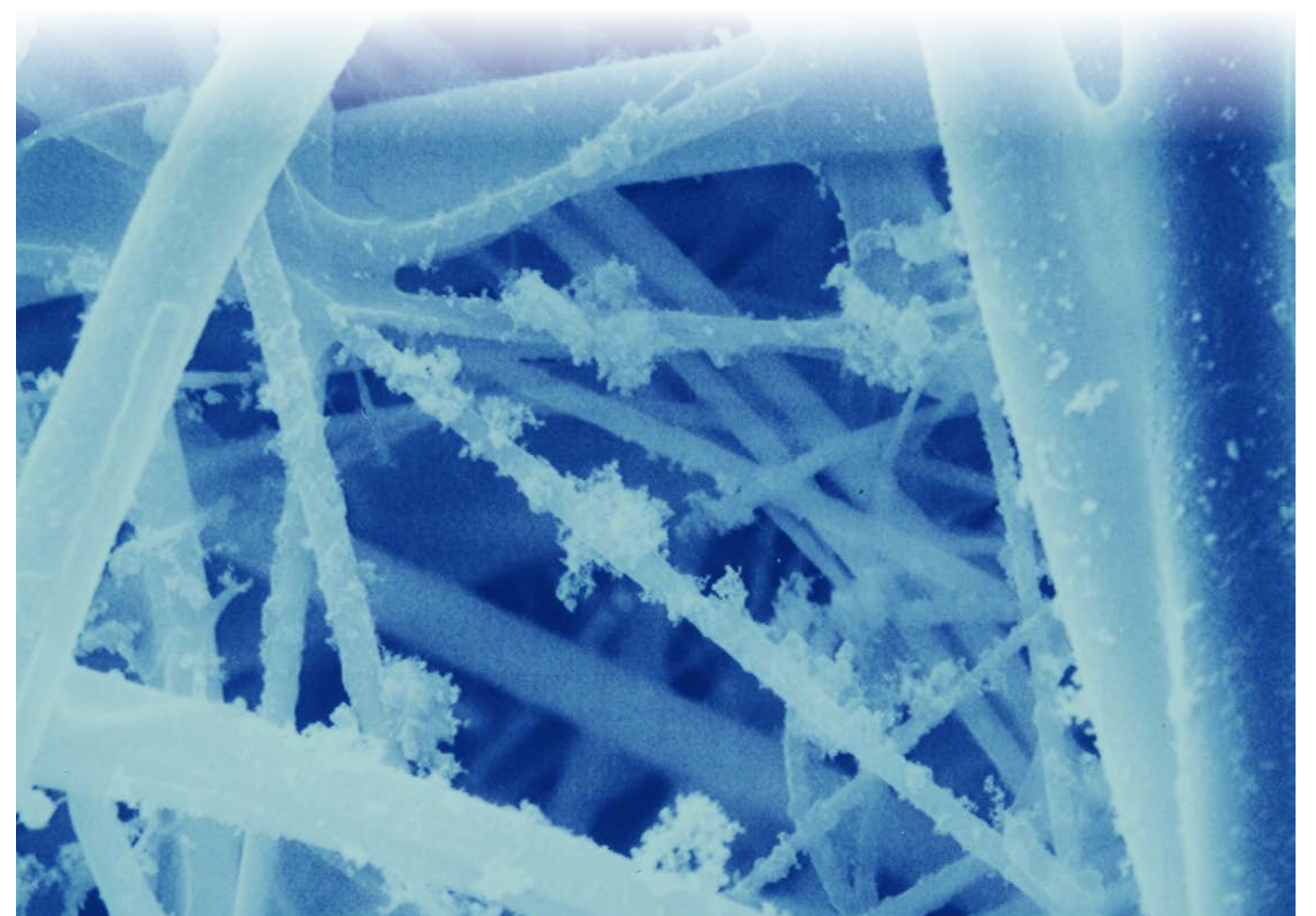
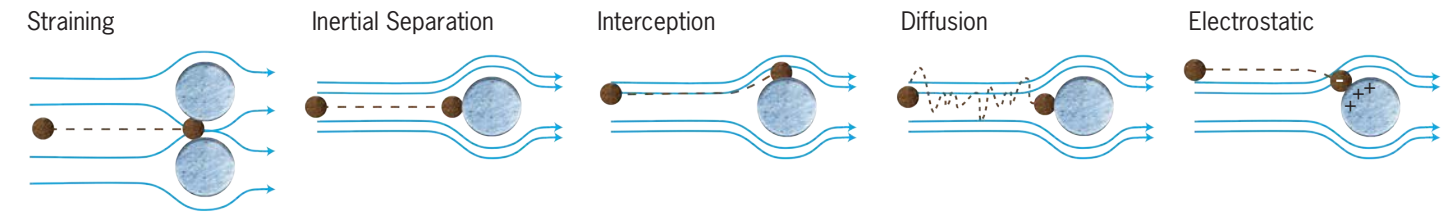
PRINCIPLES OF FILTRATION

The typical air filter is classified as a mechanical filter because of the mechanism by which particles adhere to the filter media fibers while carried through the filter in an air-stream. Four of these mechanisms are, straining (sieving), inertial separation, interception and diffusion. Each mechanism has a range of particle sizes where it is the dominant method for filtering particles.

Straining is dominant on particles larger than the pore sizes between fibers within the filter media. Inertial separation and interception are the dominant collection mechanisms for particles down to .2 microns. The diffusion mechanism is dominant for the smallest of particles.

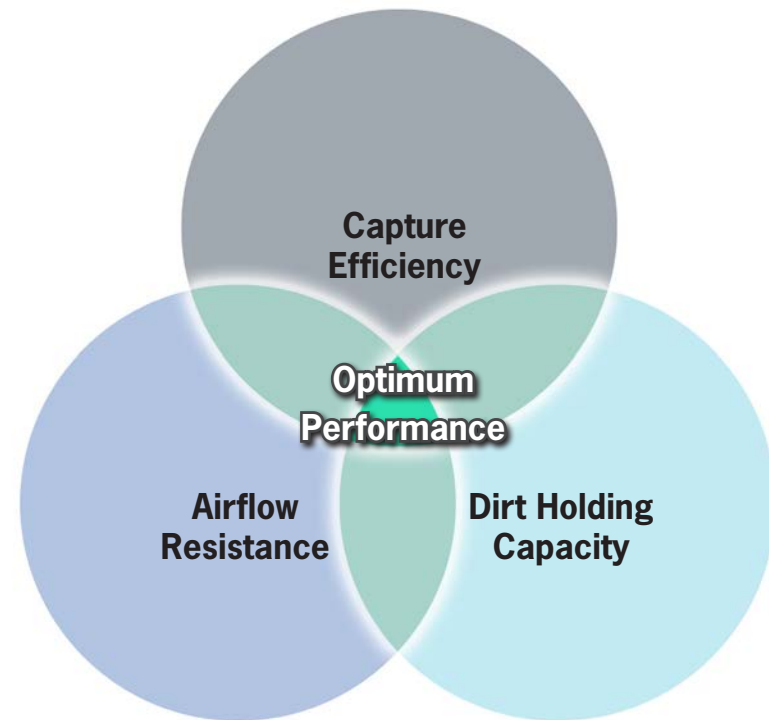
There is a fifth mechanism, a hybrid which relies on an assist from the temporary phenomenon of electrostatic attraction.

This charge is added to large diameter fibers during manufacturing. While the charge is active, it will attract smaller dirt particles. The result is a capture efficiency rating higher than expected from a mechanical filter media produced from large diameter fibers. However, depending upon environmental conditions, this is a short-lived enhancement and once dissipated or insulated, the capture efficiency quickly decreases.



AIR FILTERS AND OPTIMUM PERFORMANCE

An air filter's ability to capture dirt particles from the air-stream is its main purpose, but a closer examination reveals a filter has a total of three main attributes.



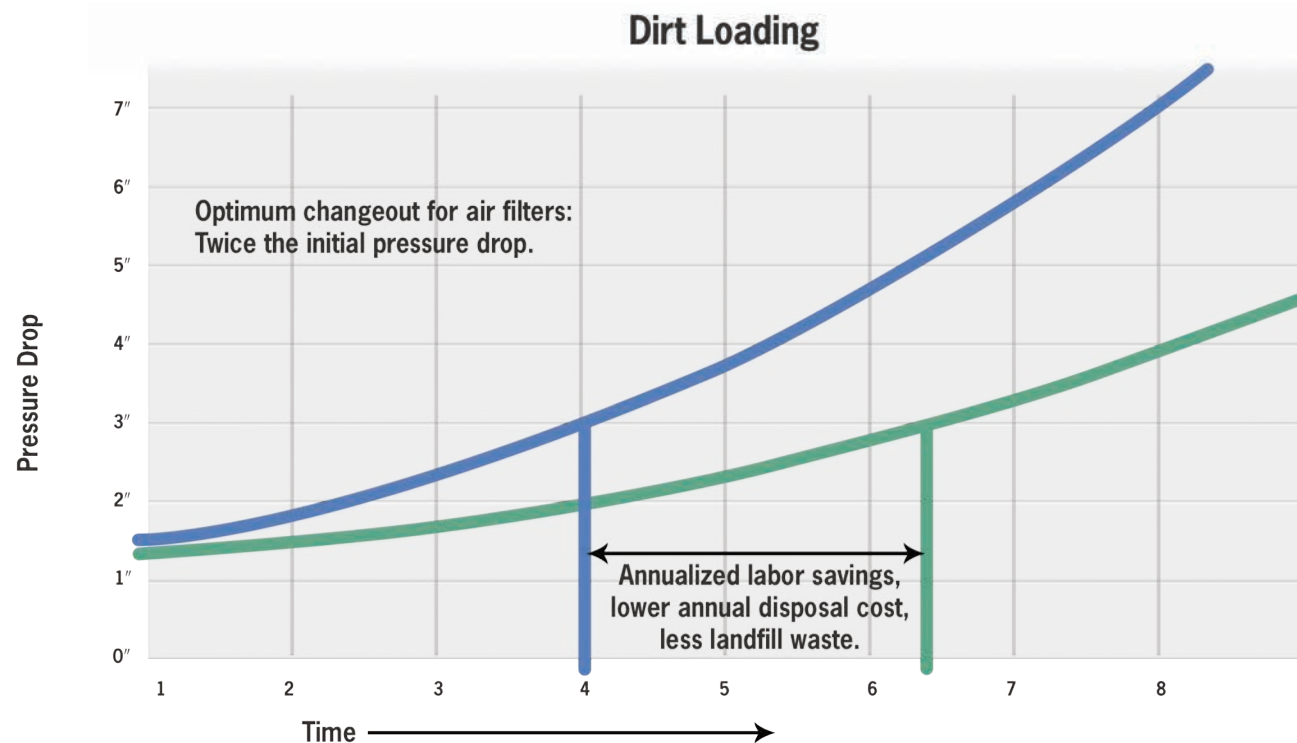
Capture Efficiency is the ratio of particles captured from the air stream via one of the mechanisms illustrated on page 3.

Dirt Holding Capacity is a measurement in weight of the total amount of particulates captured from the air stream and held within the body of the filter during its service life.

Airflow Resistance refers to the pressure differential between the front and back of the filter which increases as a filter loads with dirt.

All three continuously interact with one another to influence the overall performance of the filter.

It's relatively simple and inexpensive to produce a filter that is adequate at one or perhaps two attributes. However, it requires careful engineering, quality raw materials and exceptional manufacturing techniques to produce a filter that excels in all areas. A filter that does all three, will not only improve food safety, it will have the lowest total cost of ownership.



Most HVAC systems operate at different airflows, even from unit to unit within the same building. Optimizing filter changes for the best filter change-out point with Camfil Life Cycle Cost software can save the facility expenditures many times the actual cost of the filters.

AIR FILTRATION STANDARDS

Currently there are two air filter testing standards. The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) publishes Standard 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size. ASHRAE is primarily a North American entity that has been publishing air filter testing standards since 1968. The International Organization for Standardization (ISO), a worldwide quality management organization, publishes ISO 16890 Air Filters for General Ventilation.

The ASHRAE Standard provides the user with a filter's Minimum Efficiency Reporting Value (MERV). There are 16 MERVs ranging from 1 through 16 with the filter becoming more efficient as the number increases. Air filters with higher MERVs also remove smaller particles. The 52.2 Committee meets at least twice a year to discuss changes that may be beneficial to users of the standard. Virtually every manufacturer is represented on the committee.

Common air filter MERV applications include MERVs 4-8, used in residential applications or as pre-filters, MERV 13 for office or

commercial environments and MERV 14 for medical facilities or other environments requiring removal of biohazardous particles. ASHRAE 52.2 also includes an optional test as part of its appendix that examines a filter's ability to maintain efficiency over time; it lists this secondary value as MERV-A. The MERV and the MERV-A should always be equivalent if the user wants to ensure the same level of particle removal efficiency throughout the life of the filter.

ISO 16890 is a new standard, developed through international cooperation with many of the same committee members that authored the ASHRAE Standard. It combines the best of both standards, and creates a method globally beneficial to all users. It completely replaces the filter testing standard that was published in Europe; EN779. ISO is a highly recognized organization across the globe, and companies worldwide leverage its strong visibility to promote their ISO 9001 conformance for process and quality control. Because of ISO's global presence, the ISO filter testing standard may soon replace the ASHRAE Standard. Companies operating global businesses no longer need

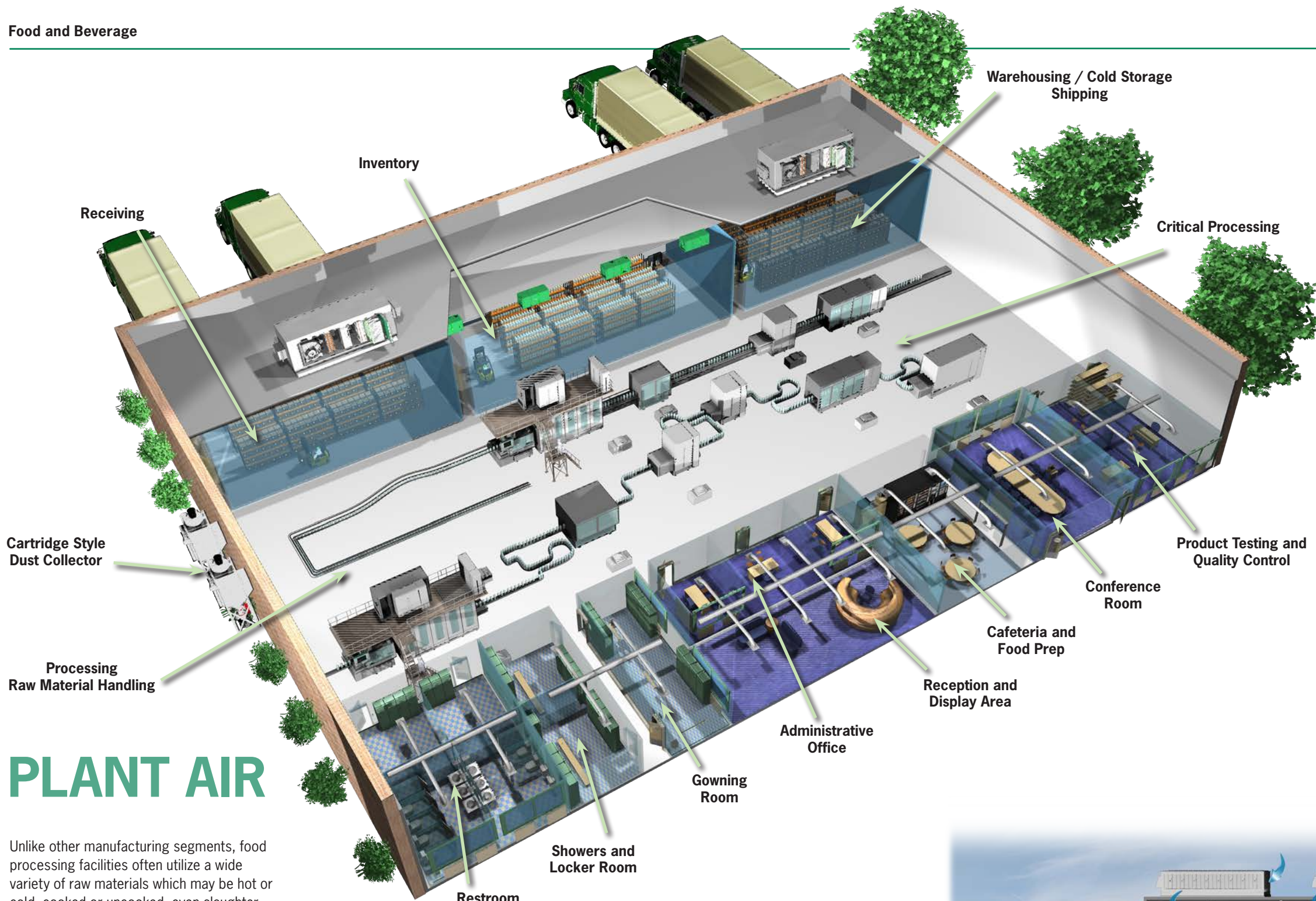
to reference standards and procedures based on geography.

With ISO 16890, a filter has a published efficiency directly related to a particulate matter (PM) value. The most common levels are PM₁₀, PM_{2.5} and PM₁. The values relate to a particulate mass measurement of particles 10-microns in size or less, 2.5-microns or less and 1-micron and less respectively. PM₁ is the most dangerous particle size and 99% of all airborne particles are classified as PM₁. So small in size, PM₁ particles can travel as far as the alveoli where air is exchanged directly with the blood and can cause damage. With ISO 16890, once the PM level is identified, then filter efficiency can be determined for that PM level. ISO values are published in the form of ePM_{1,70}, or 70% removal efficiency at PM₁ which equates to an ASHRAE MERV 14.

The ISO standard also includes a discharge procedure as an integral part of the test that exposes filters losing efficiency over time, through loss of media charge, through charge dissipation, or insulation of the media fibers by dirt particles.

AIR FILTER TESTING STANDARDS COMPARISON										
ASHRAE Standard 52.2-2012				ASHRAE 52.1-1992	EN 779 2012	ISO 16890				
Minimum Efficiency Reporting Value	Composite Average Particle Size Efficiency, % in Size Range, microns			Average Arrestance	Average Dust Spot Efficiency	Class	Group	ISO ePM ₁	ISO ePM _{2.5}	ISO ePM ₁₀
	Range 1	Range 2	Range 3							
MERV	0.30 - 1.0	1.0 - 3.0	3.0 - 10.0	%	%					
1	n/a	n/a	E ₃ < 20	A _{avg} ≥ 65	< 20	G1	Coarse			
2	n/a	n/a	E ₃ < 20	A _{avg} ≥ 65	< 20	G2				
3	n/a	n/a	E ₃ < 20	A _{avg} ≥ 70	< 20					
4	n/a	n/a	E ₃ < 20	A _{avg} ≥ 75	< 20	G3				≥ 45%
5	n/a	n/a	E ₃ ≥ 20	80	20					
6	n/a	n/a	E ₃ ≥ 35	85	20-25		G4			≥ 60%
7	n/a	n/a	E ₃ ≥ 50	90	25-30					
8	n/a	n/a	E ₃ ≥ 70	92	30-35	M5	Medium			≥ 50%
9	n/a	n/a	E ₃ ≥ 85	95	40-45					
10	n/a	E ₂ ≥ 50	E ₃ ≥ 85	96	50-55	M6		50 - 70%	≥ 60%	
11	n/a	E ₂ ≥ 65	E ₃ ≥ 85	97	60-65					
12	n/a	E ₂ ≥ 80	E ₃ ≥ 90	98	70-75	F7	Fine	50 - 70%	65 - 80%	≥ 85%
13	n/a	E ₂ ≥ 90	E ₃ ≥ 90	98	80-85					
14	E ₁ ≥ 75	E ₂ ≥ 90	E ₃ ≥ 90	99	90-95	F8		70 - 80%	> 80%	≥ 90%
15	E ₁ ≥ 85	E ₂ ≥ 90	E ₃ ≥ 90	99	95	F9		≥ 80%	≥ 90%	≥ 95%
16	E ₁ ≥ 95	E ₂ ≥ 95	E ₃ ≥ 95	100	99	N/A	N/A	≥ 90%	≥ 95%	≥ 95%

Notes:
 The final MERV is the highest level of MERV where the filter test data meets all of the requirements to have that MERV.
 The characteristics of atmospheric dust vary widely in comparison with those of the synthetic dust used in these tests. Hence test results do not provide a basis for predicting either operational performance or actual filter life. Loss of filter media charge, or shedding of particles and fibers can also adversely affect a filter's efficiency in the test and in real life.
 *Minimum efficiency is the lowest efficiency among the initial efficiencies, discharged efficiency and the lowest efficiency throughout the test procedure.



THE NECESSITY OF POSITIVE PRESSURE

A critical component of any food safety program is managing the pressure and directional flow of air throughout the plant.

Air pressure inside a food processing plant should be positive; meaning the pressure inside is greater than the pressure outside. Positive air pressure forces air to flow out open doors, windows and even gaps in the wall. This helps prevent airborne organisms from penetrating the building envelope. Within the building itself, the pressure should be highest in the most sensitive zones and lower in less sensitive zones. This prevents internally generated contaminants from moving upstream; from the warehouse to the processing floor for example.

Air is an asset and additional air is always valuable. Camfil's high performance air filters are guaranteed to have the lowest average pressure drop. This means a higher volume of air is available to create or maintain positive pressure. Additional air pressure also gives you the flexibility to direct airflow in a manner that best maintains food safety based on your plant's individual layout.

PLANT AIR

Unlike other manufacturing segments, food processing facilities often utilize a wide variety of raw materials which may be hot or cold, cooked or uncooked, even slaughter. Each step of the process carries its own unique level of risk requiring very specific air filters to minimize that risk.

Incoming ingredients are often sorted and sifted, generating product dust which is captured in hoods and ducted to cartridge collectors outside of the building.

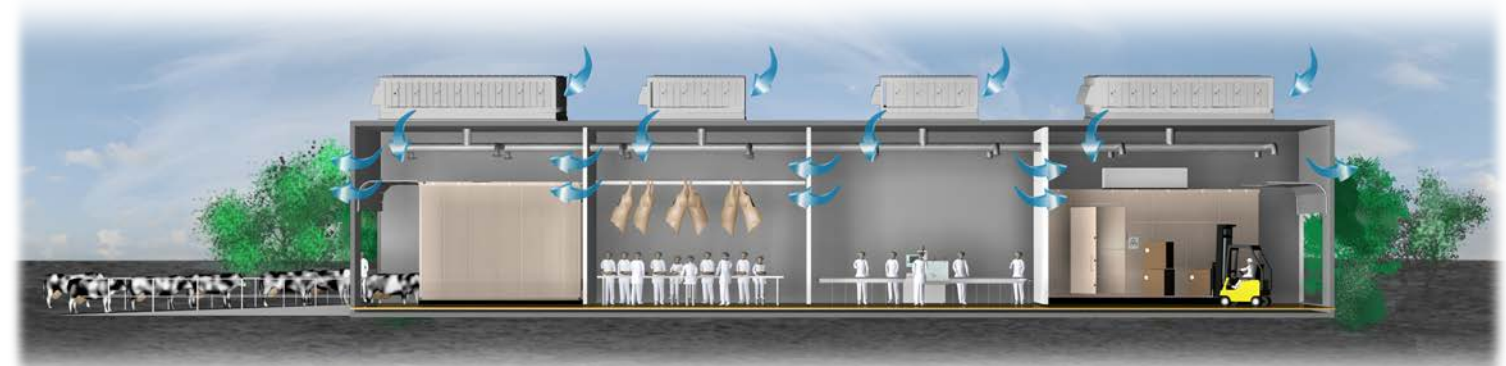
The main processing area of the plant is where the most sensitive production work is performed. Typically this is where the largest

volume of clean air is supplied through rooftop air handlers protected, with two or three stages of air filtration. Process equipment, such as aseptic packaging lines, draw their air supply from surrounding plant air making filtration in this area critical.

Quality control and taste testing rooms are often isolated from the rest of the plant and protected with HEPA filtration to ensure product quality.

Temporary product holding rooms and final warehousing may include cold storage areas which require careful temperature and airflow monitoring.

Finally, a food processing facility houses administrative areas containing a company's number one asset; employees. People working in industrial areas deserve clean air to breathe.



Inert Zone
Inventory Receiving

Sensitive Zone
Processing Raw Material Handling

Ultra-Sensitive Zone
Critical Processing Packaging

Inert Zone
Warehousing Shipping

CAMFIL 5-STAR SOLUTIONS

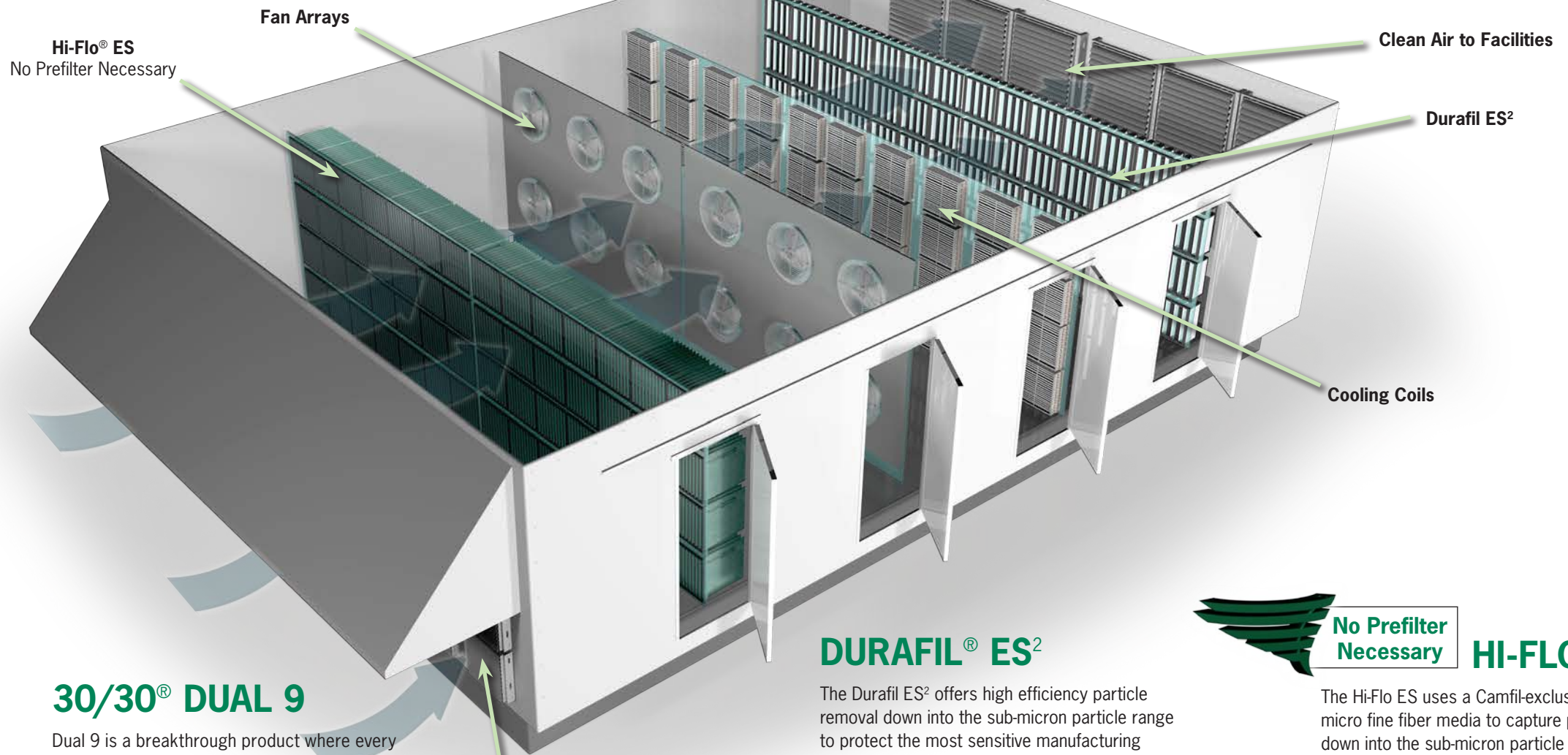


5-Star ECI Rating

Camfil filters are rated as 5-Star filters through the Energy Cost Index (ECI) program. Based upon a five-star scale, the Energy Cost Index is an indicator of what a filter will cost over its lifetime. The best rating – five stars – indicates that the filter is the most energy-efficient, longest lasting filter available.

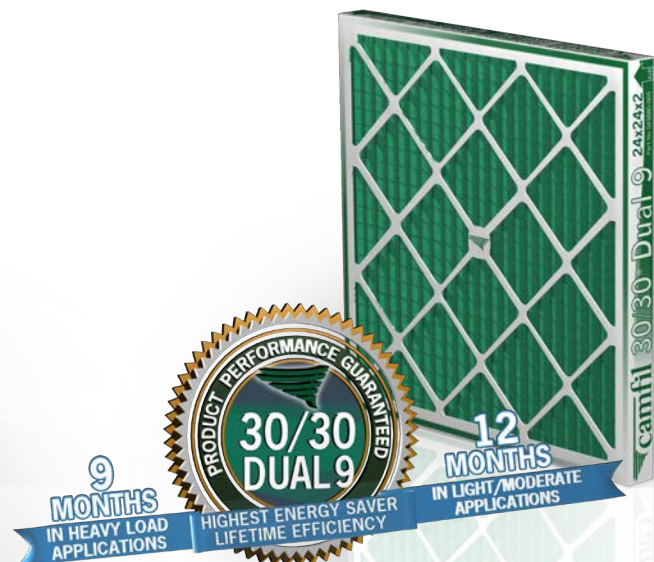
FARR 30/30®

With its industry leading 5-Star ECI Rating, the Camfil Farr 30/30 sets the standard for medium efficiency air filtration. When used as a prefilter, a stand-alone HVAC filter, or as the main filter in custom air conditioning units, the Farr 30/30 will remove nuisance dusts and staining particles, and increase the life of downstream final filters by removing contaminants that shorten the life of final filters. Using a mechanical efficiency to provide MERV 8 and MERV 8-A performance levels, the Farr 30/30 will maintain its efficiency throughout the life of the filter.



30/30® DUAL 9

Dual 9 is a breakthrough product where every component has been engineered to deliver the highest level of continuous particle removal, with the lowest energy consumption and longest service life. The Dual 9 comes with dual but equal MERV ratings (MERV 9 and MERV 9A), a dual-layered gradient density media and dual performance guarantee options of 9 or 12 months.



DURAFIL® ES²

The Durafil ES² offers high efficiency particle removal down into the sub-micron particle range to protect the most sensitive manufacturing processes and electromechanical equipment from contamination. Its fine fiber media maintains efficiency throughout the life of the filter and its increased media area ensures maintained low pressure drop and longer filter life. The Durafil ES² can save 40% or more in energy expenditures when compared to competitive products.



No Prefilter Necessary HI-FLO® ES

The Hi-Flo ES uses a Camfil-exclusive high loft micro fine fiber media to capture particles down into the sub-micron particle range. The Hi-Flo ES may be used as the only filter in a single-stage system eliminating pressure drop and service requirements associated with two-stage filtration systems that require a prefilter. Available in MERV 11, MERV 13, MERV 14 and MERV 15, its MERV and relative MERV-A testing values are equivalent ensuring that performance is maintained throughout filter life.





Camfil's state of the art multi-million dollar adsorbent air filter testing laboratory provides unique performance data analysis like no other in the industry.

CONTROLLING ODORS AND GASEOUS CONTAMINANTS



CamCarb CG

CityCarb

CamCarb cylinders are available for housing installation and can hold up to 120 pounds of adsorbent or mixes per 24" by 24" opening.

Camfil adsorbent products effectively remove molecular size contaminants that may jeopardize food safety, employee health or the local environment. Substances used to decontaminate equipment or vapor introduced to sanitize packaging can be hazardous if build up is allowed or ventilation system fails.

Filters are available for direct application in an HVAC system, as an addition to an existing system, or as stand-alone modules to service specific areas.

Your Camfil Representative can review your specific application with Camfil's global molecular control experts and provide supporting data from the world's most intricate molecular product analysis laboratory.

Camfil products are available with carbon, adsorbent and/or oxidizing media blends designed specifically to remove offending gaseous contaminants.

HEPA FILTERS High Efficiency Particulate Arrestance

HEPA Filters

Aseptic and extended shelf life food & beverage products require an extremely high level of air purity. Only quality HEPA filters are capable of providing the environment necessary to maintain food safety. Camfil's Megalam and Absolute HEPA filters are trusted by leading equipment manufacturers and end users worldwide for this most critical application.

Test Methods

Being the world's largest supplier of HEPA filters with production plants in all corners of the globe, Camfil is committed to manufacturing specific grades of filters to meet local, regional and international standards. All critical scanning and pleating machines are manufactured in-house to ensure consistency of product quality and construction throughout the world.

Camfil HEPA filters are primarily manufactured in accordance with EN-1822 part 5, IEST CC 034, and ISO29463.

Every Filter is Tested and Certified and Includes a Digitally-Stored, Permanent Record

Camfil adds a layer of assurance by scan testing every filter individually for capture efficiency, airflow and resistance. Each filter is serialized with a bar code and the test results permanently stored. A label is also attached to each filter displaying the performance data.

For traceability purposes, the original test reports for any Camfil HEPA filter can be quickly retrieved. For a process as critical as aseptic, nothing should be left to chance.

Chemical Compatibility with Sterilants and High Temperature Filters

Camfil produces a wide range of filters compatible with commonly used sterilants such as hydrogen peroxide and PAA. Specially designed high temperature HEPA filters maintain their integrity and rated performance values in applications with extremely high temperatures.



Absolute® XS HEPA

Megalam® ES

Absolute® VG HEPA

HOUSINGS, FRAMES & CLEANERS

A filter is only as effective as its holding mechanism. Deficient holding frames, or housings that have gaps or leak paths around the filter, can severely reduce filter performance. A 1/4-inch gap around a 24-inch by 24-inch prefilter equates to 18% air bypass, or the equivalent of a 3-inch hole in the middle of the filter. A gap

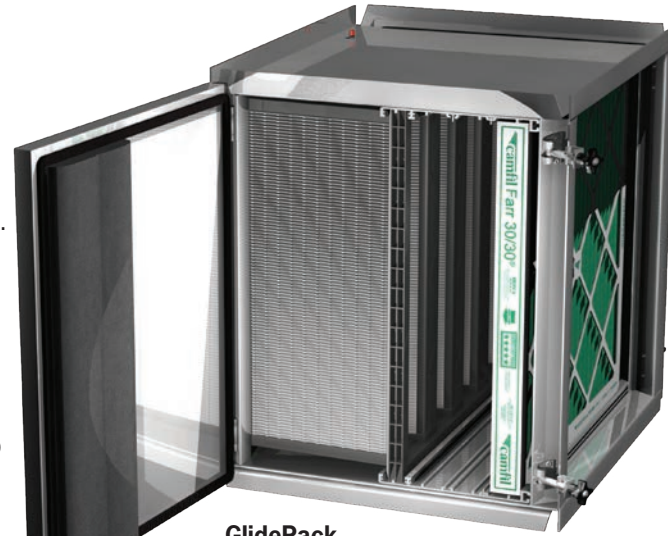
around a high-efficiency filter is even worse. Camfil housings and frames include the highest quality gasketing material to ensure that all of the air moving through the system is treated by the air filters. With Camfil designed housings, we guarantee less than 1/2 of 1% leakage across the installed filters.

The Camfil MultiTrack GlidePack®

The Camfil MultiTrack GlidePack, shown with a 30/30® prefilter and Durafil® ES² secondary filter, is the housing of choice for new or retrofit installations. It is designed to have less than one-half of 1% leakage from the housing to the conditioned space and less than one-half of 1% leakage across the filters. This ensures that all of the air moving through the system is treated by the air filters. Only a well-designed housing can ensure that the system efficiency matches the air filter efficiency.

The MultiTrack includes track adapters that slide easily in or out to facilitate different type of filters so the proper filters can be applied to the application. For ranges, the most common selection includes a Camfil 2" or 4" deep 30/30® and a Camfil Hi-Flo® SR.

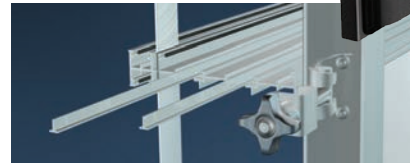
The GlidePack includes static taps so magnehelic gages may be installed to evaluate filter life, a key requirement to ensure that ranges are getting full use of filter life.



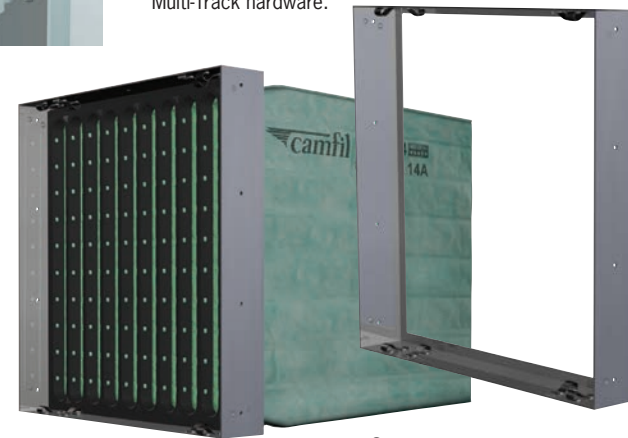
GlidePack

Your filter's efficiency is only as good as your filter housing. Camfil housings include the highest quality materials to ensure that all of the air moving through the system is treated by the air filters.

- Designed for standard size filters.
- Less than 1/2 of 1% leakage across the installed filters.



Existing systems can be retrofitted with Fast Frame or Multi-Track hardware.



Hi-Flo® ES with FastFrame

FastFrame

The Camfil FastFrame for built-up air filter banks does not require cumbersome fasteners or clips to install filters into the frame. It accepts any headered air filter, including pads, pleats, bags, boxes and V-bank filters. It can also be used for two-stage filtration applications. The FastFrame is available in 24-inch by 24-inch, 12-inch by 24-inch, 20-inch by 24-inch and 20-inch by 20-inch sizes to accommodate a variety of airflow requirements.



Global and Regional RESEARCH AND DEVELOPMENT

Using advanced research and test equipment – some of which are unique and feature proprietary designs – we can conduct R&D globally and regionally to meet the growing need for air filtration solutions that safeguard health, satisfy stricter energy efficiency and sustainability standards, and meet emerging needs for high-tech filtration.



Molecular Lab

- Development of molecular filters
- Climate controlled test rigs for carbon media and full-size molecular filters
- Gas chromatography



GT/APC Lab

- Development of filter solutions for dust collection and gas turbines
- High-Speed filter rig for gas turbines
- Climate simulation



Process Development Workshop

- Development of process equipment for manufacturing filters
- Fully equipped machine shop
- 3D printer for prototyping



Particle Lab 1

- Development of comfort and HEPA filters
- Aerosol research
- Test rig for full-scale filters and smaller filters
- Nano particle measurements using an electrostatic classifier with CPC
- Filter media testing and development



Particle Lab 2

- Classification of filters according to EN 779:2012 and ASHRAE 52.2
- Energy classification of filters
- Classification rig and IPA discharge rig
- Remote-controlled mobile laboratories for testing air filters in the field



IAQ Lab

- Quantitative and qualitative air quality analysis
- Media and fiber development
- Air quality research
- Scanning Electron Microscope, SEM

Camfil CamCleaners

The most advanced filtration technology available for efficient filtering of indoor pollutants such as warehouse dust, welding smoke, oil mist, printing fumes and chemicals, food and beverage contaminants. Camfil air cleaners for industrial and process applications are equipped with the most efficient Absolute™ HEPA filter. The product range for indoor air excellence has been developed to suit all applications and available as a portable unit or a ceiling-mount unit. It is an investment in reduced energy costs, no more odors, less dust, fewer harmful particles, and end result, a healthier working environment. In other words, reduced absence due to illness and more efficient production.

Camfil City M Air Purifier

The Camfil CITY M Air Purifier is quiet, efficient, stylish and environmentally conscious for smaller internal area with pollutants and odors. Just "plug and play." Within a few hours, it reduces millions of hazardous particles per cubic foot.



City M

CamCleaner Horizontal and Vertical

DO MORE WITH LESS

"Do more with less" is the mantra that resonates throughout every facility today. It has become a catch phrase for penny-pinching, and a call for people to work harder with fewer resources. The origin of this common phrase, however, was to allow new tools to make work easier.

Budget cuts are on everyone's mind, and one effective strategy for managing this reality is by choosing critical products based on their true life cycle costs – total cost over the life of the product with all factors considered, compared to alternatives, over time.

Camfil has developed a family of air filtration products for every area of every environment with this principle in mind. Camfil's well-engineered filtration solutions satisfy every important requirement:

- energy savings
- performance at rated efficiency throughout the life of the filter
- low frequency of change-outs
- low labor and waste disposal

The Camfil 5-Star premium filters deliver these advantages and present an intelligent alternative to the low-end commodity products pushed by many manufacturers and buying groups.

Camfil's many case studies prove the depth of knowledge and experience behind the development of intelligent, cost-efficient filtration solutions for the food and beverage industry.

CAMFIL THE GLOBAL LEADER

Camfil is the global leader in the air filtration industry with more than half a century of experience developing and manufacturing sustainable clean air solutions that protect people, products, equipment, and the environment against harmful airborne particles, gases and emissions. These solutions are used globally to benefit human health, increase performance and reduce energy consumption in a wide range of air filtration applications.

In North America, Camfil's distribution network of stocking warehouses staffed with trained personnel are located through the US, Canada and Mexico. In addition to six manufacturing facilities, the Riverdale, New Jersey facility houses a state-of-the-art R&D department and a ISO class 7 cleanroom for HEPA filter production.



Life Cycle Cost Analysis

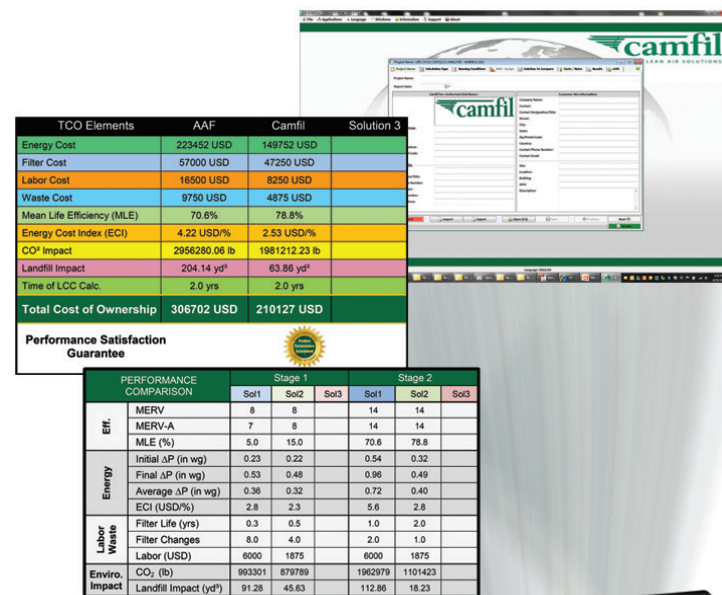
Camfil software to optimize your filter selection.

Camfil has developed a life cycle cost (LCC) software for optimizing air filters used in ventilation systems. It examines multiple parameters looking at filters, not only in terms of price but:

- Energy cost
- Operating hours
- Different environments
- Filter quality
- Labor costs
- Dust cleaning
- Disposal costs
- MLE

Based upon the design of the system and user input, if there is a filter service history, calculations are performed to determine the minimum number of filters needed for the lowest total cost over a given time period. Significant factors include average filter pressure drop, filter life and energy costs. The Camfil LCC comprehensive database incorporates 20 years of documented real-life performance of Camfil products as well as competitive air filter brands.

Discover your lowest total cost of ownership while providing superior air quality.



CAMFIL is a world leader in air filters and clean air solutions.

For more than half a century, Camfil has been helping people breathe cleaner air. As a leading manufacturer of premium clean air solutions, we provide commercial and industrial systems for air filtration and air pollution control that improve worker and equipment productivity, minimize energy use, and benefit human health and the environment.

We firmly believe that the best solutions for our customers are the best solutions for our planet, too. That's why every step of the way – from design to delivery and across the product life cycle – we consider the impact of what we do on people and on the world around us. Through a fresh approach to problem-solving, innovative design, precise process control and a strong customer focus we aim to conserve more, use less and find better ways – so we can all breathe easier.

The Camfil Group is headquartered in Stockholm, Sweden, and has 28 manufacturing sites, six R&D centers, local sales offices in 26 countries, and 4,180 employees and growing. We proudly serve and support customers in a wide variety of industries and in communities across the world.

To discover how Camfil can help you to protect people, processes and the environment, visit us at www.camfil.us.

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