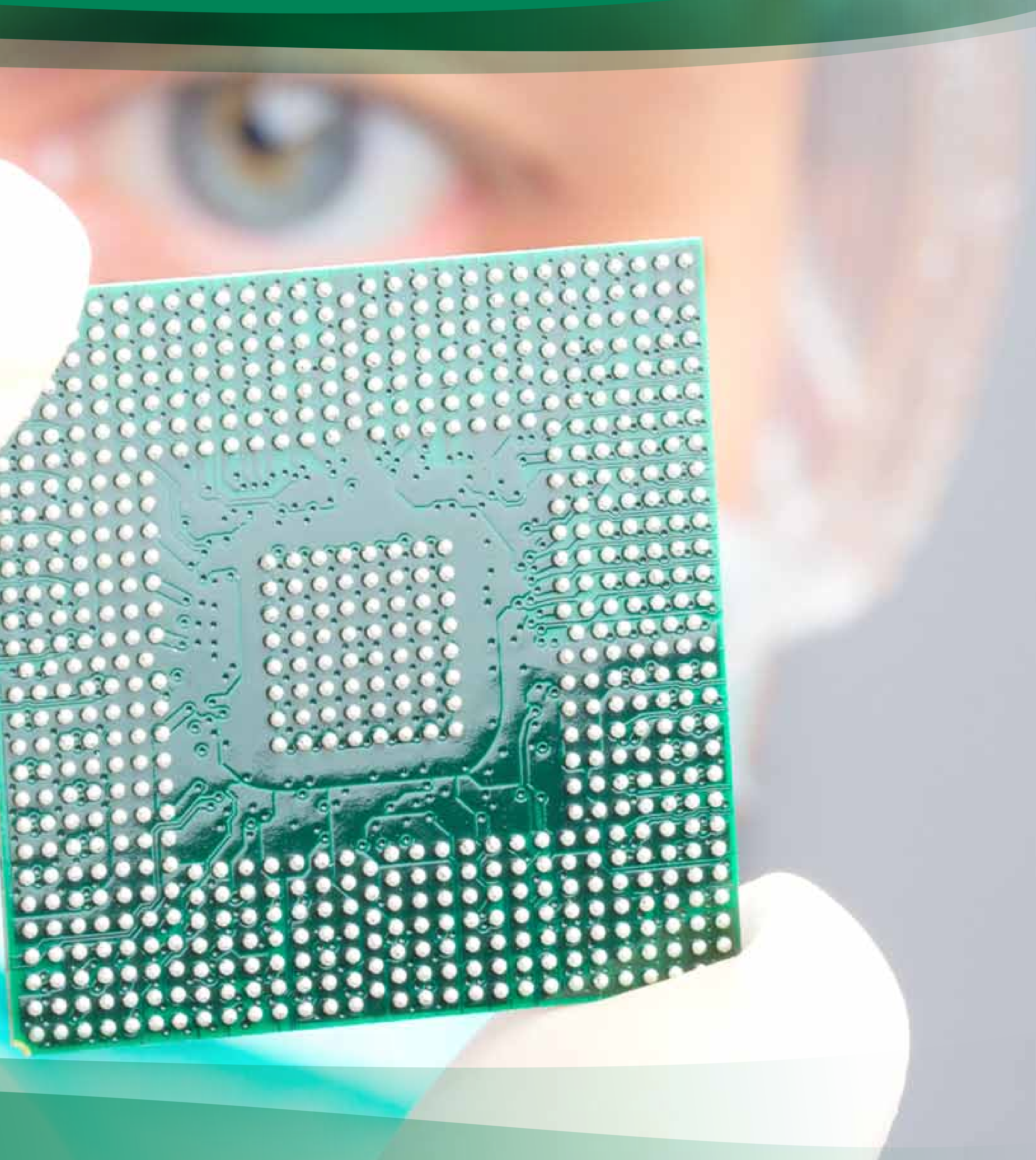
camfil

MICROELECTRONICS



Clean air solutions

Clean Air Solutions

INTRODUCTION
MICROELECTRONICS

Semiconductor
Semiconductor manufacturing is facing multiple challenges in the coming years when it comes to contamination control. The so-called technology node has now reached 20 nm and below for the most advanced Fabs. To simplify, the node is the smaller critical dimension (CD) which can be printed into patterns by lithography processes to form a transistor, the most important component of any electronic devices. The smaller the dimension the more densely packed information and the better the performance of the microelectronic equipments or memories. This is typically noticed by consumers when upgrading computers with always faster processors or larger memories. At this scale, AMC has now become a major concern for many of the processes involved in the manufacturing of logics or memories, impacting both production yield and quality. All Fabs working with these latest technologies need mandatory AMC control. AMC filters are installed in facility systems and on top of tools or tool minienvironments.

The full scale implementation of Extreme UV lithography scanners is expected to take place starting 2015 to follow the technology node pace below 14 nm. The International Technology Roadmap for Semiconductors organization expects the CD of printed patterns to reach 6 nm by 2026. To put this into perspective, it represents the approximate dimension of 10 organic molecules side by side. With surface patterns nearing the molecular dimensions, airborne molecular contamination control is of course a critical parameter for successful manufacturing. One should not forget that wafers can spend one month inside a factory going through 100s of different processes before being released as finish goods. Each small contamination impact in any part of the process chain may have serious consequences on the overall yield of the Fab.

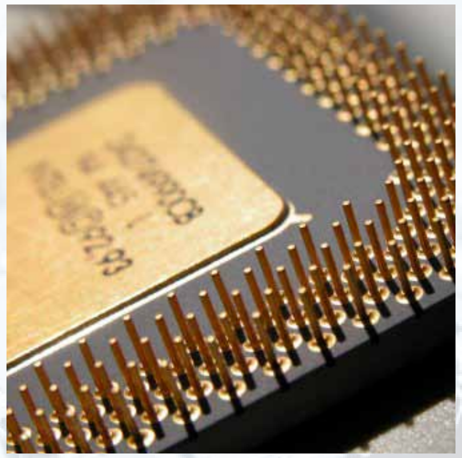
Another challenge will be the progressive use of 450 mm (18") wafers (against 200 and 300 mm today). These dimensions will drive up the cost of individual wafers and further increase the need for particle and AMC protection at the tool level.

Finally, increasing costs for defect free masks used in both EUV and multiple patterning lithography processes are putting pressure on the air contamination control systems for both facility and critical minienvironments such as inspection equipments or stockers.

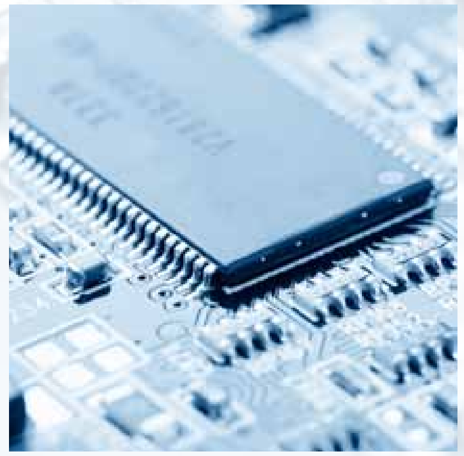
Camfil is in the unique position to offer a total clean air concept to follow the most difficult challenges to come in semiconductor manufacturing.

Flat Panels Displays
Some processes used for flat panel display (FPD) manufacturing are similar to what is found in semiconductor companies, just at a very different scale. Particle contamination control has always been a major concern for FPD companies as the probability to get particle deposition on large display surfaces is very high during key process steps. In recent years and with the progress of technologies, AMC control has also shown its benefits in thin film applications or lithography equipments. Due to the very large size of most FPD factories and the tremendous air volumes involved, contamination control optimization and energy savings have been a key priority to the industry.

Camfil 100% quality check of HEPA / ULPA filters ensures 100% compliance to the





cleanroom air quality standards. Optimization is achieved through the use of Camfil software packages (LCC, CREO, AMC). These softwares help the industry achieve best cost of ownership through filter class optimization giving energy savings representing 100s of thousands of dollars per year and facility. Furthermore Camfil long experience in AMC filtration for semiconductor manufacturing is successfully applied to FPD applications with solutions targeting different types of contaminant in different process steps.

Finally, Camfil exhaust systems are able to control high concentrations of particles and chemicals often released by the very large process equipments used in FPD manufacturing.

Solar
Solar panel manufacturing is changing at a fast pace with tremendous competition and aggressive price targets for solar products. Factories are getting larger, and air handling represents an important cost for running this type of facilities. As for FPD manufacturing, significant energy savings are achieved by smart filters choices through the use of our array of optimization softwares (LCC, CREO, AMC).

Ensuring a long lifetime for solar products is key to promote this energy source vs more conventional solutions.
As a result it is not surprising that achieving corrosion free manufacturing environment are one of the most important requirement in the solar panel industry. Camfil AMC filters for corrosive acid removal ensure concentration levels do not exceed industry requirements as measured by online corrosion monitoring sensors or gas analyzers.

Camfil exhaust systems are installed for Si dust control (from sawing processes) to protect both people from dangerous particle concentrations and the environment.

Hard Disk Drives
Hard disks manufacturers are engaged in a cost and reliability race against solid state memory makers. The reading head and the media (disk) are the most critical components which need protection during hard disk manufacturing, to ensure a high quality for the final product with less risks of critical failures during the expected life span of the disk.

All hard disk factories are using advanced particle cleanroom environments with AMC control for specific contaminants. Throughout the years, Camfil has built a database of applications which will help you achieve the most stringent requirements for different process environments. Thanks to a comprehensive analytical program, Camfil is able to analyze and quantify contamination (particle and AMC) in order to propose the best solutions to hard disk makers.

SUSTAINABILITY

ENERGY SAVINGS & CARBON FOOTPRINT

For more than 50 years, the Camfil group have been developing air filtration solutions to help customer's improve indoor air quality at lowest possible energy costs. By doing so our customers can protect people, processes and the environment from air pollution, while reducing their carbon footprint, in a profitable way.

Energy Savings

According to US EPA Agency, Sustainable buildings shall reduce the overall impact of the built environment on human health and the natural environment by:

• Efficiently using energy, water, and other resources

• Protecting occupant health and improving employee productivity

• Reducing waste, pollution and environmental degradation

Energy efficiency becomes a tool to achieve global financial performance involving business controlers and finance departments, whereas it was delegated to maintenance departments so far. Sustainable air filtration solutions, can provide concrete answer to new requirements from authorities regarding climate change mitigation and energy efficiency policies implementation, without compromising indoor air quality.

It is all about finding the right balance between energy conservation and people health or environment protection. Without a global approach, people health and environment protection will be trade off.

ISO 50001 - Energy Management

Because we apply to ourselves what we recommend to our customers, many Camfil manufacturing facilities are already certified for the recent ISO 50001 standard. The standard ensures that we develop an energy management system with real practical targets on energy use and continuous improvements.

Carbon Footprints

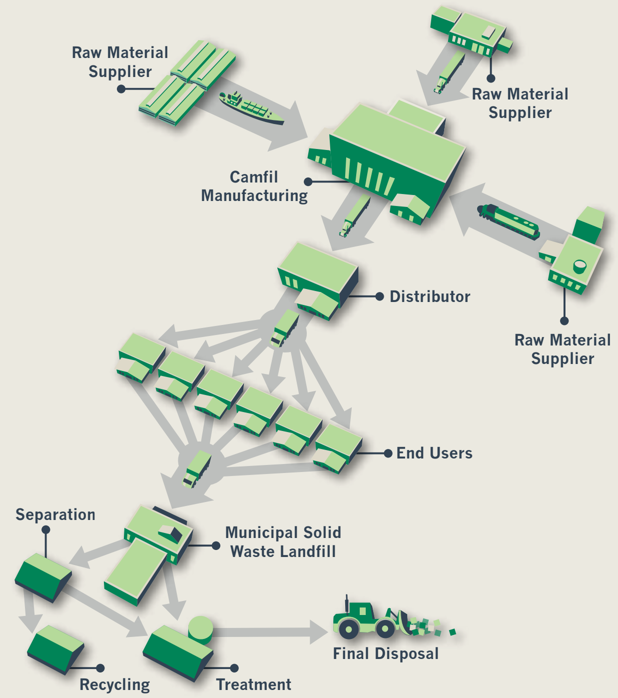
The benefits of using filters that perform more efficiently, use less energy, and require less-frequent changeouts, are substantial. Using fewer filters means fewer dollars spent on fuel at every step – from raw material acquisition and processing to filter manufacturing, distribution, transportation to users, and ultimately, transport to a landfill, and recycling.

Using fewer filters also reduces the consumption and demand for critical raw materials, including lumber, metals, adhesives and filter media, which are often petroleum-based. Of course, there are also savings in the energy necessary to produce the filters.

At the other end of the filter's life cycle, fewer filters translates directly into reduced greenhouse gas emissions. All landfills generate greenhouse gases, including CO2, sulfur, and methane – which contribute mightily to water and air pollution.

The lower amounts of energy consumed at every stage of the filter's life can contribute substantially to a reduced carbon footprint.

Air Filters Have a Powerful Impact on Carbon Footprint because Energy is Consumed at Every Step, from Raw Materials Sourcing, to Filter Utilization, to Disposal



Energy Efficiency Classification

In Europe, Eurovent, the trade association for the HVAC industry, has put greater emphasis on the energy aspects of filters in recent years.

In the Eurovent Energy Efficiency Classification System for filters, introduced in 2012 and based on Eurovent 4/11 for energy consumption combined with EN779:2012 for efficiency, filters are now graded from A to G, with "A" standing for the lowest energy consumption and "G" for the highest (see table below).

Camfil pioneered a classification for its own filters already in 2007, several years before Eurovent. With the push to lower the energy consumption of HVAC systems, a filter's energy classification gives customers a clearer understanding of a filter's annual energy consumption, initial efficiency and minimum efficiency.

Camfil's labels and product names include the A to G energy rating to clearly point out the difference between our filters and competitor products. This will become more and more important as EU directives require public and commercial buildings to improve the energy efficiency of their ventilation systems.

In addition to energy classifications, several Camfil filters in Europe and the U.S. have names to indicate low energy consumption.

Examples are the Opakfil Energy series in Europe and the energy-saving Hi-Flo ES and Durafil ES in North America and Asia Pacific.

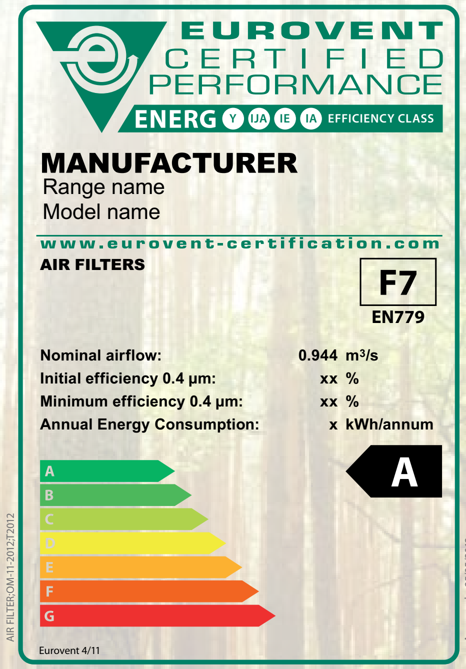
Calculations and classification

The new standard measures both filtration efficiency and pressure drop as a function of dust loading. A representative energy consumption level is calculated using the mean pressure drop difference averaged over the course of dust loading. On the basis of these figures, the energy performance of a filter over an operating period of one year is simulated in a laboratory. This representative energy value is used for a classification of air filters into energy classes from A (best) to G (worst).

$$W = \frac{q_V \cdot \Delta p \cdot t}{\eta \cdot 1000}$$

The calculation used in the new energy efficiency classification by Eurovent 4/11.

Filter efficiency is measured in independent tests based on the EN779:2012 standard and both initial and minimum efficiency are stated on the labels (see example).



Filter class ME	G4 -	M5 -	M6 -	F7 ME ≥ 35%	F8 ME ≥ 55%	F9 ME ≥ 70%
	M_G = 350g ASHRAE	M_M= 250g ASHRAE		M_F = 100g ASHRAE		
A	0 - 600kWH	0 - 650kWh	0 - 800kWh	0 - 1200 kWh	0 - 1600 kWh	0 - 2000 kWh
B	> 600 kWh - 700 kWh	> 650 kWh - 780 kWh	>800 kWh - 950 kWh	>1200 kWh - 1450 kWh	>1600 kWh - 1950 kWh	>2000 kWh - 2500 kWh
C	> 700 kWh - 800 kWh	> 780 kWh - 910 kWh	>950 kWh - 1100 kWh	>1450 kWh - 1700kWh	>1950 kWh - 2300 kWh	>2500 kWh - 3000 kWh
D	> 800 kWh - 900 kWh	> 910 kWh - 1040 kWh	>1100 kWh - 1250 kWh	>1700 kWh - 1950 kWh	>2300 kWh - 2650 kWh	>3000 kWh - 3500 kWh
E	> 900 kWh - 1000 kWh	> 1040 kWh - 1170 kWh	>1250 kWh - 1400 kWh	>1950 kWh - 2200 kWh	>2650 kWh - 3000 kWh	>3500 kWh - 4000 kWh
F	> 1000 kWh - 1100 kWh	> 1170 kWh - 1300 kWh	>1400 kWh - 1550 kWh	>2200 kWh - 2450 kWh	>3000 kWh - 3550 kWh	>4000 kWh - 4500 kWh
G	> 1100 kWh	> 1300 kWh	>1550 kWh	>2450 kWh	>3350 kWh	>4500 kWh

SOFTWARE INTRODUCTION

LCC
Is a powerful software modeling tool that identifies the most effective filter strategy for every operating condition based on “life cycle” cost, which includes the cost of filters, energy, labor, carbon footprint and waste disposal. It indicates the ideal pressure drop at which changeout is recommended to minimize energy use, and maximize the filter life. Competitors use literature claims and partial incomplete test data, not verified real-life application data.

CREO
The CREO software is essentially a marriage of Camfil's well known and frequently used LCC (Life Cycle Cost) Green software along with its clean room design software. The two software programs combine to make a robust planning tool that identifies the best air filter options to optimize clean room filtration and energy consumption. Taking into account the latest international industry norms, the tool also generates complete filter and hardware specifications in a simple, easy-to-use format. The software is ideally suited for A&E companies and end users who operate clean rooms in order to optimize their air filtration needs.

Clean-AMC
Airborne molecular contamination in a modern microelectronic factory are complex with contributions from both outside air and process chemicals used by manufacturing equipments or wet benches. In order to optimize filtration systems and give microelectronics companies best cost of ownership, Camfil is using a 3 step approach:
- Identify and quantify all AMC through advanced analytical services.
- Run simulations with advanced softwares to understand concentration levels in different part of the air handling system.
- Recommend the best cost of ownership solution with optimized filter lifetime and performance.

Simulating achievable AMC concentrations in different parts of a cleanroom environment is impossible without advanced simulation tools. Our Clean-AMC software provides a unique solution to achieve our customers most demanding contamination control targets.

LCC SOFTWARE

The LCC (Life Cycle Cost) software is a tool we have used successfully for many years in the Microelectronics industry. The volatile oil and energy markets and the ever increasing cost of supplying clean air are critical for this industry.

The LCC software allows us to simulate different combinations of filter types with the desired efficiency to maximize lifetime, reduce energy costs and number of filter changes which can save the Electronic manufacturer valuable resources. An additional benefit is the positive effect reduced motor power and disposal has on the environment.

After filter survey's are carried out at the manufacturing facility, we can input the existing filter set up in the air handling units and optimize the selection of the lowest LCC filter combination for the facility in question.

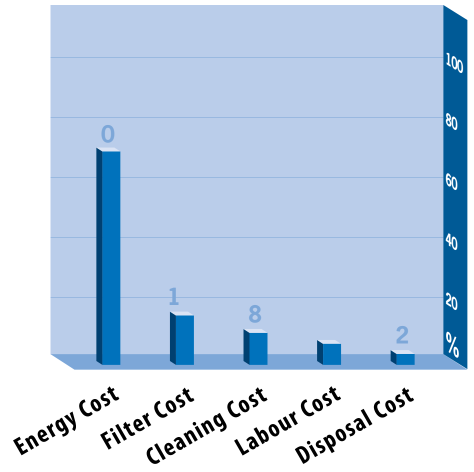
Parameters the software includes:
- Type of filters in use
- Outside air condition (environmental condition in the plants location)
- Airflow
- Number of filters in the air-handling units engineering tools
- Current change out conditions (we can select filters being changed on time or pressure drop)
- Current energy cost
- Installation cost
- Disposal and cleaning costs

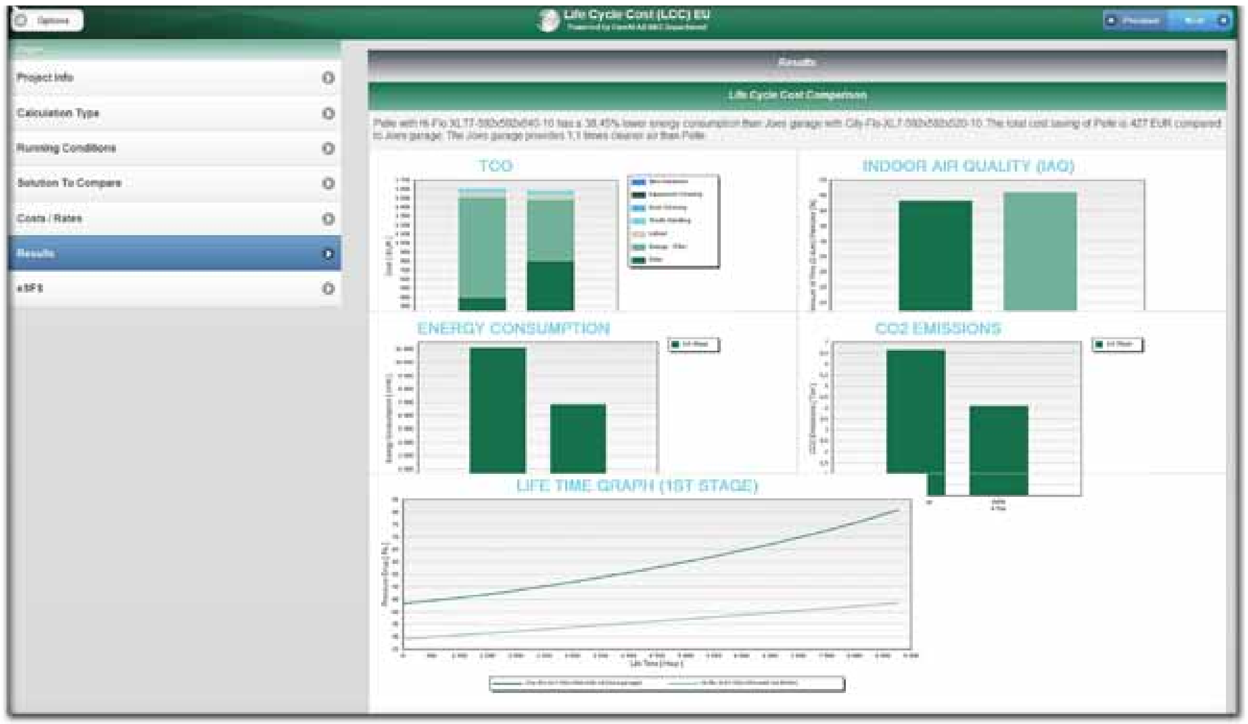
THE COST OF VENTILATION
It is well known that building ventilation costs are significant. The “typical” energy cost of filters as a percentage of the total system is approximately 30%.

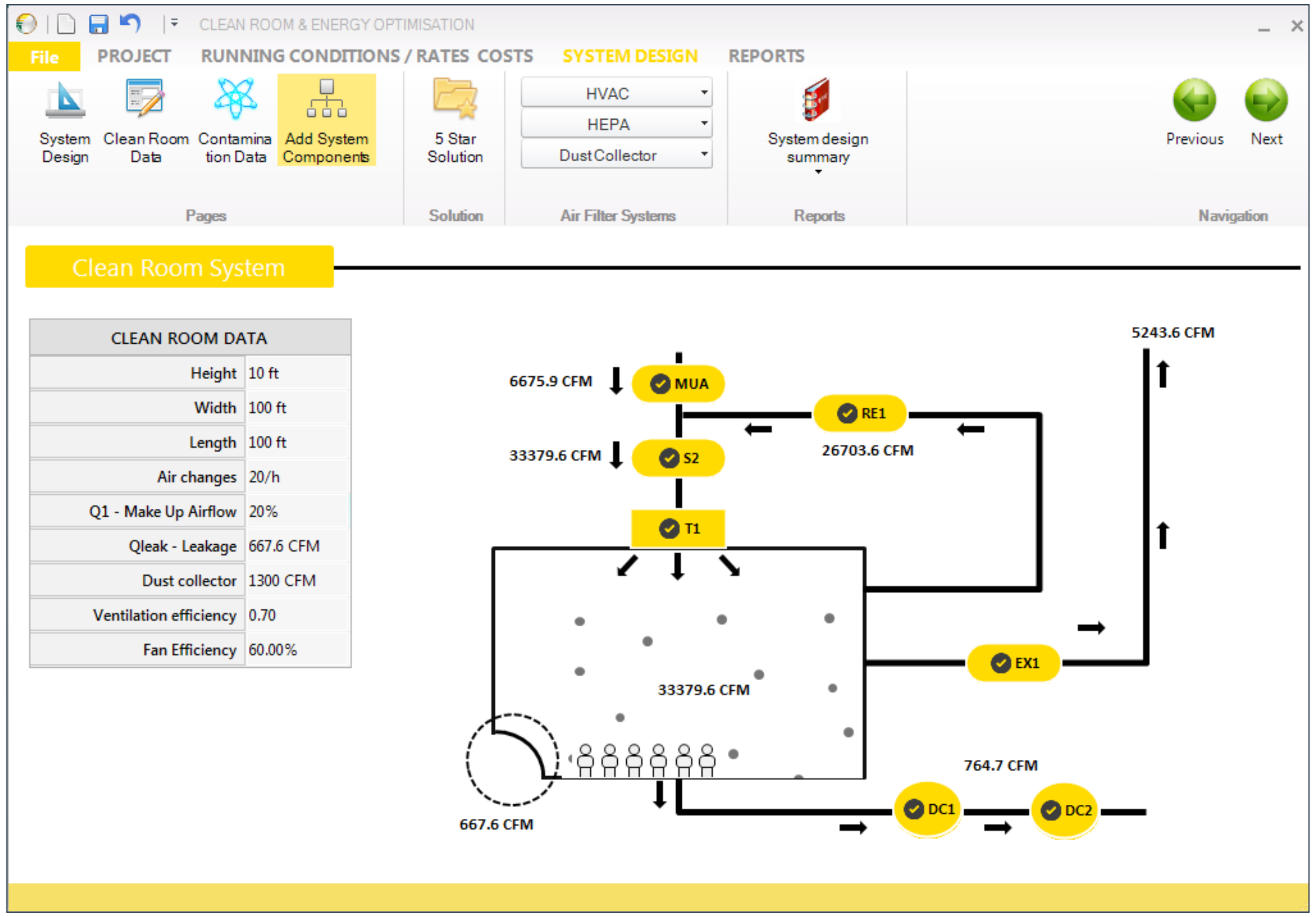
A bad filter construction could add 50 Pascal (0.2” wg) compared to a “good” construction, even when the same filter class is used. In other words it adds $75 on the annual energy bill.

70% OF THE COST IS ENERGY

Calculations reveal that energy normally accounts for **70 % of the total life cycle cost** of the system. The energy consumption is directly proportional to the average pressure drop over the filter.







CREO SOFTWARE

The **Clean Room and Energy Optimization** software enables the user to create a customized clean room application. The software allows the user to calculate the Life Cycle Cost and cleanliness class for different Clean room designs.

Different Cleanroom configurations can be analyzed ranging from ventilating to unidirectional (Laminar flow) installations.

Benefits of good ventilation effectiveness:
- Reduced energy costs
- Reduced cleanroom contamination
- Reduced installation costs (less FFU)
- Reduced maintenance costs

Selection options include:
- Particle size of interest, 0.1, 0.3 or 0.5 micron
- Particles generated from the process and activity from people in the room
- Dimensions of the room
- No. of air changes/airflow
- Ventilation effectiveness
- Amount of recirculated air from 0 – 100%
- Pre and terminal filter efficiencies

Wide ranges of reports are available, including Cleanroom classifications as well as specifications for selected products. Additional information such as CO_2- emissions and efficiency of the filter system are also available.

CLEAN AMC SOFTWARE

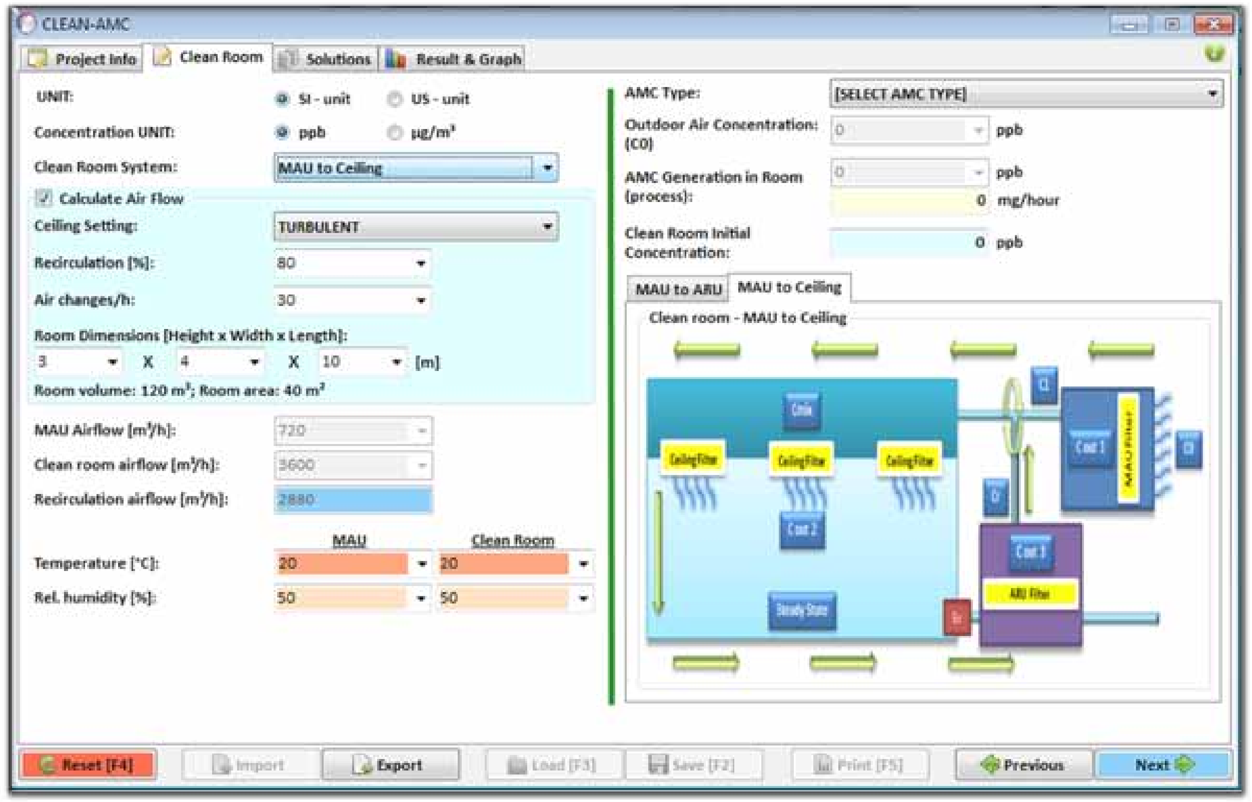
CLEAN-AMC allows users to simulate different filter solutions to gather information on achievable AMC concentrations in different parts of a cleanroom system, for instance above the ceiling, below FFU filters or as an average cleanroom concentration in return ducts. This tool is used to help microelectronic manufacturing facilities design their total AMC control concept and optimize their total filtration cost of ownership.

The possible uses for the AMC software include:

- Cleanroom dimensioning using air changes, recirculation percentage and cleanroom dimensions to calculate the recommended air flows of the MAU and ARU/ceiling system.
- Determination of average cleanroom concentrations after installing filters at MAU, FFU or ARU.
- Estimation of AMC generation inside cleanrooms in mg/hour.
- Define an overall strategy for contamination control of different contaminants like acids, bases or organics.
- Determination of theoretical AMC concentrations at the inlet of a selected recirculated air filtration stage once the system is running. Combined with pressure drop and air flow information, these concentrations can be used for filter dimensioning and filter lifetime determination using our unique filter design softwares and AMC consulting engineers recommendations.
- Determination of optimal filter coverage on the top of cleanroom ceiling FFU. Different coverages will give different scenario for the achievable local and average AMC concentrations inside the cleanroom.
- Highlight the difference between average cleanroom concentrations and local cleanroom concentrations (e.g. just below ceiling filters). This difference is an important parameter to evaluate the possibility to follow given AMC specifications in different area of the facility system.
- Comparison of achievable concentrations for different filter final removal efficiencies. This parameter helps defining at which residual efficiency the filters should in theory be removed for a given cleanroom or local specification.

The software allows you to find the right balance between final filter efficiency requirements and filter coverage and selection. For instance, shall I use 500 ceiling filters down to 70% efficiency to maintain 2 ppb NH3 in the cleanroom or 1000 filters down to 40% efficiency to get the same result?

The CLEAN-AMC software will help you answer these questions in a very simple way. This information can then be used by our experienced team together with other parameters like filter lifetime, mechanical risk assessment, space, future intentions for unused coverage and cost; to decide about the final AMC control technical recommendation for the entire cleanroom system.



Hi-Flo

Opakfil

Durafil

HVAC
PRODUCTS & STANDARDS

HVAC Air Filter Standards
The filtration industry is inundated with multiple filtration standards to classify, identify, and evaluate various performance characteristics of an air filter.

In the USA, the organization known as ASHRAE (American Society of Heating, Refrigerating, and Air-Conditioning Engineers) was founded in 1894 and is currently an international organization of 50,000 persons.

ASHRAE has published a laboratory filtration performance standard for testing air filters since 1968 and all have been accredited by the American National Standards Institute (ANSI) to define minimum values or acceptable performance.

In Europe, the history of the filtration standards mimics the ASHRAE standard path. The European Committee for Standardization (CEN) formalized their filtration standard in 1993 with the publication of EN-779:1993.

This document was very similar to ASHRAE 52.1-1992 and with only minor differences, used the same equipment and test method of the ASHRAE standard.

In 2002 CEN followed the ASHRAE lead by revising EN- 779 into a particle removal efficiency standard similar to ASHRAE 52.2. However, this new document EN-779:2002 had some striking differences.

As with the 1999 revision to the ASHRAE document, this new procedure converted from Dust Spot efficiency to a particle removal test method. The actual test method and equipment used is different between the two standards in a number of ways with the most important variations listed below:

- Particle size range measured – Since 99% of all the particulate found in atmospheric air is below 1.0 micron it is important to know the filtration performance below that point. ASHRAE went with a higher upper limit to be able to provide particle removal efficiency for lower end pre-filters.

In 2012, CEN took another major step forward with the EN 779:2012 revision. This is now the most comprehensive and stringent standard in the industry and EN779:2012 now classifies fine air filters according to their lowest filtration efficiency, referred to as "Minimum Efficiency" (ME). The introduction of the new criteria for F7 to F9 filter classes secures the air cleaning ability of air filters over time, regardless of the type of filtration media that the filters are made of. This will have a beneficial impact on indoor air quality and at all times guarantee the user a minimum efficiency.

To support the selection of energy-efficient air filters, EUROVENT, the trade association for the European HVAC industry, has developed the guideline "Eurovent 4/11" to classify air filters according to their performance and energy consumption during the usage phase. As a result, air filters offering the same air cleaning performance can be compared on the basis of their annual energy consumption. This tool now allows the selection of efficient filters according to EN779:2012, while keeping energy consumption as low as possible.

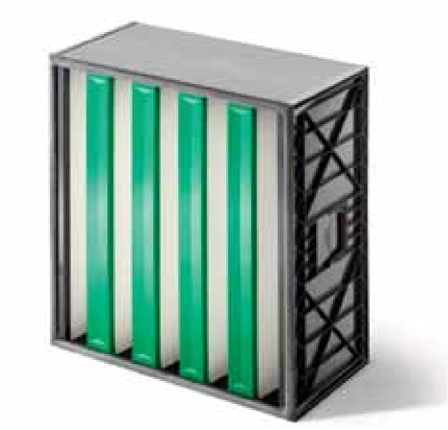
Eurovent combines a stringent efficiency standard with energy consumption for optimal solutions and transparency for the user.

AIR FILTERS TESTING COMPARISON

EN779:2012						ASHRAE Standard 52.2 - 2012					EN 779:2002 (obsolete)	ASHRAE 52.1 -1992 (obsolete)
Group	Class	Final Pressure Drop (test)	Average arrestance of synthetic dust	Average efficiency[1] for 0.4 µm particles	Minimum efficiency[1] for 0.4 µm particles	Minimum Efficiency Reporting Value	Composite Average Particle Size Efficiency, % in Size Range, microns: Range 1	Range 2	Range 3	Average Arrestance	Class	Average Dust Spot Efficiency
		Pa	%	%	%	MERV	0.30 - 1.0	1.0 - 3.0	3.0 - 10.0	%		%
Coarse	G1	250	50≤ A <65	-	-	1	n/a	n/a	$E_3 < 20$	$A_{avg} \geq 65$	G1	<20
	G2	250	65≤ A ≤80	-	-	2	n/a	n/a	$E_3 < 20$	$A_{avg} \geq 65$	G2	<20
						3	n/a	n/a	$E_3 < 20$	$A_{avg} \geq 70$		<20
						4	n/a	n/a	$E_3 < 20$	$A_{avg} \geq 75$		<20
	G3	250	80≤ A <90	-	-	5	n/a	n/a	$E_3 \geq 20$	80	G3	20
						6	n/a	n/a	$E_3 \geq 35$	85		20-25
	G4	250	90≤ A	-	-	7	n/a	n/a	$E_3 \geq 50$	90	G4	25-30
						8	n/a	n/a	$E_3 \geq 70$	92		30-35
Medium	M5	450	-	40≤ E ≤60	-	9	n/a	n/a	$E_3 \geq 85$	95	F5	40-45
						10	n/a	$E_2 \geq 50$	$E_3 \geq 85$	96		50-55
	M6	450	-	60≤ E ≤80	-	11	n/a	$E_2 \geq 65$	$E_3 \geq 85$	97	F6	60-65
						12	n/a	$E_2 \geq 80$	$E_3 \geq 90$	98		70-75
Fine	F7	450	-	80≤ E ≤90	35	13	n/a	$E_2 \geq 90$	$E_3 \geq 90$	98	F7	80-85
	F8	450	-	90≤ E ≤95	55	14	$E_1 \geq 75$	$E_2 \geq 90$	$E_3 \geq 90$	99	F8	90-95
	F9	450	-	95≤ E	70	15	$E_1 \geq 85$	$E_2 \geq 90$	$E_3 \geq 90$	99	F9	95
-	-	-	-	-	-	16	$E_1 \geq 95$	$E_2 \geq 95$	$E_3 \geq 95$	100	n/a	99

Notes:
The final MERV value is the highest MERV where the filter data meets all requirements of that MERV
The characteristics of atmospheric dust vary widely in comparison with those of synthetic dust used in the tests. Because of this the test results do not provide a basis for predicting either operational performance or life. Loss of media charge or shedding of particles or fibers can also adversely affect efficiency.
[1] Minimum efficiency is the lowest efficiency among the initial efficiency, discharged efficiency and the lowest efficiency throughout the test procedure.

Megalam



Absolute™ V-G series

Absolute™ V-G-HF

EPA, HEPA & ULPA
PRODUCTS & STANDARDS

Advanced filtration solutions are required to ensure no contaminated air reach the manufacturing of semiconductors, hard disks and other highly sensitive processes in the Microelectronic industry. A few uncollected particles or gas molecules can have extremely serious consequences in some processes

Camfil's HEPA/ULPA filters are specified daily and chosen by our customersworld-wide for the most critical applications in the Microelectronic industry. Our advanced HEPA/UPA filters combined with our AMC solutions are used to protect the most sensitive processes from contamination and thereby ensuring high output yields.

Manufacturing

Camfil's HEPA/ULPA filters are produced within controlled environments in our ISO 9000 certified plants and are individually tested and certified to ensure compliance. Camfil develops own manufacturing equipment in our hi-tech machine development centre. Our in-house manufacturing of all major scanning and pleating machines ensure consistency of product quality and construction throughout the world. In our HEPA/ULPA filters we make use of our Controlled Media Spacing™ technology. CMS™ which ensures optimized filter element depth and pleat spacing resulting in minimized configuration losses and low resistance to airflow resulting in energy savings and improved lifetime.

Test standards

All HEPA/ULPA filters are tested according to EN1822:2009 using an automated scanning process to assure accuracy and reliability of the test result. Testing is performed in ISO 5 clean zones within a ISO 7 clean room. All testing is conducted by the controlled and documented procedures of Camfil's ISO 9001-2000 certified quality system. This gives our clients individually certified filters with a unique serial no. and a complete test report specifying test conditions, target values and actual performance of our filters. Tests according to other standards are also performed upon request.

Outgassing tests

Based on our stringent incoming inspection we carry out outgassing tests of our raw materials for presence of e.g. flame retardants such as organophosphates, with damaging doping or refractory properties to some manufacturing modules of semiconductor facilities. Solid latex spheres are normally chosen as test aerosols for sensitive applications due to their low outgassing properties. We have third party outgassing tests for all major components in the filters and can as an additional safeguard offer testing of the final product.

Fire rating

When fire rating are is required Camfil HEPA/ULPA filters are certified according to below standards and can be configured accordingly:

- DIN 53438
- UL 900
- FM 4920

Scanner

ISO 29463 CLASSIFICATIONS

Filter Class (Group)	Particle Size for Testing	Global Values		Local / Leak Values		
		Collection Efficiency (%)	Penetration (%)	Collection Efficiency (%)	Penetration (%)	Multiple of Global Efficiency (%)
ISO 15 E	MPPS	≥ 95	≤ 5	-	-	-
ISO 20 E	MPPS	≥ 99	≤ 1	-	-	-
ISO 25 E	MPPS	≥ 99.5	≤ 0.5	-	-	-
ISO 30 E	MPPS	≥ 99.9	≤ 0.1	-	-	-
ISO 35 H	MPPS	≥ 99.95	≤ 0.05	≥ 99.75	≤ 0.25	5
ISO 40 H	MPPS	≥ 99.99	≤ 0.01	≥ 99.95	≤ 0.05	5
ISO 45 H	MPPS	≥ 99.995	≤ 0.005	≥ 99.975	≤ 0.025	5
ISO 50 U	MPPS	≥ 99.999	≤ 0.001	≥ 99.995	≤ 0.005	5
ISO 55 U	MPPS	≥ 99.9995	≤ 0.0005	≥ 99.9975	≤ 0.0025	5
ISO 60 U	MPPS	≥ 99.9999	≤ 0.0001	≥ 99.9995	≤ 0.0005	5
ISO 65 U	MPPS	≥ 99.99995	≤ 0.00005	≥ 99.99975	≤ 0.00025	5
ISO 70 U	MPPS	≥ 99.99999	≤ 0.00001	≥ 99.9999	≤ 0.0001	10
ISO 75 U	MPPS	≤≥ 99.999995	≤ 0.000005	≥ 99.9999	≤ 0.0001	20

ISO 29463-1:2011 establishes a classification of filters based on their performance, as determined in accordance with ISO 29463-3, ISO 29463-4 and ISO 29463-5. It also provides an overview of the test procedures, and specifies general requirements for assessing and marking the filters, as well as for documenting the test results. It is intended for use in conjunction with ISO 29463-2, ISO 29463-3, ISO29463-4 and ISO 29463-5.

EN 1822 CLASSIFICATION

Filter Class (Group)	Particle Size for Testing	Global Values		Local / Leak Values		
		Collection Efficiency (%)	Penetration (%)	Collection Efficiency (%)	Penetration (%)	Multiple of Global Efficiency (%)
E10	-	≥ 85	≤ 15	-	-	-
E11	-	≥ 95	≤ 5	-	-	-
E12	-	≥ 99.5	≤ 0.5	-	-	-
H13	MPPS[a]	≥ 99.95	≤ 0.05	≥ 99.75	≤ 0.25	5
H14	MPPS[a]	≥ 99.995	≤ 0.005	≥ 99.975	≤ 0.025	5
U15	MPPS[a]	≥ 99.9995	≤ 0.0005	≥ 99.9975	≤ 0.0025	5
U16	MPPS[a]	≥ 99.99995	≤ 0.00005	≥ 99.99975	≤ 0.00025	5
U17	MPPS[a]	≥ 99.999995	≤ 0.000005	≥ 99.9999	≤ 0.0001	5

[a] MPPS - Most Penetrating Particle Size

EN 1822
This European standard is based on particle counting methods that actually cover most needs for different applications. EN1822: 2009 differs from its previous edition (EN1822:1998) by including the following:
An alternative method for leakage testing of Group H filters with shapes other than panels
An alternative test method for using a solid, instead of a liquid, test aerosol.
A method for testing and classifying of filters made out of membrane-type media
A method for testing and classifying filters made out of synthetic fiber media
The main difference is related to the classification for the filter classes H10 - H12, which has now been changed to E10 - E12.

IEST RP CC001

Filter Class (Group)	Particle Size for Testing	Global Values		Local / Leak Values		
		Collection Efficiency (%)	Penetration (%)	Collection Efficiency (%)	Penetration (%)	Multiple of Global Efficiency (%)
A	0.3[a]	≥ 99.97	≤ 0.03			-
B	0.3[a]	≥ 99.97	≤ 0.03	Two-Flow Leak Test		-
E	0.3[a]	≥ 99.97	≤ 0.03	Two-Flow Leak Test		-
H	0.1-0.2 or 0.2-0.3[b]	≥ 99.97	≤ 0.03			-
I	0.1-0.2 or 0.2-0.3[b]	≥ 99.97	≤ 0.03	Two-Flow Leak Test		-
C	0.3[a]	≥ 99.99	≤ 0.01	≥ 99.99	≤ 0.01	1
J	0.1-0.2 or 0.2-0.3[b]	≥ 99.99	≤ 0.01	≥ 99.99	≤ 0.01	1
K	0.1-0.2 or 0.2-0.3[b]	≥ 99.995	≤ 0.005	≥ 99.992	≤ 0.008	1.6
D	0.3[a]	≥ 99.999	≤ 0.001	≥ 99.99	≤ 0.005	5
F	0.1-0.2 or 0.2-0.3[b]	≥ 99.9995	≤ 0.0005	≥ 99.995	≤ 0.0025	5
G	0.1	≥ 99.9999	≤ 0.0001	≥ 99.999	≤ 0.001	10

[a] MPPS - Most Penetrating Particle Size

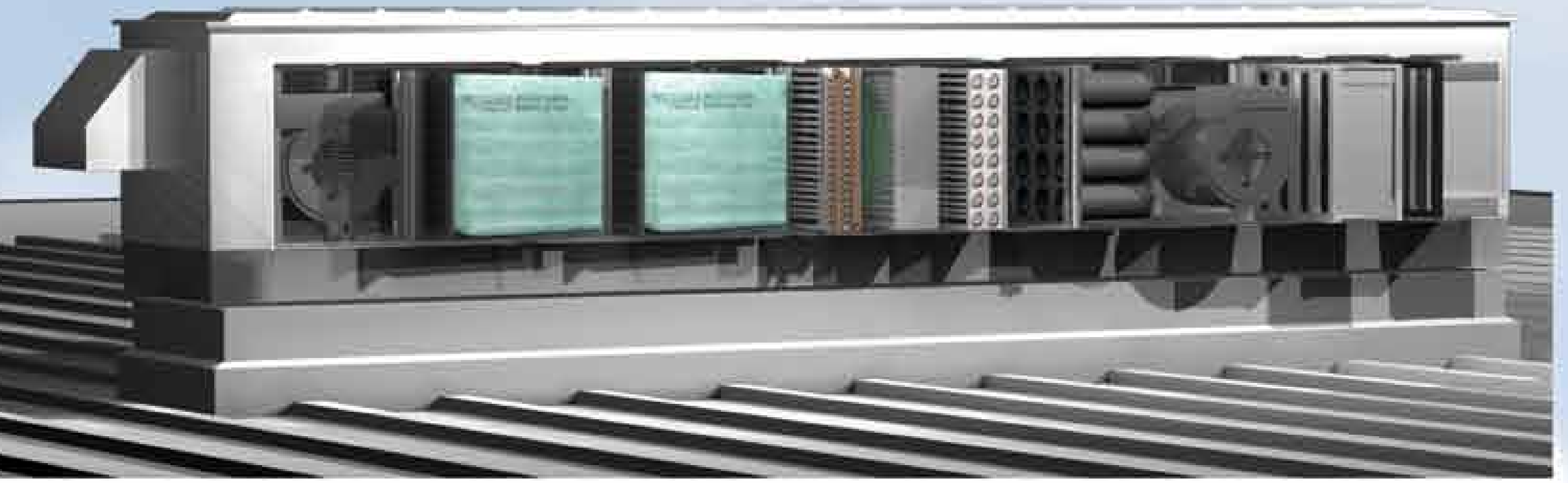
IEST RP CC001
This Recommended Practice (RP), IEST-RP-CC001.5, covers basic provisions for HEPA (high efficiency particulate air) and ULPA (ultra-low penetration air) filter units as a basis for agreement between customers and suppliers. HEPA filters and ULPA filters that meet the requirements of this RP are suitable for use in clean air devices and cleanrooms that fall within the scope of ISO 14644 and for use in supply air and contaminated exhaust systems that require extremely high filter efficiency (99.97% or higher) for sub micrometer (μm) particles. This RP describes 11 levels of filter performance and six grades of filter construction. The customer's purchase order should specify the level of performance and grade of construction required. The customer should also specify the filter efficiency required if it is not covered by the performance levels specified in this RP.

Business-critical solutions for the microelectronics industry

Controlling both AMC and particle contamination represents a significant technology barrier as feature sizes continue to shrink in integrated circuit (IC) manufacturing. Critical AMCs include sulphur dioxide, volatile organic compounds (VOCs), diverse acids and ammonia. In outdoor air and cleanroom environments, all these gases are present in concentrations that are too high for many electronic manufacturing processes. For example, it is no longer possible to manufacture microprocessors, memories or displays for smartphones and tablets without advanced AMC filtration in the cleanroom and on the process equipment.

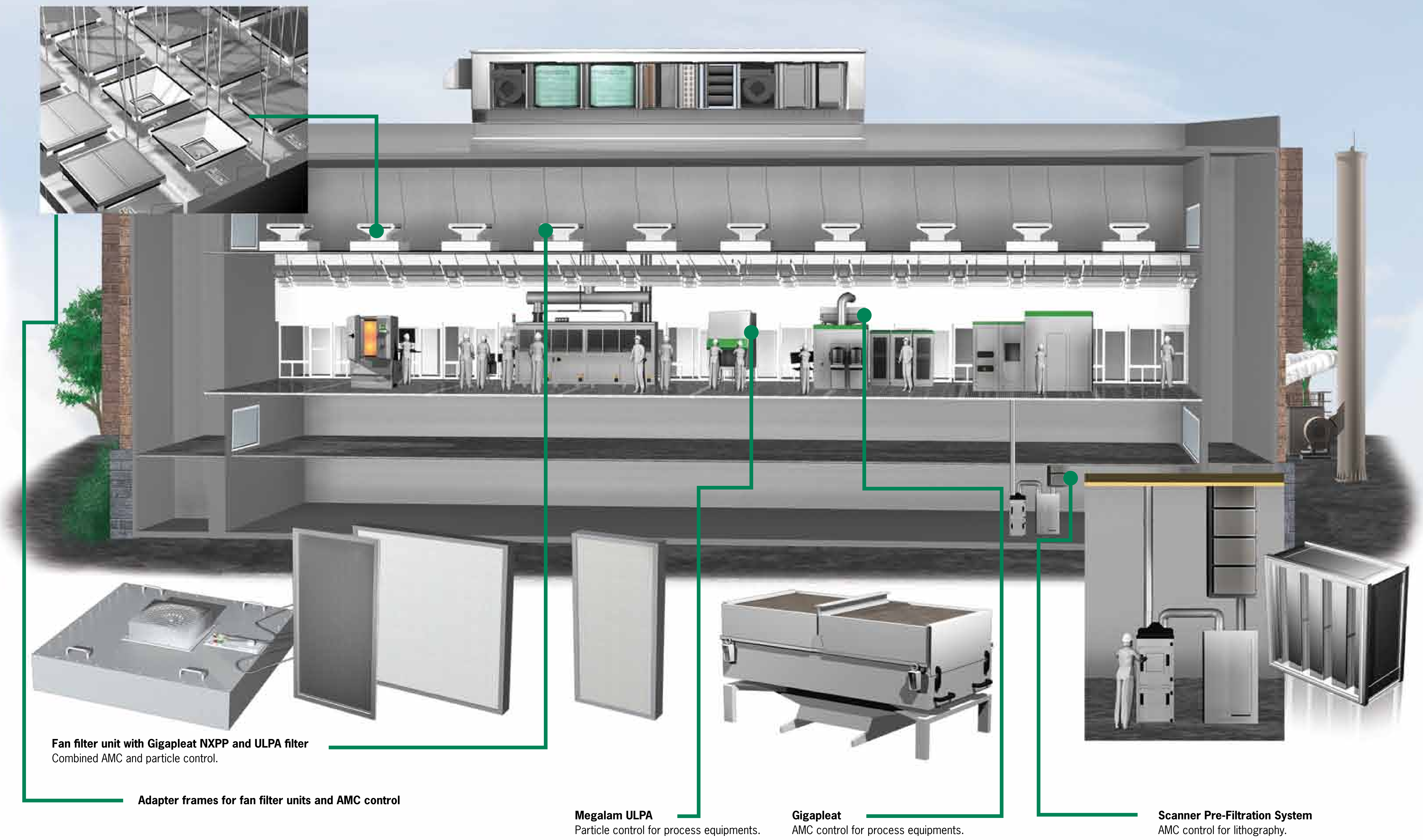
MICROELECTRONIC INDUSTRY SOLUTIONS

SUPPLY AIR



Hi-Flo Particle Control | **Hi-Flo** Particle Control | **CamCarb** AMC Control | **Absolute** Particle Control

Hi-Flo Particle Control | **Durafil/Opakfil** Particle Control | **Gigapleat XPC** AMC Control | **Absolute** Particle Control



RECIRCULATION AIR

Durafil/Opakfil Particle Control | **Absolute** Particle Control | **Gigapleat NXPH** AMC Control | **Gigapleat NXDP** AMC Control

EXHAUST AIR

CamCarb

NXPH

XPC

NXPC

NXDP

NXPP

AMC
PRODUCTS & STANDARDS
Gigapleat & Moebius
Molecular filter solutions using specific adsorbents in a range of framing options

Molecular filter solutions are available for virtually all installation designs and applications.

Application / Model	NXPC (cell)	NXPP (panel)	NXPH (header)	NXDP (header/cell)	XPC/XPH (header/cell)	CamCarb (cylinder / panel)
Make-up air	Yes		Yes	Yes	Yes	Yes
Recirculation units	Yes		Yes	Yes	Yes	
Ceilings / FFU		Yes				
Tools / mini-environments	Yes	Yes		Yes		

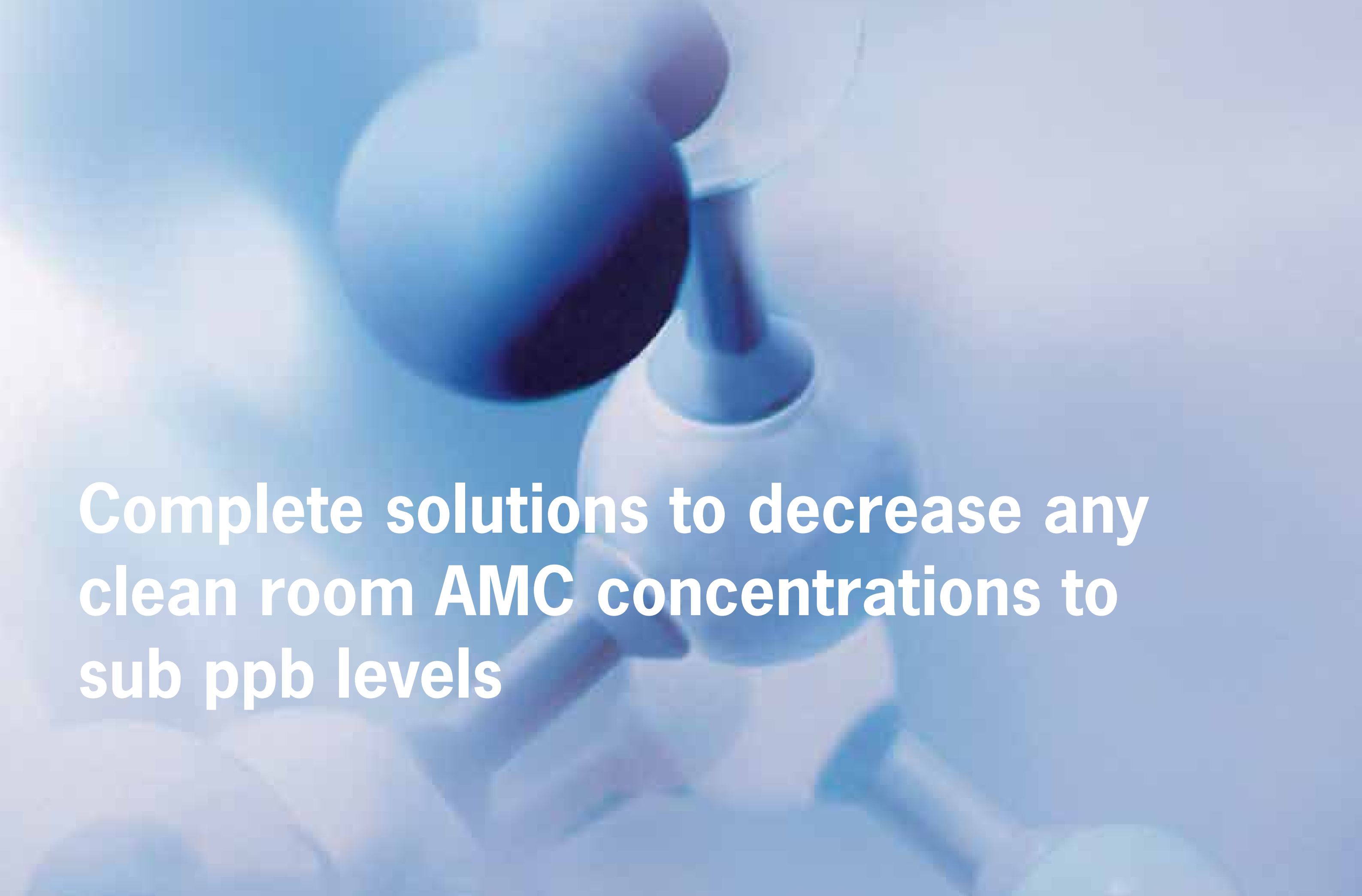
Table 1: Application guide for different patterns of molecular filters.

AMC vs Media Type	Lx*	Ax*	Bx*	Cx*	Dx*
Acids				YES	YES
Bases		YES	YES		
Condensables (B.Pt>150 deg. C)	YES	Yes		Yes	
Dopants (Organophosphates)	YES	Yes		Yes	
Dopants (BF3)				YES	
Organics (B.Pt < 150 deg. C)	YES				
Ozone	YES	Yes		Yes	

Table 2: The primary and secondary applications for different chemical filter media types are shown in the adjacent table. x*is a number referring to one of the multiple media grades used by Camfil for different pressure drop or performance requirements.

Features / Models	NXPC (Cell)	NXPP (panel)	NXPH (header)	NXDP (cell/header)	XPC / XPH (cell/header)
Initial efficiency	Typically >95%	Typically >95%	Typically >95%	Typically >95%	Typically >95%
Rated face velocity	2.0 m/s (610x610)	<0.8 m/s (depends on layer configuration)	2.0 m/s	e.g. 2.0 m/s (depends on layer configuration)	e.g. 2 m/s (depends on layer configuration)
Pressure drop	50 Pa	(depends on layer configuration)	50 Pa	(depends on layer configuration)	50 Pa
Frame material	Galvanized S. or Aluminium	Aluminium	PS / ABS	Galvanized S. / Aluminium	Stainless Steel
Particle filtration	F7 Option	HEPA/ULPA option	F7 option	F7 Option	No
Available sizes (mm)	610x610x292 595x595x292 (half size versions)	Flexible 1220x1220 (WxL) Height: 66, 90, 110, 150, 200	592x592x292 592x490x292 592x287x292	610x610x292 595x595x292 592x592x292 (half size versions)	610x610x592 592x592x292

Table 3: Features of diffferent AMC Filters.



SEMI STANDARD F21-1102
AMC DEFINITIONS

Since 1995 SEMI and Sematech have been investigating the effects of AMC on production yields in microelectronics manufacturing processes.

According to the SEMI standard AMC are classified into molecular acids (MA), molecular bases (MB), molecular organic condensables (MC) and molecular dopants (MD). Maximum permissible concentration levels in the air were defined in parts per trillion molar (or volume), also called ppt(M) or ppt(v).

Today most people in the industry are using ppt or parts per billion (ppb) to describe the AMC concentration levels inside cleanrooms or process equipments. Since the original standard was developed, new problematic contaminant classes were added by the industry such as molecular refractory (MR) and volatile organic compounds (VOC). The vocabulary developed by SEMI is now used to describe AMC related issues in other microelectronic processes such as flat panel display, light emitting diode or hard disk drive manufacturing.

Table 4 and 5 gives some example of AMC contamination and their classification.

ISO developed a standard to describe cleanroom class based on AMC concentrations (ISO 14644-8). This standard is more general than the SEMI standard with AMC classes being applied to a wider range of industries. However most companies still use ppt or ppb values to describe concentrations levels and do not speak in ISO levels as it is currently done for particle contamination.

MA	MB	MD	MR
HF, hydrogen fluoride	NH3, ammonia	TEP, triethyl phosphate	TEP, triethyl phosphate
HCl, hydrogen chloride	NMP, N-methyl pyrrolidone	TCEP, Tris(chloroethyl) phosphate	TMS, trimethyl silanol
SO2, sulfur dioxide	Triethyl amine	BF3, boron trifluoride	Hexamethyldisiloxane
CH3COOH, acetic acid	Trimethyl amine	B(OH)3, boric acid	D4, Octamethylcyclotetrasiloxane
H2S, hydrogen sulfide	Ethanol amine	PH3, phosphine	Tetrachloroethylene

Table 4: Example of AMC following SEMI F21-1102 standard and new categories following later developments.

Category of organic contamination	AMC	Boiling point (°C)	Remark
Volatile organic compounds	IPA, Isopropanol	82	Common cleaning agent
	Heptane	98	Higher boiling point than benzene but elute before.
Volatile organics according to ITRS definition. GC-MS retention time >= benzene	Benzene	80	Vehicle exhaust contamination
	Toluene	111	
	Butanol	117	
	Xylene	140	Vehicle exhaust contamination
	PGMEA	146	Process chemical. Often considered condensable
MC: Condensable organics according to SEMI and ITRS definition	Ethyl lactate	154	Process chemical
	Trimethyl benzene	165	Common traffic contamination
	NMP, N - methyl pyrrolidone	204	Process chemical
	Triethyl phosphate	215	Fire retardant
	BHT, butylated hydroxy toluene	265	Plasticizer
	Diethyl phthalate	298	Plasticizer
	DOP, Dioctyl phthalate	385	Plasticizer, Test aerosol for ULPA filters.

Table 5: Example of organic AMC following SEMI F21-1102, ITRS definitions and a more general definition for volatile organic compounds

ITRS
ROADMAP FOR SEMICONDUCTORS

ITRS is an organization discussing and setting the requirements for successful production of the future semiconductor devices. One working group is working on AMC contamination control and discusses allowable concentration levels in air for logics or memories manufacturing. The table below summarizes the current requirements when it comes to AMC contaminati on for different process steps and different locations. This work is published every year and new challenges are expected to arise as new processes such as Extreme UV or 450 mm wafers are implemented.

	ACIDS		BASES	ORGANICS		
ITRS recommended AMC concentrations in ppb(v) for semiconductor manufacturing. Technology levels: 25 nm for flash 1/2 pitch, 36 nm for DRAM 1/2 pitch and 22 nm for MPU physical gate length (2012 update)	Total inorganic acids e.g.HCl, HF, H2SO4, HNO3). NOx & H2S not considered.	Total organic acids (e.g. formic, acetic lactic)	Total bases (e.g. NH3, NMP, TMA)	Volatile organics (GC-MS retention time > benzene, calibrated to hexadecane)	PGMEA and ethyl lactate	Condensable organics (SEMI definition boiling point > 150°C)
Cleanroom air: lithography scanner	5	2	20	26	5	Included in volatile
Wafer environment: lithography scanner	0.05	0.02	0.2	0.26	0.05	Included in volatile
Cleanroom air: coater developper and inspection tool	2	2	2	Not relevant	5	1
Wafer environment: coater developper and inspection	0.2	0.2	0.2	Not relevant	0.5	0.1
Reticle storage and exposure	0.2	0.2	0.2	Not relevant	Not yet defined	0.1
Salicidation wafer environment	0.5	5	Not relevant	Not relevant	Not relevant	Not relevant
Exposed copper wafer process environment	0.5	0.5	2	Not relevant	Not relevant	Not relevant
Exposed aluminium wafer process environment	0.5	Not yet defined	Not yet defined	Not relevant	Not relevant	Not relevant
Gate, furnace wafer environment	Not relevant	Not relevant	Not relevant	20	Not relevant	Not relevant

Table 6 : ITRS recommended AMC concentrations in ppb(v) for semiconductor manufacturing.

Table 6 (continued):	SULFUR		ACIDS	REFRACTORY	METALS	DOPANTS
ITRS recommended AMC concentrations in ppb(v) for semiconductor manufacturing. Technology levels: 25 nm for flash 1/2 pitch, 36 nm for DRAM 1/2 pitch and 22 nm for MPU physical gate length (2012 update)	H2S	Total sulfur compounds	Total other corrosive species such as O3 and Cl2	Refractory compounds (organics with other atoms than C, N, O)	Total metals (atoms/cm2 depositing on wafer /week)	Dopants (atoms/cm2 depositing on wafer /week)
Cleanroom air: lithography scanner	Not yet defined	Included in acids and refractory	Not yet defined	0.1	Not relevant	Not relevant
Wafer environment: lithography scanner	Not yet defined	Included in acids and refractory	Not yet defined	0.1	Not relevant	Not relevant
Cleanroom air: coater developper and inspection tool	Not yet defined	Included in acids and refractory	Not yet defined	Not yet defined	Not relevant	Not relevant
Wafer environment: coater developper and inspection	Not yet defined	Included in acids and refractory	Not yet defined	Not yet defined	Not relevant	Not relevant
Reticle storage and exposure	Not yet defined	Included in acids and refractory	Not yet defined	Not yet defined	Not relevant	Not relevant
Salicidation wafer environment	Not yet defined	Included in acids and refractory	Not yet defined	Not relevant	Not relevant	Not relevant
Exposed copper wafer process environment	1	2.5	1	Not relevant	Not relevant	Not relevant
Exposed aluminium wafer process environment	Not yet defined	Not yet defined	1	Not relevant	Not relevant	Not relevant
Gate, furnace wafer environment	Not relevant	Not relevant	Not relevant	Not relevant	10	10

Table 6 (continued) : ITRS recommended AMC concentrations in ppb(v) for semiconductor manufacturing.

AMC
PROCESS EQUIPMENT

Our AMC filters are used for bare wafer, processed wafer surfaces, optics, reticles, hard disk media, hard disk heads, flat panel displays or solar panel applications.

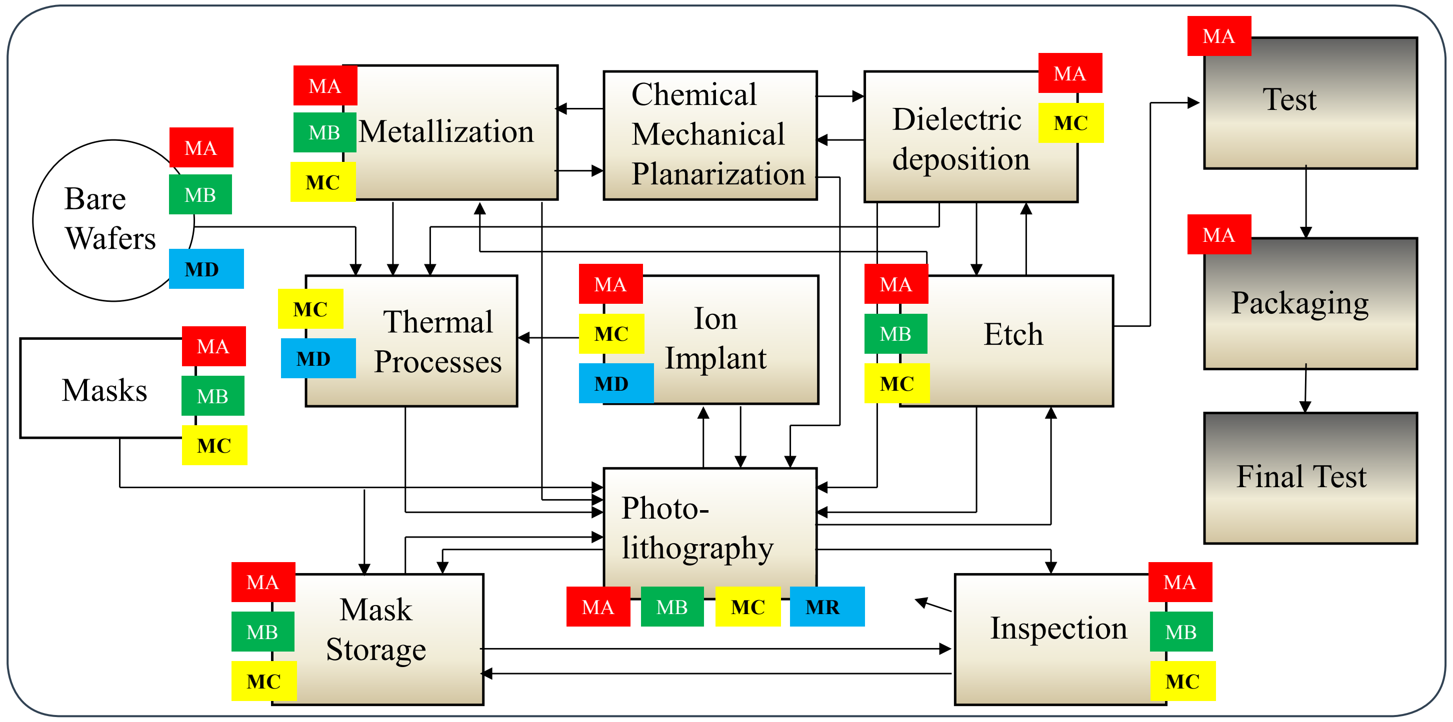
Camfil has qualified AMC tool filters with reference list for all major semiconductor manufacturing modules like lithography, etch, diffusion, metallization, thin films, ion implantation, inspection tools or reticle / wafer stockers.

Thanks to our gobal team of experts we can help you define Cross Contamination Control (CCC) strategies and optimize your overall AMC control concept.

DO YOU KNOW?

Camfil is the first company in the filtration industry to guarantee VOC outgassing and particle cleanliness of its AMC products thanks to a unique scanner developed for its manufacturing facility. After being the first company to test 100% of ULPA filters, Camfil is the first company to test 100% of AMC tool filters!

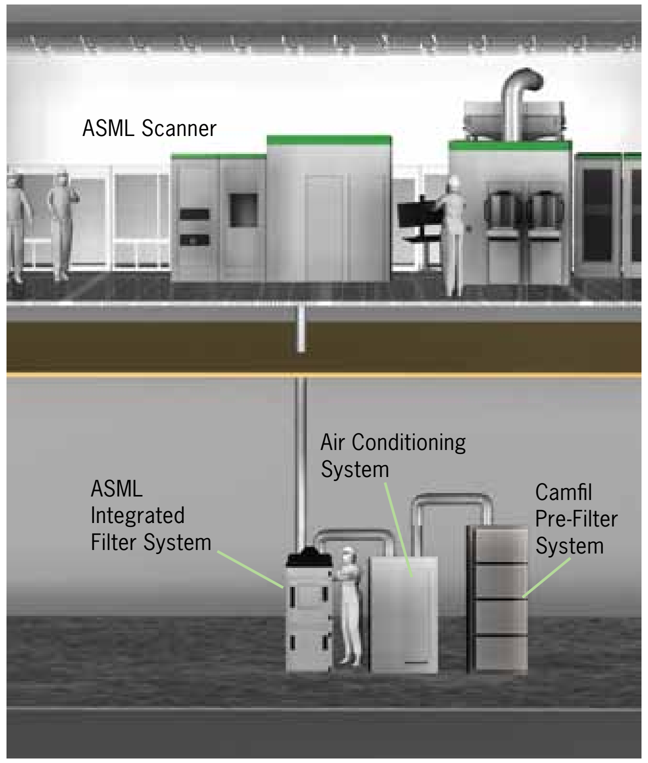
AMC filtration on top of process equipments



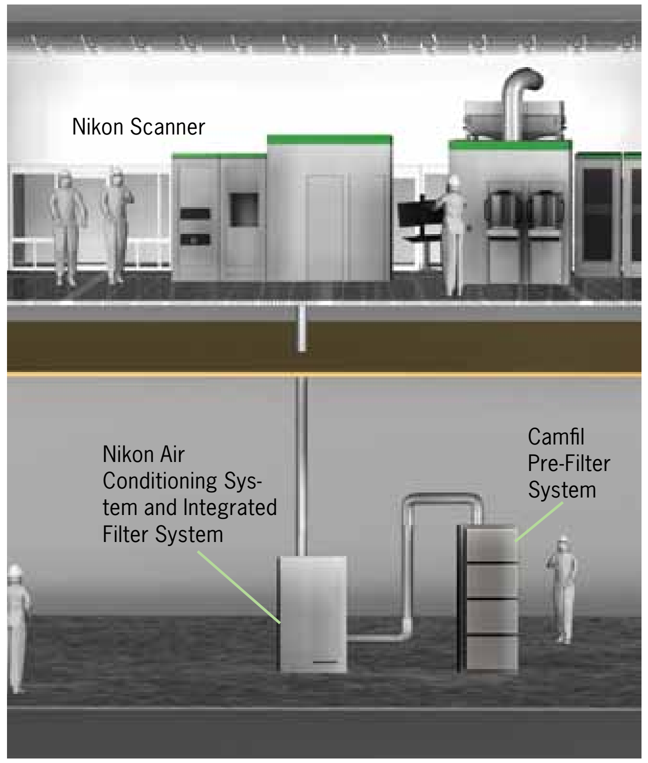
Process flow for semiconductor manufacturing with example of customized AMC control concept.

Camfil is able to offer you a complete solution for lithography processes to follow TEL and Screen coater developer requirements as well as latest generation scanners from ASML or Nikon. We are able to tailor made our advanced solutions to the specific AMC issues of your manufacturing facility to ensure best protection of the most critical process steps.

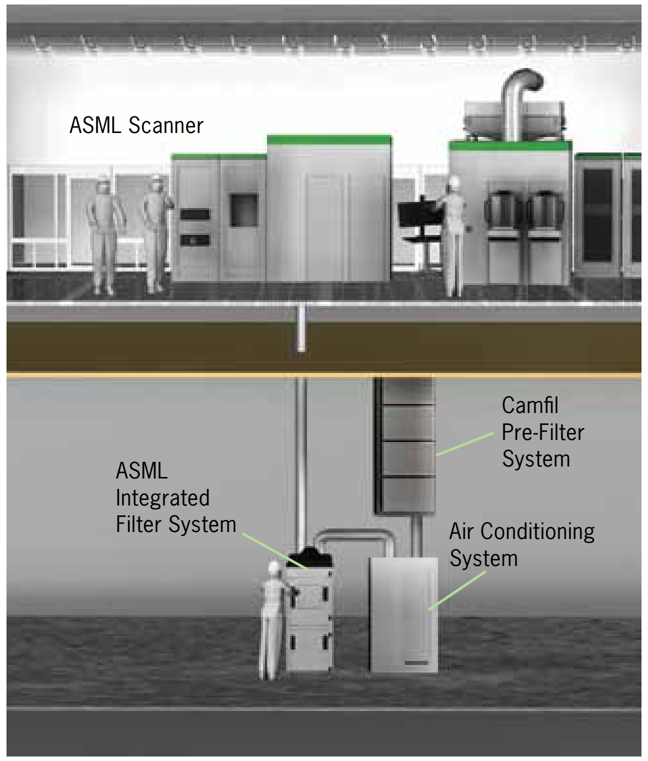
ASML Typical Layout



Nikon Typical Layout



ASML Typical Layout



Camfil AMC pre-filtration system (SPFS) allows end users to optimize the overall total cost of ownership of their filtration system by improving performance for Fab specific AMC.

SPFS has a unique design providing a small foot print and may also be attached to walls or ceilings in very crowded sub Fab areas.

Scanner AMC pre-filtration is critical to target relevant AMC such as:

- Refractory compounds - for lens protection
- Ammonia and amines - avoiding process defect such as T-topping through photoresist poisoning
- Organic acids - stop crystal formation on masks
- Inorganic acids - block formation of ammonium sulphate haze on masks and optics.

Camfil analytical team will help you optimize TCO after performing a thorough analysis of the air quality and reviewing all the available data.

AMC SERVICES

Camfil offers a wide range of AMC focused services that allow our customers to remain focused on their core business. These service include filter life time analysis, real time online measurement of contaminants and passive sampling to precisely determine the type and concentration of the problem compounds.

Once local analysis has been completed our AMC experts can propose comprehensive AMC solutions based on the minimum possible Life Cycle Cost available to meet customer needs.

Camfil is the only filter company equipped with a full size filter test facility designed to performance test not just filter media samples but also full size filters under precisely simulated conditions. This full size filter testing is the basis for all our published technical data and can be used to test filter performance against wide and varied range of AMC challenges under precise temperature, humidity and air flow conditions. This type of performance data can be invaluable when it comes to determining the optimal solution for any specific AMC challenge.

Advanced Online Gas Monitoring

If you need to understand the short term variation of airborne molecular contaminant (AMC) concentrations in your cleanroom for an extended period of time, Camfil Farr online monitoring equipment will be the perfect solution. Equipped with 8 sampling ports, our system is able to measure the concentrations of Ammonia (NH3), Ozone (O3), Sulfur Dioxide (SO2), Hydrogen Sulfide (H2S) or total reduced Sulfur compounds (TRS), down to a detection limit of 0.5 ppb(v). Data are recorded and can be plotted into graphs showing concentration changes over time in different location of your cleanroom or process equipments.

Our technology follows the recommendations of the International Technology Roadmap for Semicondutors (ITRS) for advanced air monitoring applications, using chemiluminescence technology for NH3, UV fluorescence detectors for SO2 and H2S, NH3 and Sulfur compounds are the most critical contaminants in semiconductor and microelectronic applications, resulting in serious yield losses and product quality issues, even when present at trace levels.

Please contact our local Camfil team of experts to assist you with your advanced online AMC measurements.

Test rig in Trosa Tech Center

Gigacheck

Online Gas Monitoring

Gigacheck™

The Camfil Gigacheck™ is a passive analytical system to selectively measure airborne molecular contaminants (AMC) in cleanrooms and accompanying air handling systems used for microelectronics and integrated circuit manufacture.

Common contaminants of analysis include acids, acid precursors, bases and ozone.

The kit and the samplers are supplied in a case and sealed plastic bags. The Gigacheck™ can be located inside the cleanroom, in a ventilation duct, inside make-up air systems, or in a mini environment. A proven tool, it is small, light weight, cost effective, and does not require any electrical connections or field calibration.

The only requirements are ambient temperature and normal airflow. Sampling time is 1 day – 1 month depending on the application. The Gigacheck™ provides average concentrations of AMC over the sampling period.

The Gigacheck™ is sealed and returned to our laboratory at the end of the exposure period.

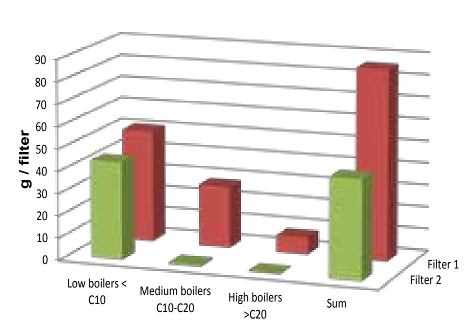
The resulting data and information about the ventilation system and the process being protected allows us to design an optimized molecular filtration system based on your specific site condition.

Gigamonitor

Gigamonitor is a technique to evaluate the condition or residual life of a chemical filter based on analysis of the adsorbent media. In the case of a filter used to control condensables (L), a representative media sample will be analysed to determined the content of organic molecules in different C-atom ranges.

For acids (C) and base (A, B) the analysis is to determine the residual chemical adsorption capacity. It is strongly recommended that a series of Gigamonitor measurements are made over time to provide a predictive trend for the end of the life of the filter.

Uptake of VOC & Condensables in Filters



Gigamonitor Media Analysis

Gold Series® Collectors

Bag-In Bag-Out

AIR POLLUTION CONTROL
DUST COLLECTOR

Gold Series® Collectors
Our flagship "Gold Series®" cartridge collector combines rugged heavy-gauge construction with a compact modular design that provides premium performance while taking up less floor space. Service benefits include easy access and fast, trouble-free filter change-out with no special tools required. Options include OSHA safety platforms and ladders, ASHRAE-type safety monitoring filters, and a new integrated HEPA safety monitoring filter that comes mounted on top of the collector so that no additional floor space is required.

The Gold Series collector is equipped with the award-winning "HemiPleat®" filter, which delivers lower pressure drop than standard cartridge filters for extended service life and energy savings.

A full line of accessories are available for the dust and fume collectors including user-friendly control panels, premium efficiency fans self-dumping hoppers, extractor arms, safety monitoring filters.

HemiPleat® cartridge filters also for retrofits
HemiPleat replacement filters are also available to enhance performance in most competitive cartridge collectors. The HemiPleat® design promises numerous and valuable benefits to end users of dust collection equipment. State-of-the-art pleating technology is the key to the HemiPleat's superior performance.

Techniques used to manufacture the media packs of this cartridge are unique and have never been applied to a cylindrical industrial dust collection filter before. Synthetic beads hold the pleats of the cartridge open with wide pleat spacing not found in competitive cartridges, which are packed too tightly to maximize media use. The wider spacing of the HemiPleat design exposes more media to the gas stream and results in lower pressure drop as well as improved cartridge release characteristics during pulse cleaning.

HemiPleat filters

GAS SCRUBBERS
DEEP BED FILTERS

Horizontal Deep Bed Filters (HDBs)
Horizontal Deep Bed filters (HDBs) are highly durable cost effective molecular filtration scrubbers for process industries. This product is designed to give the very highest levels of performance in those applications where plant reliability and elimination of corrosive gases, toxic gases and odours is essential for operational security and regulatory compliance.

Performance is delivered in terms of extremely high removal efficiency and the longest possible lifetime per fill of filtration media. Standard and optional features ensure reliable and safe operation. Five standard sizes are available with airflow capacities ranging from 850 m^3/hr to 5100 m^3/hr.

Vertical Deep Bed Filters (VDBe)
Vertical Deep Bed filters (VDBe) are durable cost effective molecular filtration solutions for exhaust streams from industrial processes. This product is designed to ensure the very highest levels of performance in those applications where the elimination of toxic gases and odours is essential for operational security and/or regulatory compliance.

Performance is delivered in terms of extremely high removal efficiency and the longest possible lifetime per fill of filtration media. Standard features ensure reliable and safe operation. Two equipment configurations are available with airflow capacities ranging from 10,000 to 105,000 m^3hr^{-1}. Virtually any molecular filtration media may be selected for use in the filters, depending on the contaminant(s) to be controlled. VDBe filters are completely adipiscing elit.

Target gases and media options
Target gases for this equipment include:

- acidic gases (hydrogen sulphide, oxides of sulphur, hydrogen fluoride etc.)
- organic compounds
- odour responsible gases
- toxic gases

Filter may be filled with activated carbon or CamPure (activated alumina) media. These may be used individually or in a layered configuration, depending on the contaminant challenge

Minimal Life Cycle Cost (LCC)
It is a fact that the most cost efficient way to use any molecular filtration media is to provide the maximum possible contact time[1] and ensure an even air velocity profile across all the media.

In this design we have balanced a long contact time value with acceptable media bed pressure loss values resulting in fan motors that have minimum possible kW rating. These factors ensure very effective use of the filter media and maximum possible service interval. Taking into account media replacement, service cost, downtime and electrical power requirement, VDBe filters will provide the minimum LCC value.

- Long contact time to ensure optimum media usage and lifetime
- Inherently leak-free design.
- Media compartments have the same volume as a Supa-sack.
- Integrated pre-filter
- Access ladder and handrail
- Large area footprint and structural base
- Carbon contact parts from 316 quality stainless steel.
- Magnahelic pressure loss gauges for all filter stages
- Painted carbon steel construction

Horizontal Deep Bed Filters (HDBs)

Vertical Deep Bed Filters (VDBe)

We carry out research so you can breathe clean air.

RESEARCH FOR THE MICROELECTRONICS INDUSTRY

Camfil is a family company with an unusually strong interest in technology. Since the earliest days we have invested large amounts of money in research and development. We believe that R&D is one of the most important factors behind our success.

By constantly investing in our business, we have become the world's leading filter manufacturer. And by collaborating with universities, colleges and organisations such as the Karolinska Institute, the Wallenberg Laboratory and the IVL Swedish Environmental Research Institute, we keep ourselves permanently up-to-date. We also have representatives within a number of international organisations, including Eurovent, CEN, ISO and ASHRAE.

We are continuously working to ensure that our end-products are the best on the market. And by staying at the leading edge, we can meet the requirements of the future.

Constant new investment

The most recent expansion of our corporate R&D facility is the latest in a series of major investments. We now have four completely new labs – a particle lab, a molecular lab, an IAQ (Indoor Air Quality) lab and a gas turbine lab – all complete with the latest technical equipment. Our high efficiency particle and comfort filter lab can carry out tests in accordance with EN 779 for Europe and ASHRAE for the USA.

The ultramodern technical centre covers an area of 2,500 m2 and acts as an innovation hub for product and process solutions. It includes the air filter industry's largest and most advanced laboratory for research into indoor air quality, with gas chromatography systems and a scanning electron microscope.

Air quality analysis

We have been using a proprierity air quality analysis method for more than 10 years. This method is unique within the industry and involves collecting particles from the air and studying them using a scanning electron microscope and accompanying X-ray analysis system.

The analysis shows the particle content of the air and the size and appearance of the particles. This provides useful information about the efficiency of the ventilation system. Using this method, we can carry out air, gas and dust analyses which show the actual benefits of our high efficiency air filters.

Our own innovations

Chemists, engineers and air quality specialists work at our technical centre. Their expertise ensures that we stay up-to-date on the latest developments. We use one area of the centre to develop our own processes, including designing machinery, creating new concepts and optimising industrial processes for filter production.

Our filters are known for maintaining their high efficiency over long periods, their low pressure drop and minimal servicing requirements. And their lower energy consumption also reduces overall operating costs.

By always setting high standards and not buying in standard solutions, we have maintained our position as the global market leader.

1. Molecular Lab

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

2. GT/APC Lab

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

3. Process Development Workshop

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

4. 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

5. 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-controled mobile laboratories for testing air filters in the field

6. IAQ Lab

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

CAMFIL IS THE WORLD'S LARGEST AND LEADING MANUFACTURER OF FILTERS AND CLEAN AIR SOLUTIONS

Camfil is the global industry leader in clean air solutions with more than 50 years of experience. Our solutions protect people, processes and the environment to benefit human health, increase performance, and reduce and manage energy consumption. 23 manufacturing plants, 6 R&D sites and over 65 local sales offices worldwide provide service and support to our customers. The Camfil Group is headquartered in Sweden but more than 95% of sales are international. The Group has around 3,500 employees and sales in the range of SEK 4.9 billion.