



LAMINAR AIR FLOW SOLUTIONS FOR CLEANROOM APPLICATIONS

Manufacturing Forward





Mikropor began its journey in 1987 with a passion to create “Tomorrow’s Technology” and has become one of the leading manufacturers of atmospheric air filtration solutions and compressed air treatment systems for a variety of industries.

By closely following the latest developments in technology, Mikropor’s “Best in Class” products and solutions are appreciated by customers in more than 140 countries.

The company’s sustainable growth has been provided by its passion for innovation and commitment to quality, as well as its dedication to technology. Mikropor is an environmentally conscious company that values people, while developing products that extend the needs and expectations of customers.

With this mission, Mikropor continues to become one of the most recognized brands in the world by expanding its global penetration in the field of technological filtration and contributes to a healthier planet.

www.mikropor.com

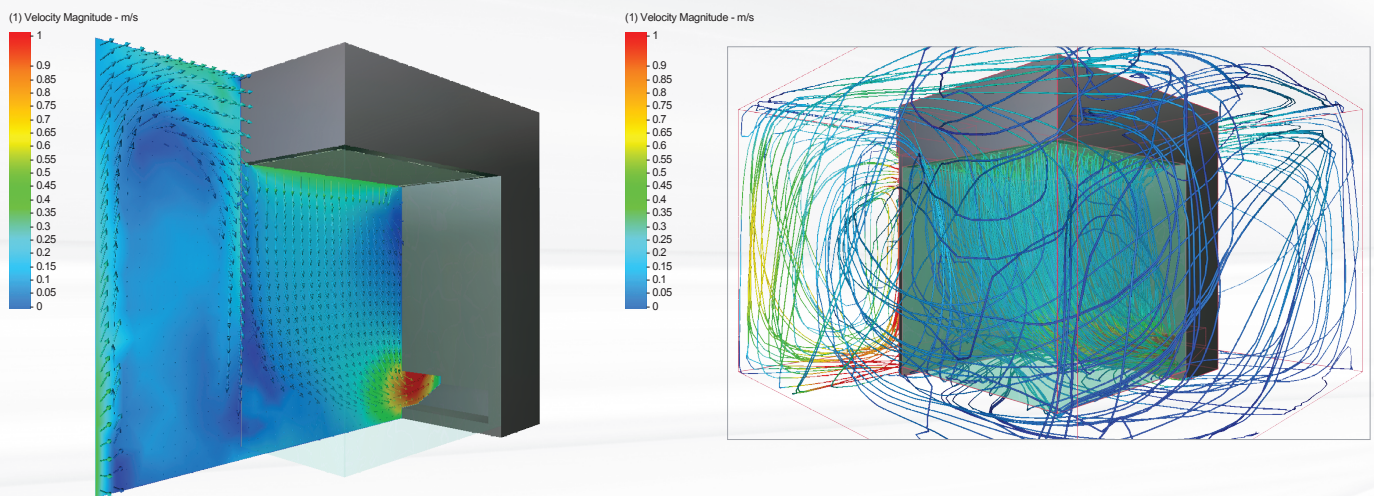
LAMINAR AIR FLOW

Working Principle

Aside from the actual air quality generated for clean room applications, it is vital to avoid unintended contamination (chalking) for the reliability of the processes.

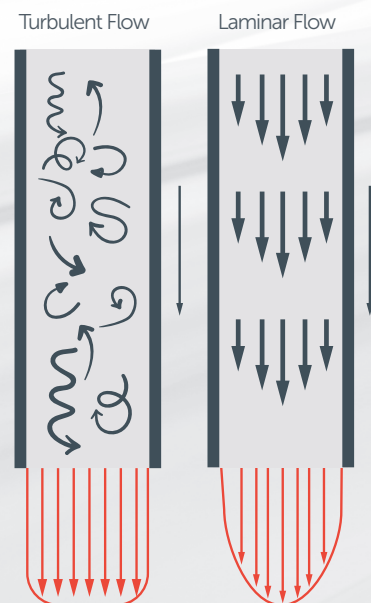
In Pharmaceutical, Food & Beverage and other similar industries, it is extremely important to force contaminant particles (airborne or generated during the process) away from finished products and employees.

An alternative way to avoid contamination risks is to implement a Laminar Air Flow System in the filtration system.



What is Laminar Flow

Laminar Flow is a flow regime characterized by the fluid flow lines, where the related fluid layers are directional in any particular layer of the fluid bed. Laminar Flow should also flow without any lateral mixing or cross current. The diagram illustrates a comparison between laminar and turbulent flow regimes in a tubular channel.



LAMINAR AIR FLOW

ISO 14644 specifies the approved air flow speed limits in Laminar Flow systems. This standard basically specifies that to obtain accurate Laminar Flow, the air flow speed needs to be 0.45 m/s within a 20 cm distance of the HEPA Filter's surface (With a 20 % tolerance so minimum flow of 0.36 m/s and a maximum of 0.54 m/s).

These flow speed can vary depending on the average ceiling height of the related application's construction. These applications could be Fan Filter Units, LAF Rooms/Platforms or even Automotive Paint Booths, where the distance from the ceiling to the most vertically remote point is a maximum of 4.3 m.

According to the mathematics behind Fluid Dynamics, when air has a flow speed of 0.54 m/s (maximum acceptable speed according to ISO 14644 standard) we know that it will flow in a laminar regime within a 2.9 m distance. After 2.9 m the flow will be in a transition zone which will not be detrimental or dangerous for the process. When air has a flow of 0.36 m/s this length will be increased to 4.3 m.

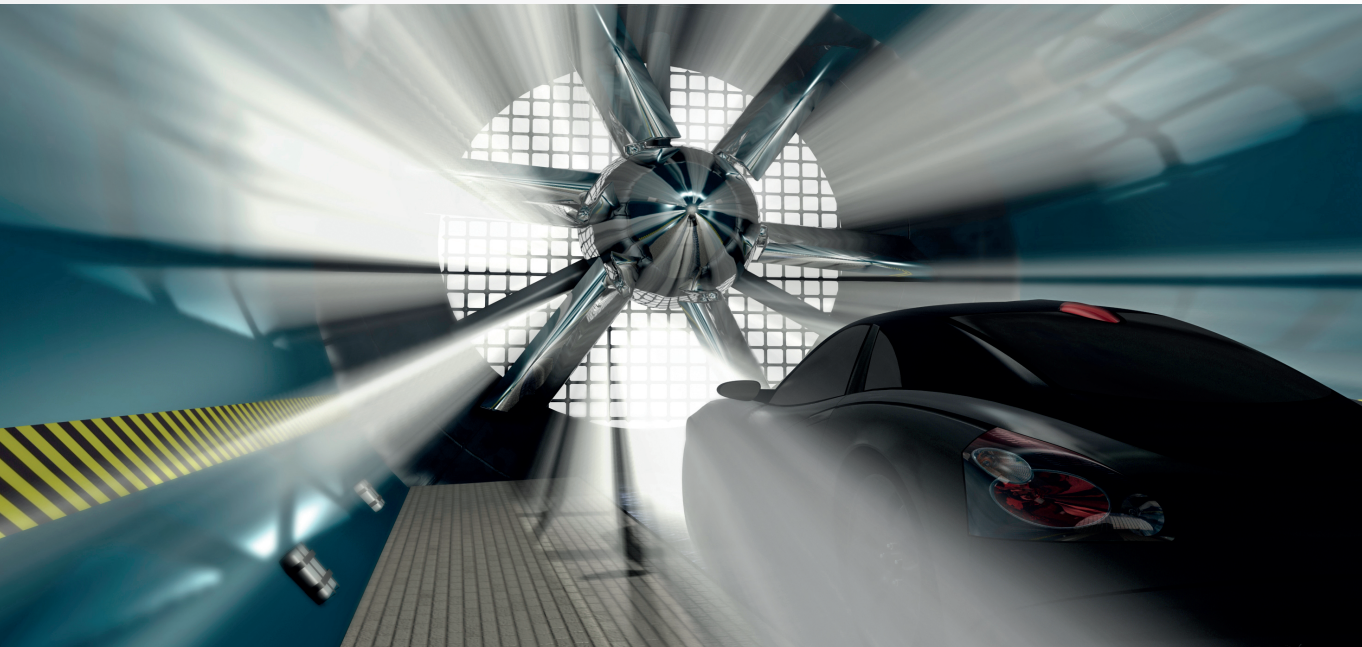


As previously stated, laminar air flow is crucial to industries such as pharmaceutical, food&beverage, cosmetics and many more. In addition to creating a laminar flow regime for a reliable process, some applications (e.g. LAF Units) are designed to increase the clean room class in accordance with the ISO 14644 standard.



Mikropor Solutions

With more than 20 years of global filtration experience as a World Class Manufacturer utilizing state of the art technologies and equipment, Mikropor understands its customers’ demands and provides the ultimate solutions for Laminar Air Flow systems with the widest possible range.



There will be undesirable airborne particles in the working areas of Pharmaceutical, Food&Beverage and Automotive Industries .

Production facilities of these industries are designed and classified according to the ISO 14644 standard. According to this standard, different steps of processes should have different levels of cleanliness class.

To make this classification reliable; FFU, LAF, MLAF and Down Flow Weighing Booths must be used. These products can be used for Laminar Air Flow in the areas in which they are also used to increase the class level of the isolated area.

As per the standard, requirements for clean room classification are shown in the table below.

STANDARDS			PARTICLE COUNT			
US 209E 1992	ISO 14644 1996	BS 5295 1989	0,1 micron (per m³)	0,3 micron (per m³)	0,5 micron (per m³)	0,5 micron (per ft³)
-	CLASS 1	-	10	-	-	-
-	CLASS 2	-	100	10	-	-
1	CLASS 3	C	1000	102	35	1
10	CLASS 4	D	10000	1020	353	10
100	CLASS 5	E/F	100000	10200	3530	100
1000	CLASS 6	G/H	1000000	102000	35300	1000
10000	CLASS 7	J	-	-	353000	10000
100000	CLASS 8	K	-	-	3530000	100000

LAMINAR AIR FLOW SOLUTIONS

FAN FILTER UNIT (FFU)

FFU (Fan Filter Units) that require precise cleanliness of environmental air (as per ISO 14644 standard flow environments) also need to operate in a laminar air flow in these situations.



Mikropor produces Fan Filter Units with two stage filtration. Fan Filter Units (FFU) are based on a push and pull working principle, with environmental air drawn through a G4 class coarse filter to capture relatively large particles.

Thanks to Mikropor's highly efficient HEPA class filters on the second stage, outlet air on the production lines will have the highest level of air purity. Mikropor produces standard or custom sized Fan Filter Units, designed and manufactured to meet the cleanroom application requirements.

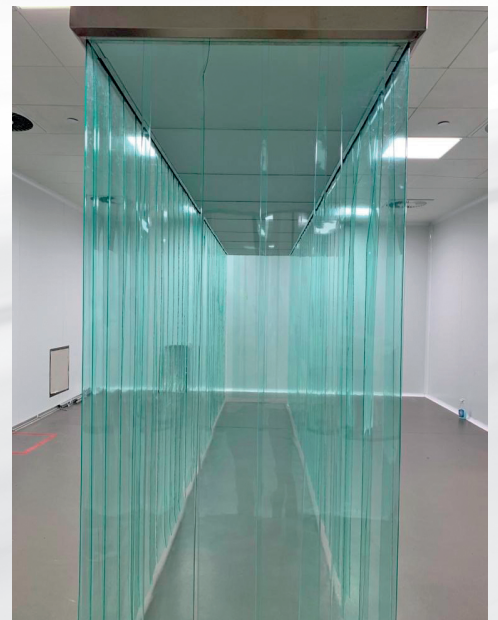
Model No.	610 x 610		610 x 915		610 x 1220	
Structure Options	Aluminum Alloy / Stainless Steel 430 / Stainless Steel 304		Aluminum Alloy / Stainless Steel 430 / Stainless Steel 304		Aluminum Alloy / Stainless Steel 430 / Stainless Steel 304	
Dimensions (mm)	610 (W) x 610 (L)		610 (W) x 915 (L)		610 (W) x 1220 (L)	
Power	220V 50Hz		220V 50Hz		220V 50Hz	
Speed Levels	Normal Mod	Standby Mod	Normal Mod	Standby Mod	Normal Mod	Standby Mod
Electric Current (A)	0.5	0.42	0.6	0.5	0.65	0.5
Power Consumption (W)	110	95	130	110	165	122
Total Pressure (Pa)	160	110	160	110	160	110
Pre Filter Options	G4 / M5		G4 / M5		G4 / M5	
Main Filter Options	H13 / H14 / U15		H13 / H14 / U15		H13 / H14 / U15	
Air Velocity (M/S)	0,44	0,30	0,44	0,30	0,44	0,30
Air Volume (m³/h)	570	388	855	583	1440	775
Noise (dB(A))	53	42	56	46	56	46
Weight (Kg)	25 kg		32 kg		37 kg	

LAMINAR AIR FLOW SOLUTIONS

LAMINAR AIR FLOW (LAF) CABINET



Mikropor's LAF (Laminar Air Flow) Cabinets are manufactured in accordance with ISO 14644-1. The LAF Cabinet is designed to provide a vertical air flow which is different from regular fan filter units. LAF Cabinets are isolated on the down flow area with plastic curtains. With the assistance of positive pressure inside this isolated area, any air outside this unit will not be able to get inside and cause contamination.



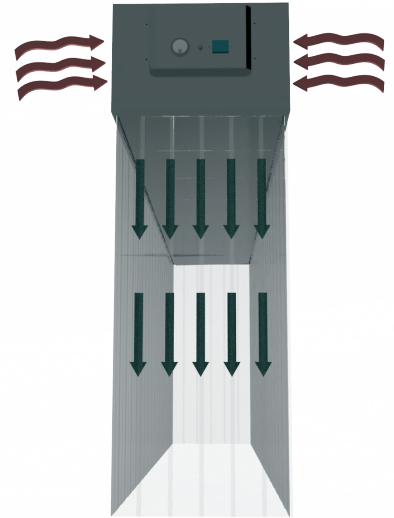
Laminar Air Flow Cabinets provide a sterile environment to protect product quality which is essential where sensitive products (water, food, medicine etc.) can be affected by dust and particles.

These cabinets filter the air and reduce dust and particles in the environment. The fan draws the ambient air through the pre-filter and the pre-filter (G4) protects the HEPA filter and fan from coarse particles. The air is let to the working area after passing through the HEPA filter and diffuser.

LAMINAR AIR FLOW SOLUTIONS

The curtain in laminar flow cabinets provides protection up to the desired height in the work area. The working area is under positive pressure and this allows the air to be conveyed from under the curtain to the environment the device is located in. With this configuration, the finished product is protected by preventing contaminated air from entering the work area.

Filter replacement time can vary depending on the frequency of operation of the system and environmental pollution. It is recommended to perform a monthly visual check of the pre-filter and change if needed. HEPA filters should be changed when the pressure gauge reaches 450 Pa. After changing a HEPA filter, a filter leak test should be performed using DOP test fittings.



MOBILE LAMINAR AIR FLOW (M-LAF) UNIT



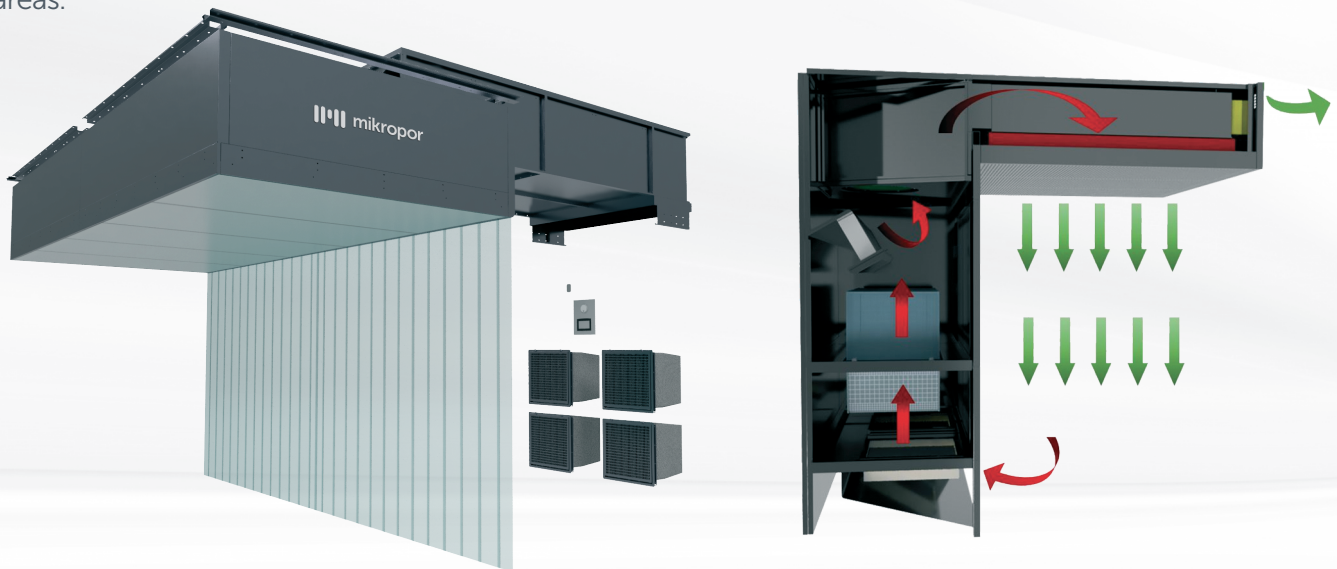
For some processes, static LAF units are not practical if you have to move products around inside the facility. It would be expensive and unnecessary to site multiple LAF cabinets throughout the facility to carry for this. As such Mikropor offers Mobile Laminar Air Flow (M-LAF) Units to solve this issue.

M-LAF Units are combined with the static conveyor of LAF and finished products are delivered to the M-LAF system without any contact outside of the Laminar Air Zone. Once within the LAF, products can be carried anywhere within the facility without risk of contamination.

LAMINAR AIR FLOW SOLUTIONS

DOWN FLOW WEIGHING BOOTH

During processes that involve weighing or mixing, raw materials are at risk of contamination. In order to prevent this (and to ensure precise mixing) special isolated weighing rooms are required. These could be for pharmaceutical, food&beverage or cosmetic industries. Mikropor's dedicated team provide a turnkey solution for these types of rooms offering design, manufacturing and commissioning services for such areas.



Mikropor technical team works closely with the customers to analyse and determine their needs. Customised solutions are designed and developed matching the specific requirements. Mikropor provides a fully integrated service to its solution partners, with wealth of experience and measurement equipment. In addition to these core services Mikropor can provide measurements of particle size, air velocity, air flow validation. Annual pressure sensor tests and biannual DOP (filter leak) tests are also performed to support the project through it's whole life cycle.



LAMINAR AIR FLOW SOLUTIONS

Model No	NTK-16x16	NTK-20x16	NTK-20x20	NTK-25x20
Inner Dimensions	1720 x 2650 x 2600	2120 x 2650 x 2600	2120 x 3050 x 2600	2620 x 3050 x 2600
Inner Working Area Dimensions (WxDxH) mm	1600 x 1600 x 2100	2000 x 1600 x 2100	2000 x 2000 x 2100	2500 x 2000 x 2100
Filter Stages*	MC		G4 / M5	
	MV		F7 / F8 / F9	
	MVX		E10 / E11 / E12 / H13	
	MAIN FILTER		H14/ U15	
	EXHAUST FILTER		H14/ U15	
Cleanroom Class (FED209/ISO/GMP Standards)	Class 100 / ISO 5 / GMP A			
Air Velocity (EU GMP ANNEX-1-2004)	0,45 m/s +-20% Laminar Flow			
Working Area Pressure and Air Flow Direction / Air Mixture Factor M (ASHRAE Standard)**	Neutral Pressurization (100% Recirculated Air)			
	Negative Pressurization (70% Recirculated Air %30 Fresh Air)			
	Positive Pressurization (70% Recirculated Air %30 Exhaust Air)			
Voltage and Frequency	380 V, 50-60 Hz			
Max. Power Consumption	2,95 kW		3,05 kW	
Weight (kg)	< 800 kg	< 900 kg	< 1000 kg	< 1150 kg
Body Material	AISI 304 / 316			
Inner Material	AISI 304 / 316			
PLC Control and Automation System	System ON / OFF Air Velocity Control & Balancing Filter Pressure Drop / Life Time Monitoring Audible and Visual Alarm Lighting ON / OFF / Light Setting User Encryption and Registration Recording Humidity - Temperature Automation Information Systems / Alarm Data			
Front Opening Closure Options	Anti Static PVC Curtain Sliding Door Swing Up Door Glass Chamber + Hinged Door			
Additional Equipment Options	ATEX Certificated Equipment Cooling Battery and Control Equipment Chiller Cooling Group (Cold Water Source) Working Area Protection Barrier Counter and Available Areas for Weighting Equipment in Workplace Bag In - Bag Out Filter Change Protection zone with glove ports in the work area for personnel protection Fixed or movable workbench options mounted on the wall Ready ports for compressed air, nitrogen and water connections Ex-proof electric connection system			

* Filter stages and classes are determined according to usage needs and analysis.

** Ratios depend on the needs and analysis.

LAMINAR AIR FLOW SOLUTIONS FOR CLEANROOM APPLICATIONS



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