

Genano Application Note

Cleanroom contamination control

In cleanrooms, air quality is an important factor in assuring production and research quality. Airborne contamination can, at worst, lead to product recalls, expensive investigations and cleaning procedures. Reliability and repeatability of research results and protecting the staff from particles in the air are also a concern.

Technically, a cleanroom is an environment with a low and controlled level of environmental contaminants such as dust, airborne microbes, fine particles, and chemicals. The international ISO 14644 standard establishes classes of air cleanliness for airborne particulate levels in cleanrooms and associated cleanroom areas (clean zones).

The cleanroom ISO classes are defined according to particle count per cubic meter (depending on particle size) at certain conditions. To verify compliance with ISO class a discrete-particle-counting instrument is used to determine the concentration of airborne particles, equal to and greater than the specified sizes, at designated sampling locations.

In addition to particle count, other important factors in cleanroom design are the rate of air volume change per hour (ACH) and pressure difference between the clean room and outside environment. Organization-specific **Good Manufacturing Practice (GMP) guidelines must also be considered.**

The ISO 14644 standard addresses particles within the size range of 0,1–5 µm, while a new standard

for monitoring of air purity by concentration of airborne nanoscale particles (aka ultrafine particles) is currently under development (ISO/DIS 14644-12).

HEPA filters commonly utilized to filter supply air flow in a cleanroom can only collect particles of 0.3 microns and larger in diameter, which renders need for additional air decontamination technologies such as additional air purifier units in the room. Also, while most sub-micron and macro particles in cleanrooms can be related to human activity, nanoparticles are generated by electrostatic discharge, chemical reactions such as oxidation, and gas phase nucleation. Therefore **majority of the nanoparticles in cleanrooms are process-related and cannot be effectively removed by ceiling-mounted pre-filtering HEPA systems.**

Airborne Particulate Cleanliness Classes
(by cubic meter) (ISO 14644-1)

CLASS	Number of Particles per Cubic Meter by Micrometer Size					
	0.1 µm	0.2 µm	0.3 µm	0.5 µm	1 µm	5 µm
ISO 1	10	2				
ISO 2	100	24	10	4		
ISO 3	1,000	237	102	35	8	
ISO 4	10,000	2,370	1,020	352	83	
ISO 5	100,000	23,700	10,200	3,520	832	29
ISO 6		237,000	102,000	35,200	8,320	293
ISO 7				352,000	83,200	2,930
ISO 8					832,000	29,300
ISO 9						293,000

GENANO'S ADVANTAGES

- 1** Purifies air from particles and microbes down to $0.003\ \mu\text{m}$ size and removes gaseous substances.
- 2** Highly cost-efficient with low life-time costs and facile maintenance compared to HEPA systems.
- 3** Easy installation and possibility for fast relocation.



GAN/CLEAN/EN.170411.001

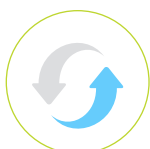
CLEANROOM DESIGN with Genano air purifiers



**EFFICIENT
CONTAMINATION
CONTROL**

Genano air purification technology has been tested according to the ISO 14644 Standard. **Cleanrooms of ISO class 7 to 5 cleanliness can be reached cost-efficiently and rapidly with Genano units.** The solution can be designed to fit any room-specific needs for ACH, pressurization or other details.

Genano air purifiers also work as additional purification system in existing cleanrooms and clean zones, where nanoscale decontamination is needed.



**FLEXIBLE
PURIFICATION
SOLUTIONS**

Building cleanrooms with Genano is highly cost-efficient and fast compared to traditional HEPA systems. Only minor piping work is needed to connect the Genano air purifier to central ventilation. All of the supply air enters the room through the unit, while air flow is controlled to create pressure difference to outside environment. A second unit is utilized to constantly circulate and purify the air from any process and human-related contaminants.



**INNOVATIVE
FILTER-FREE
TECHNOLOGY**

Genano provides constant air flow and cleanliness level. The unit system does not get clogged up by dust or other particles for the absence of any filter media. Genano does not suffer from increase in pressure drop due to accumulation of particle mass, nor does it provide substrate for microbes to grow.

In addition, Genano air purifiers are equipped with high-surface-area active carbon collectors that remove gaseous substances.

**GENANO
TECHNOLOGY
PROVENLY
REMOVES**

PARTICLES

*dust & fibers
nanoparticles
DNA fragments
proteins, lipids*

MICROBES

*Aspergillus niger
Escherichia coli
Staphylococcus
aureus*

VOC GASES

*Isopropanol
Formaldehyde
Toluene
Softeners, Odours*

