

Cleanroom Technologies in Food Processing and Beverage Packaging Rooms.

An Introduction to Cleanroom Technologies

Cleanroom technologies significantly reduce the contamination of foods and their interior primary packaging by the use of reduced air and waterborne dust and microorganisms, plus a hygienic environment in which the low level of pollutants or particulates is controlled through the implementation of very specific design. Cleanrooms are engineered to minimize food and beverage contamination by application of positive filtered or incinerated air pressure and a tightly controlled environment. Long used in hospital operating rooms and for pharmaceutical packaging, cleanrooms help to extend shelf life and deliver a safer food/beverage product for the consumer. We shall explore cleanroom basics, the steps of designing a cleanroom for food and food packaging industry applications, common uses, and the assets and liabilities inherent to technologies of today and for the future.

Applied in industries that require an environment free of dirt, dust, and ubiquitous microorganisms for processing, cleanrooms have entered into the food and food packaging industries. The roots of cleanrooms can be traced back to Swiss watchmakers who covered their work to prevent dust from falling on their timepieces. Various other attempts were made to control particulates throughout history, but the big strides in the technology came during and after World War II with the need to control particulates for nuclear and aerospace testing and production. Today's cleanrooms need not be rooms with four walls, a floor, and a ceiling. Rather they are controlled three-dimensional space with, for example, barriers from air curtains.

ISO Classification of Cleanrooms

ISO 14644-1 states that a cleanroom is “a room in which the concentration of airborne particles is controlled, and which is constructed and used in a manner to minimize the introduction, generation, and retention of particles and microbes inside the room and in which other relevant parameters, e.g., temperature, humidity, and pressure, are controlled as necessary,” according to the National Science Foundation. Cleanrooms are classified according to the cleanliness needed for the product. Classifications are determined by the maximum number of particulates for each particle size found in a cubic meter of air. Table 1 shows the classifications of clean room as determined by ISO 14644-1.

ISO Classification Number	Maximum Concentration Limits (particles/m ³ of air) for Particles Equal to and Larger Than the Considered Sizes Shown Below					
	0.1 μm	0.2 μm	0.3 μm	0.5 μm	1 μm	5 μm
ISO Class 1	10	2				
ISO Class 2	100	24	10	4		
ISO Class 3	1,000	237	102	35	8	
ISO Class 4	10,000	2,370	1,020	352	83	
ISO Class 5	100,000	23,700	10,200	3,520	832	29
ISO Class 6	1,000,000	237,000	102,000	35,200	8,320	293
ISO Class 7				352,000	83,200	2,930
ISO Class 8				3,520,000	832,000	29,300
ISO Class 9				35,200,000	8,320,000	293,000

NOTE: Uncertainties related to the measurement process require that concentration data with no more than three significant figures be used in determining the classification level.



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Filtration.

The effective of air filters is determined primarily by particle size, but can be affected by the relative electrical charges of particles and filters. Bacteria typically are quite small, requiring filters that remove particle below 1 micron in size. ANSI/ ASHRAE Standard. Specifies a test procedure for evaluating the performance of air-cleaning devices as function of particle size.

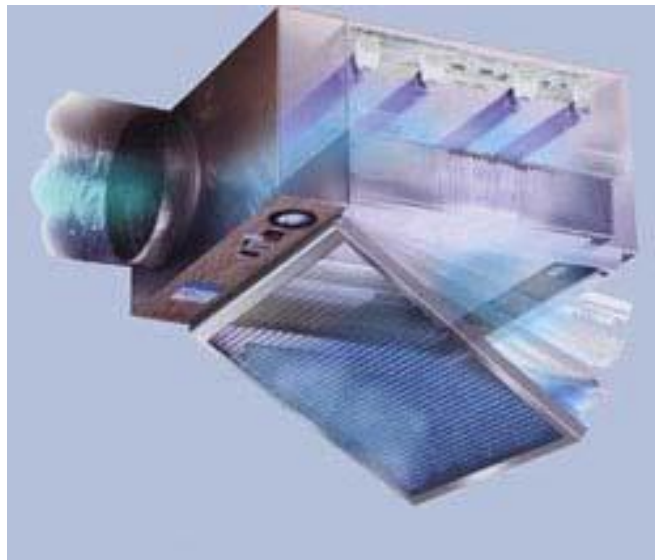
The true HEPA 99.99% filters required only for protective environment rooms.

Laminar Array System.

Laminar flow diffusers are nonaspirating diffusers with air flowing downward from the ceiling and minimum entrainment of room air. All laminar diffusers must be room-side accessible for cleaning and/or filter replacement.

The laminar diffusers are set into arrays intended to create uniform laminar airflow profile covering a critical zone

FFU with UV Light
Pre-Filter & HEPA Filter with Side
Air inlet Connection



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