



CLEANROOM AND CLEAN ZONE CERTIFICATION

In the past, cleanroom certification and classification was conducted according to Federal Standard 209 E. However, the International Organization for Standardization (ISO) has recently approved a new standard, ISO 14644-1, entitled "Cleanrooms and associated controlled environments - Part 1: Classification of air cleanliness." Complementing ISO 14644-1 will be ISO 14644-2 that is expected to be approved first quarter 2000 and is entitled, "Specifications for testing and monitoring to prove continued compliance with ISO 14644-1."

Although ISO 14644-1 derived its structure from Federal Standard 209 E, there are some significant differences that will most likely affect medical device and pharmaceutical manufacturers. ISO 14644-1 primarily addresses the cleanroom classification system and the pending ISO 14644-2 will contain specifics on "how" to test and monitor cleanrooms or clean zones for compliance. However, there are some items in ISO 14644-1 that manufacturers should be preparing for and implementing as applicable. In preparation for the publishing of ISO 14644-2, many of you will want to begin addressing some of the following issues:

1) New Classifications for Cleanrooms and Clean Zones:

Table 1 - Selected airborne particulate cleanliness classes for cleanrooms and clean zones

ISO classification number (N)	CLASS LIMITS (particles/m ³)					
	Maximum concentration limits (particles/m ³ of air) for particles equal to and larger than the considered sizes shown below					
	0.1 um	0.2 um	0.3 um	0.5 um	1 um	5 um
ISO Class 1	10	2				
ISO Class 2	100	24	10	4		
ISO Class 3	1000	237	102	35	8	
ISO Class 4	10000	2370	1020	352	83	
ISO Class 5	100000	23700	10200	3520	832	29
ISO Class 6	1000000	237000	102000	35200	8320	293
ISO Class 7				352000	83200	2930
ISO Class 8				3520000	832000	29300
ISO Class 9				35200000	8320000	293000

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.



All classification levels are based on particle counts per cubic meter (m³) instead of particles per cubic foot (ft³). This will result in a change in how the particle counts are reported. Our particle counters operate at a flow rate of 1 CFM (cubic feet per minute) which is equal to 28.3 Lpm (liters per minute). Therefore, to convert particles per ft³ to particles per m³, the particle count value will need to be multiplied by 35.31.

Below is an example of how test results were reported under Federal Standard 209 E and how those results would be reported under the new ISO classification system in ISO 14644-1:

Particle Counts/ft ³ (≥0.5um)	Federal Standard 209 E Class	Particle Counts/m ³ (≥0.5um)	New ISO 14644-1 Class
75000	Class 100000	2640000	ISO Class 8
1500	Class 10000	52800	ISO Class 7
675	Class 1000	23800	ISO Class 6
25	Class 100	880	ISO Class 5
7	Class 10	246	ISO Class 4
1	Class 1	35	ISO Class 3

ISO 14644-1 added two additional classes, Class 1 and Class 2, that were not part of Federal Standard 209 E. These two new classes are for cleanrooms or clean zones that have very low numbers of particles in the <0.5m range.

2) Considered Particle Size:

The particle size to be considered in the cleanroom or clean zone evaluation will be determined by the sponsor. For most applications, the considered particle size will continue to be 0.5m, as was required by Federal Standard 209 E. Other particles sizes could be evaluated to determine the ISO classification for a cleanroom or clean zone.

3) Sampling Locations:

The minimum number of sampling location is based entirely on the area of the cleanroom or clean zone. ISO 14644-1 does not take into consideration the classification and under this new ISO requirement, sponsor's may need to increase the number of sites sampled in the cleanroom or clean zone.

The minimum number of sample locations taken in each cleanroom or clean zone is calculated by taking the square root of the area of the cleanroom or clean zone, in square meters. This number is rounded up to the nearest whole number.



4) The calculation for determining the minimum sampling volume to collect at each location is documented in the ISO standard. Where only one sampling location is required, a minimum of three single sample volumes is required at that location. Unless you are attempting to meet an ISO Class 4 or cleaner, a one minute sample collection at 28.3 Lpm (1 CFM) will generally be a sufficient volume at each location.

5) Statistical Analysis

When the number of locations sampled is more than one and less than ten, compute the overall mean, standard deviation, and 95% upper confidence limit from the average particle concentrations for all locations in the cleanroom or clean zone.

Note: When only a single location is sampled, or when more than nine are sampled, computing the 95% confidence limit is not applicable.

6) Interpretation of Results:

The cleanroom or clean zone has met the desired classification if neither the average particle concentration for the area or the 95% UCL exceed the concentration limits specified in Table 1 for the considered particle size(s)