



Useful Information in Cleanroom Application

Table 1: Airborne Particle Requirements for ISO 14644 and Federal Standard 209							
ISO 14644-1	Obsolete Federal Standard 209	Number of particles per m ³ by micrometer size					
		0.1µm	0.2µm	0.3µm	0.5µm	1µm	5µm
1		10	2				
2		100	24	10	4		
3	1	1,000	237	102	35	8	
4	10	10,000	2,370	1,020	352	83	
5	100	100,000	23,700	10,200	3,520	832	29
6	1,000	1,000,000	237,000	102,000	35,200	8,320	293
7	10,000				352,000	83,200	2,930
8	100,000				3,520,000	832,000	29,300
9					35,200,000	8,320,000	293,000

Table 2: Recommended Filter Ceiling Coverage Guide		
Cleanroom Class to FS209D	Equivalent Cleanroom Class to ISO 14644	Percentage Ceiling Coverage
100,000	8	5-10
10,000	7	15-20
1,000	6	30
1-100	3-5	100

Table 3: Recommended Filtration Stages				
ISO 14644 Cleanliness Class	First Filter Stage	Second Filter Stage	Third Filter Stage	Fourth Filter Stage
2	G4	F7	H12	U17
3	G3	F6	H11	U16
4	G2	F5	H10	U15
5	F5	F9	H14	
6	F5	F8	H13	
7	G4	F7	H12	
8	G3	F6	H11	
9	G3	F5	H10	

Table 4: Comparison of FDA, NASA, EU-GMP Standards									
Cleanliness Class	FDA	NASA	CFU/m ³	EU-GMP					
				CFU/m ³ (CFU/ft ³)	CFU/m ³ (CFU/ft ³)	At Rest		In Operation	
						0.5µm/m ³	5µm/m ³	0.5µm/m ³	5µm/m ³
A 100	-	-	<1	3,520	20	3,520	20		
B 100	3.5 (0.1)	3.5 (0.1)	10	3,520	29	352,000	2,900		
C 10,000	-	18 (0.5)	100	352,000	2,900	3,520,000	29,000		
D 100,000	88 (2.5)	88 (2.5)	200	3,520,000	29,000	-	-		

Note: The above information is for reference only. Please refer to the respective Standards for exact details.



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Useful Information on Particle Generation

Particle Generation from Personnel		
Personnel Movement	Number of generated particles (P/min)	
	Over 0.3 µm	Over 0.5 µm
Light	$1 \times 10^5 \sim 1 \times 10^6$	$1 \times 10^5 \sim 5 \times 10^5$
Middle	$1 \times 10^6 \sim 1 \times 10^7$	$5 \times 10^5 \sim 5 \times 10^6$
Heavy	$1 \times 10^7 \sim 3 \times 10^7$	$5 \times 10^6 \sim 1 \times 10^7$

Particles (over 0.3 µ)	
Kind of Movement	Nos. of Particles/minute (≥0.3µ)
Sitting or standing (no movement)	100,000
Sitting (slightly moving head, arm and hands)	500,000
Sitting (slightly moving body and foot)	1,000,000
Standing up from a sitting position	2,500,000
Walking about 1 meter / second	5,000,000
Walking about 1.5 meters / second	7,500,000
Walking quickly	10,000,000
Climbing stairs	10,000,000
Gymnastic exercise	15,000,000 – 30,000,000



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Place	Particles (over 0.5 µft ³)
Shops, Station	2,000,000
Department Store	1,000,000
School	2,000,000
Office	1,000,000
House	600,000
Hospital & ordinal operation room (unattended)	50,000
Ward (6 beds)	150,000
Outpatient Medical Consulting Room	150,000
Medicine Room	1,000,000
Residential Area	500,000
Industrial Area	2,000,000

Bacteria	
Kind of Movement	Nos. of Bacteria/minute
<u>In Operation:</u>	
Under strict bacterial control	5,000
On average	10,000
Without bacterial control	50,000
<u>In Laboratory:</u>	
Light movement	4,000
Medium movement	8,000
Heavy movement	15,000