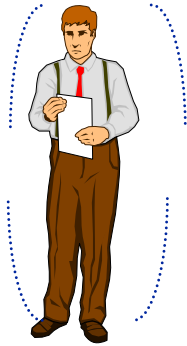


# Clean rooms

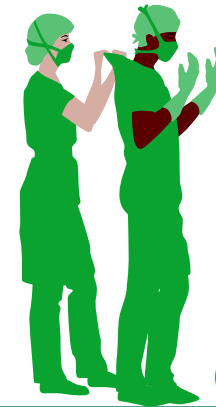
30 000 000  
particles/m<sup>3</sup>

Several  
million



particles/mn

3 500 particles/m<sup>3</sup>



(Class 100)

➤ Architecture

➤ Operation

➤ Air treatment

- . Re-circulated air and Fresh air
- . T° and H%
- . Pressure differences
- . Diffusion
- . Filtration




AIR FILTECH JSC

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# Cleanliness classification - Norms correspondance

number of particles ≥ 0,5 µm/ m3	US Fed. Std 1992		EN ISO 14644-1	FRANCE AFNOR NFx44,101 NF x 44,101 1981	CEE Pharma.I industry Guide BPF 1997	nb of particles ≥0,1µm/m3
						
1	209D	209E	ISO 1			10
4			ISO 2			35
10		M1				100
35	1	M1,5	ISO 3			350
100		M2				1 000
353	10	M 2,5	ISO 4			3 500
1 000		M3				10 000
3 530	100	M3,5	ISO 5	4 000	A* et B**	35 000
10 000		M4				100 000
35 300	1000	M4,5	ISO 6			350 000
100 000		M5				1 000 000
353 000	10 000	M5,5	ISO 7	400 000	B*** et C**	
1 000 000		M6				
3 530 000	100 000	M6,5	ISO 8	4 000 000	C*** et D**	

## Program of normalisation ISO

ISO 14644-1 : cleanliness classification norm (05/99).

ISO/DIS 14644-2 : Requirement of test to demonstrate conformity ISO 14644-1 (06/00)

ISO/DIS 14644-3 : Metrology and test methodology (06/01)

ISO/DIS 14644-4 : Design, manufacture and comissioning of clean rooms (06/00)

...ISO/DIS 14644-8 : Control of molecular contamination (2003)



# Norms and contamination




There is no direct correlation between the number of particles and of micro-organism. The cleanliness classification doesn't reflect the state of hygiene of a room but rather the efficiency of the air treatment system.

Norms **ISO/DIS 14698 : CONTROL OF BIOCONTAMINATION** (03/2001)

- **14698.1** : risk analysis, definition of risk zones.
- **14698.2** : evaluation and interpretation of biocontamination data.
- **14698.3** : Measurement methodology of cleaning and decontamination procedures.

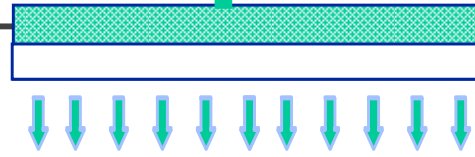
## USUAL APPLICATIONS

ISO 3	ISO 4	ISO 5	ISO 6	ISO 7	ISO 8
MICRO-ELECTRONICS					
		CHEMICAL			
		AUDIO/VISUAL SUPPORTS			
		PHARMACEUTICAL/OPERATING THEATRE			
			ELECTRONICS		
			MICRO-MECANICS		
			FOOD INDUSTRY		
			AEROSPACE		
			AUTOMOTIVE		
			OTHERS		



**FRESH  
AIR**

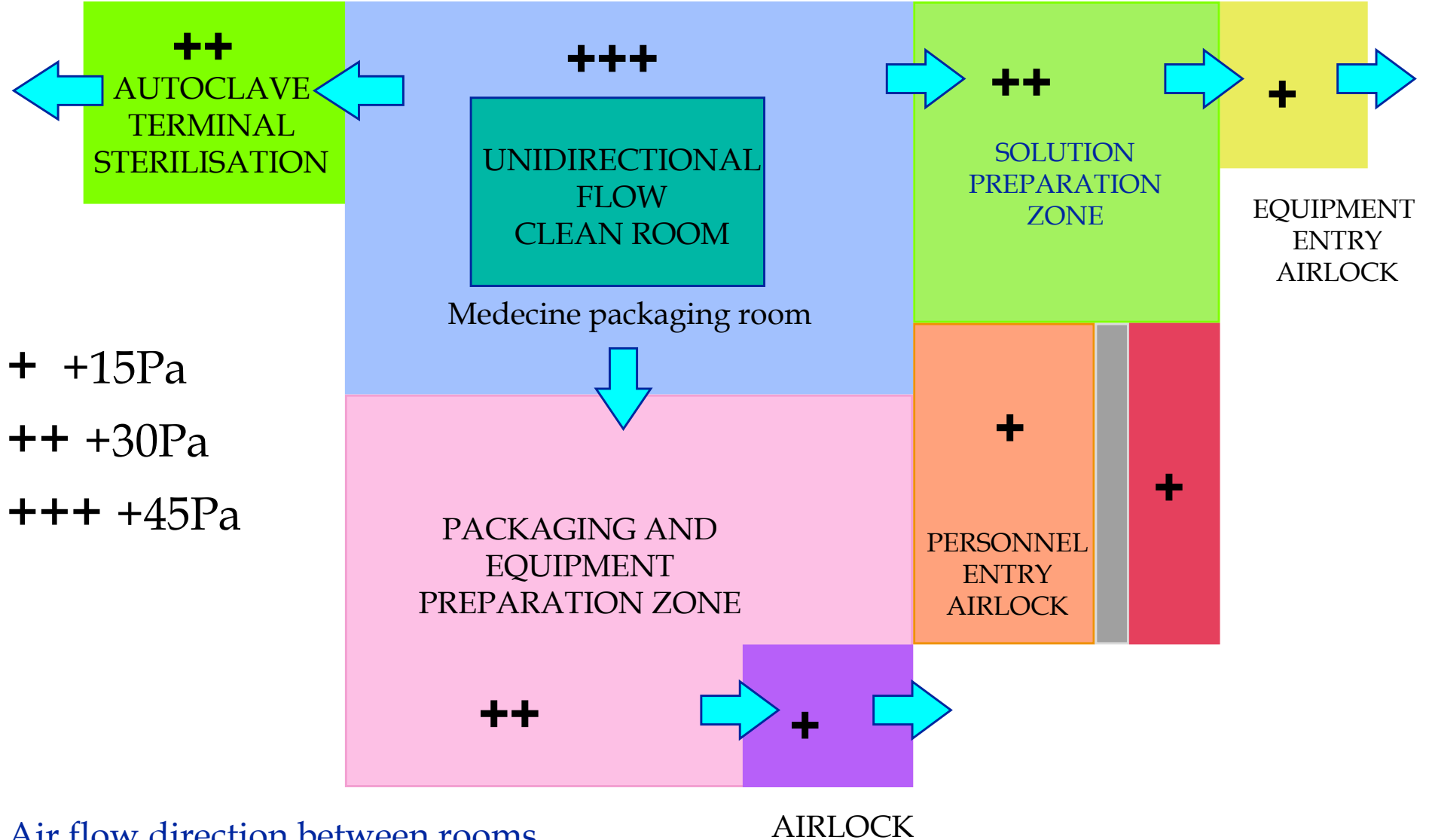
- . To dilute carbon dioxide (60 m<sup>3</sup>/h/pers)
- . To dilute specific pollution (15 vol/h for example in operating theatre)
- . To maintain overpressure



**RE-CIRCULATED AIR**

US Fed Std 209D	EN ISO 14644-1	RE-CIRCULATION RATE
1	3	> 600
10	4	600
100	5	200 to 600
1 000	6	50 to 100
10 000	7	30 to 50
100 000	8	15 to 30

# Overpressure - underpressure



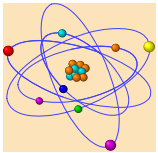
➡ Air flow direction between rooms  
Avoid entry of particles  
Avoid cross contamination

AIR TREATMENT  
IN CLEAN ROOMS

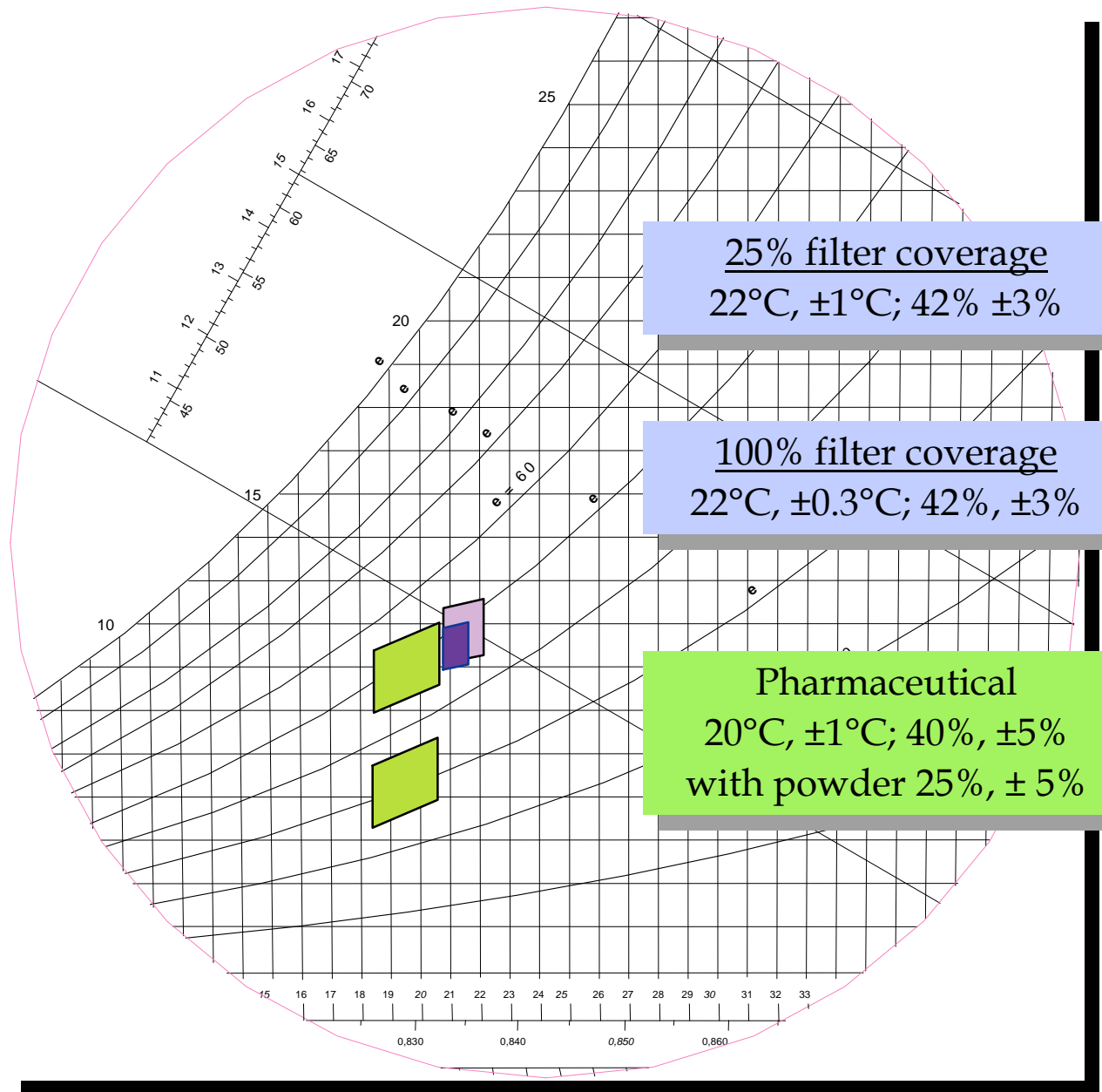
Air treatment.

# T° and H%

## Micro électronics



## Pharmaceutical



AIR TREATMENT  
IN CLEAN ROOMS

Air treatment.

# T° and H%

## Hospital

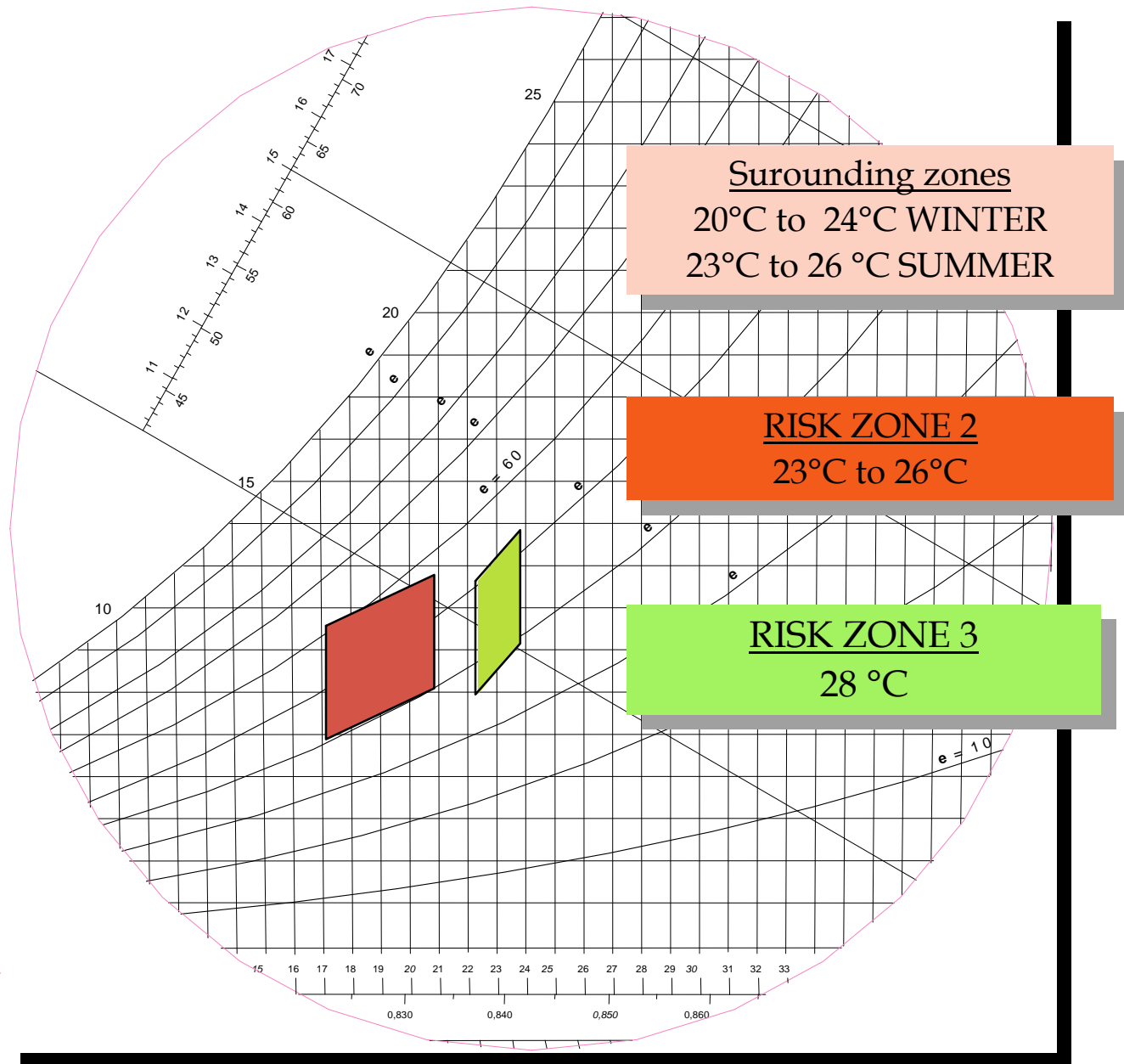


H% : 40 to 60%

. COMFORT

. AVOID CONDENSATION

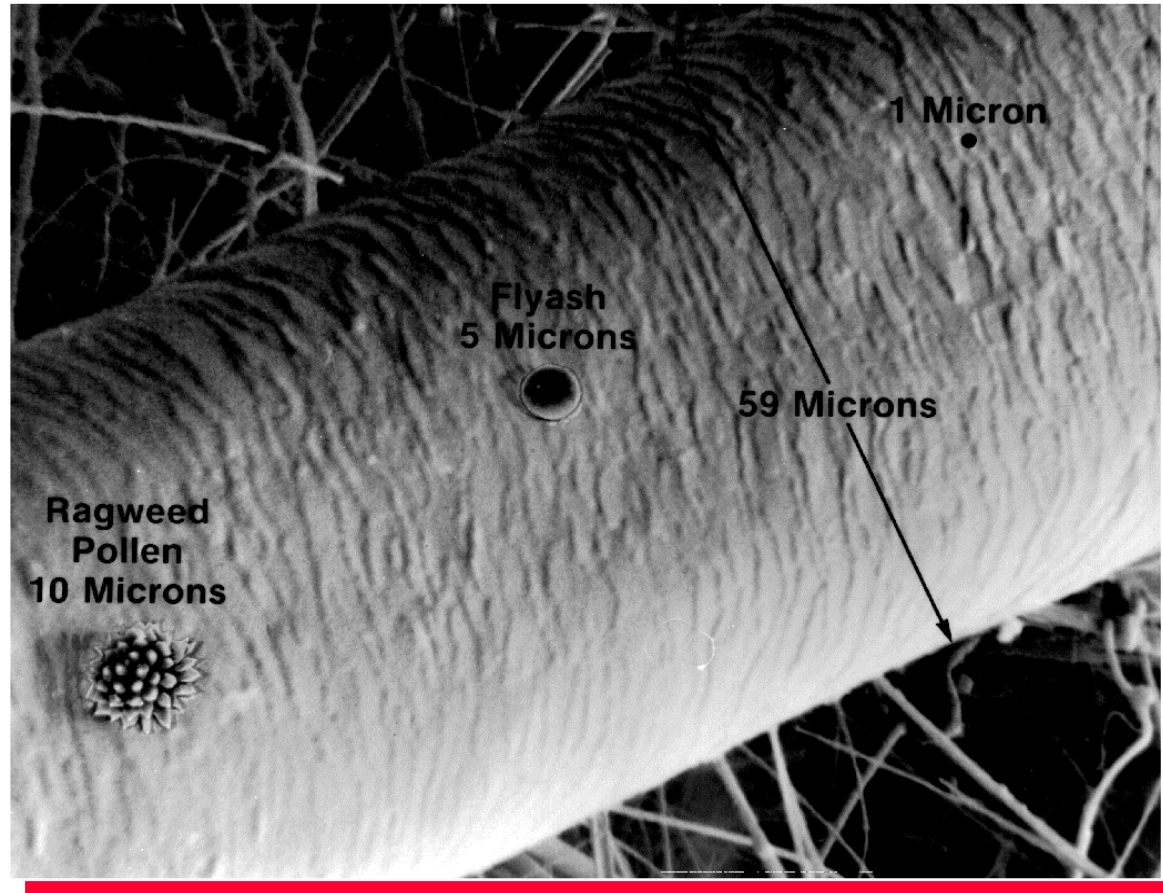
AIR TREATMENT  
IN CLEAN ROOMS



Air treatment.



# Micro-particle size comparison

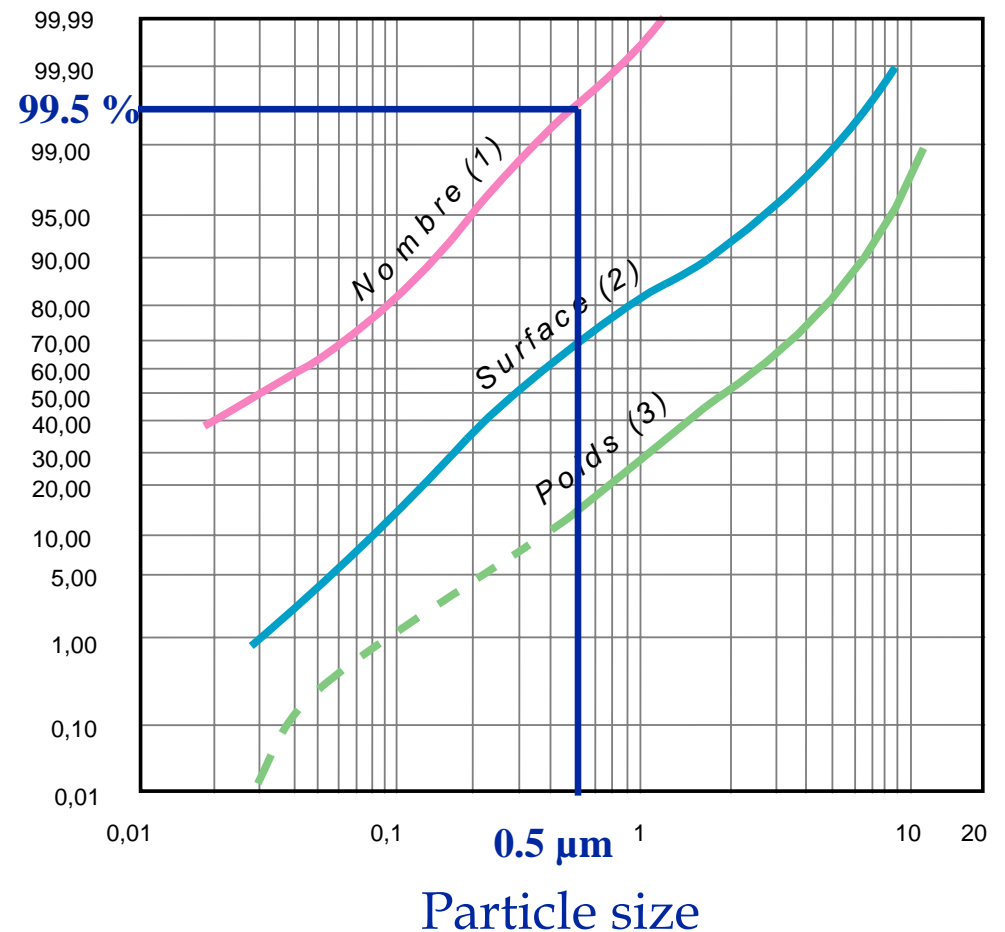


**Particles size : bacteria 0.05 à 10  $\mu\text{m}$ , virus 0.002 à 0.08  $\mu\text{m}$ ,  
gas molecules < 0.008  $\mu\text{m}$ . Visible to the naked eye : > 30  $\mu\text{m}$**

# WHITBY Diagram

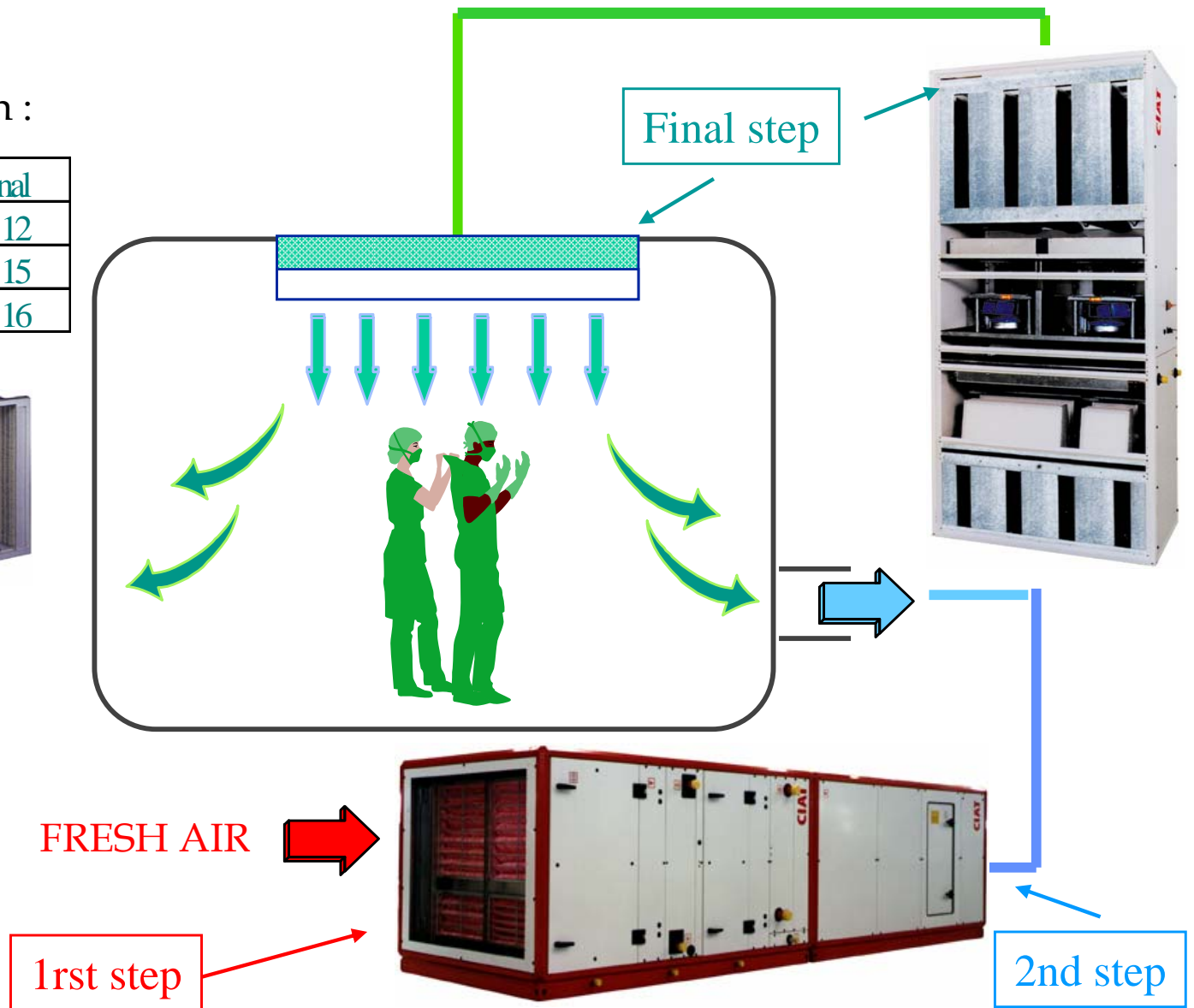
99.5 %  
of particles in the air  
have a size less than 0.5 $\mu$ m.

## Particle distribution in atmospheric air



Example of filtration chain :

Class	1st	2nd	Final
10 000 / ISO 7	G4+F7	F9	H12
1 000 / ISO 6	F7	H10	U15
100 / ISO 5	F9	H12	U16



AIR TREATMENT  
IN CLEAN ROOMS

Air treatment

Particles		1µm			0,5 µm		
Filter type	Efficiency	Penetration	Purif. coeff	Efficiency	Penetration	Purif. coeff	
90 % GRAVI (G4)	10%	90%	1,1	5%	95%	1,05	
50 % OPACI (F5)	30%	70%	1,4	10%	90%	1,1	
65 % OPACI (F6)	45%	55%	1,8	25%	75%	1,3	
85 % OPACI (F7)	85%	15%	6,6	70%	30%	3,3	
95 % OPACI (F8/9)	95%	5%	20	90%	10%	10	

**The pre-filtration in fresh air must have a F7 filter  
minimum a G4 filter is insufficient.**



Classe EN 1822	MPPS efficiency	Purification coefficient
<b>E 10</b>	85 %	6,7
<b>E 11</b>	95 %	20
<b>E 12</b>	99,5 %	200
<b>H 13</b>	99,95 %	2000
<b>H 14</b>	99,995 %	20 000
<b>U 15</b>	99,9995 %	200 000
<b>U 16</b>	99,99995 %	2 000 000
<b>U 17</b>	99,999995 %	20 000 000

AHU

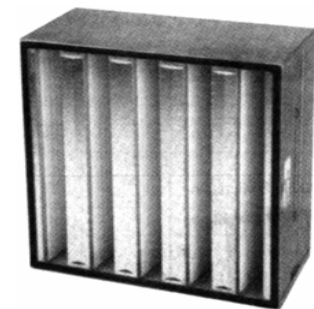
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End  
filtration

**H : H.E.P.A : High efficiency Particulaire Air Filter**

**U : U.L.P.A. : Ultra Low Penetration Air Filter**

**Purification coefficient** = concentration before over concentration after

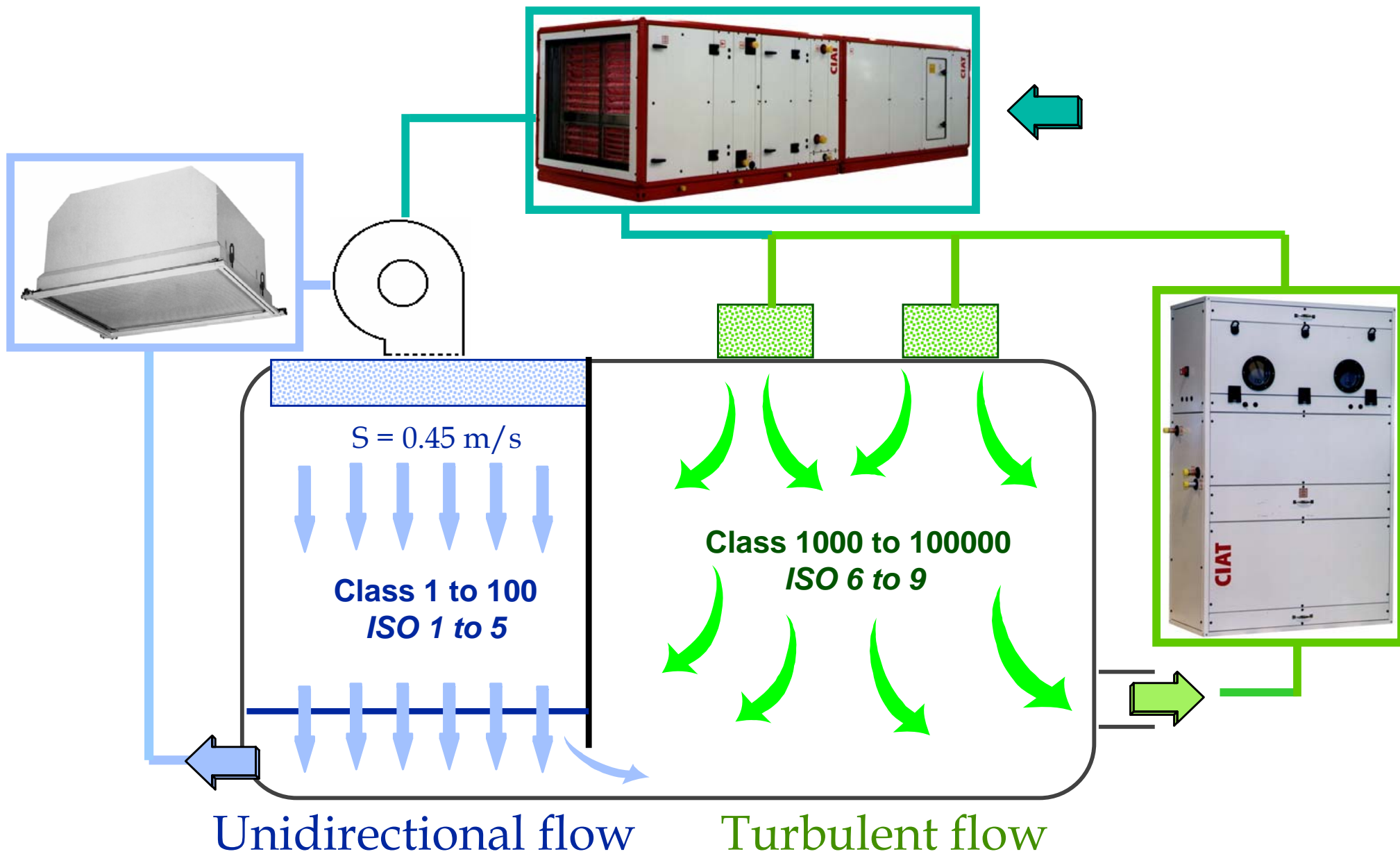



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**AIR TREATMENT  
IN CLEAN ROOMS**

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**Filtration.**



AIR TREATMENT  
IN CLEAN ROOMS

Diffusion.