بسم الله الرحمن الرحيم

PRESENTATION

ON

CLEAN ROOM
HEATING, VENTILATION & AIR CONDITIONING (HVAC) SYSTEM

FOR

PHARMACEUTICAL MANUFACTURER

BY

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Topic of Presentation

a. What is HVAC system.

b. Role of HVAC system in Pharma

c. What standard/specs. To follow for selection of class of each area

d. What procedure to follow for testing/revalidation

e. Air Distribution

f. Bacteria free Pre-Insulated Ducting

g. Article on Cleanroom (HVAC System) for pharmaceuticals

a. What is HVAC System

Heating Ventilation & Air Conditioning system

The HVAC system Comprises of two Parts

1. **AHU (Air Handling Unit)**
2. **Source of cooling**

a. What is HVAC System

1. AHU (Air Handling Unit)

There are three type of AHU used in Pharma.

i. Injectable AHU for Class-A, Class-B, Class-C

	Class-A	Class-B	Class-C
Efficiency	99.999%	99.997%	97%

ii. Non-Injectable AHU for Class-D of 95% efficiency.

iii. Standard AHU for Class-E of 35% efficiency.

Comparison of AHUs

Specification	Standard AHU	Non-Injectable AHU			Injectable AHU		
External Body	Single Skin	Double Skin			Double Skin		
Type of Fan	Low Static 1.25 psi	1.75 to 2.5 psi			2.5 to 7 psi		
Cooling Coil	Yes	Yes			Yes		
Heating Coil	No	Yes			Yes		
In Build Dehumidifier	No	Yes			Yes		
Filtration	Dust Filter 35% Efficiency	Dust 35%	Pre 65%	Bag 95%	Dust 35%	Pre 65%	Bag 95%
Indication of Filter Performance	Optional	Compulsory			Compulsory		
No of Air Change	12-16	14-25			25-50		
In Build Fresh Air System	No	Optional			Compulsory		
Controller	Simple	Digital Display			Digital Display		

“ECONOMIA”

CLEAN ROOM HVAC SYSTEM

Difference Between Injectable & Non-Injectable

Injectable

- Washable Filter
- Pre Filter
- Bag Filter
- Cooling Coil
- Dehumidifier
- Electric Heater
- Fan
- Digital Control with Display
- **Bypass Damper**
- **Air Changes 25-50**
- **Recycle 100% to 100% Fresh Air**

Non-Injectable

- Washable Filter
- Pre Filter
- Bag Filter
- Cooling Coil
- Dehumidifier
- Electric Heater
- Fan
- Digital Control with Display
- **Air Changes 14-25**

a. What is HVAC System

2. Source of Cooling

Source of Cooling can be air cooled condensing unit OR water chiller which can be air cooled OR water cooled based on various types:

- **Absorption Chiller**
- **Reciprocating Chiller**
- **Centrifugal Chiller**
- **Screw Chiller**
- **etc.**

The above chiller/condensing unit is not a requirement to be discussed and the same is a choice of manufacturer which they can afford.

b. Role of HVAC System in Pharma

In Manufacturing Process of Pharma we developed the Role of HVAC into three categories:

1. Filtration to keep clean from bacteria from Class A to E
2. Humidity to manage standard of validity from 65% to 20% of medicine
3. Temperature 15 ^{0}C to 27 ^{0}C to reduce the bacteria growth as well as to provide better working environment.

c. What Standard/Specification to Follow for Design and Classification

i. Information for Design Approval

ii. Zone Classification for Design Selection

i. Information for Design Approval

1. Height of the ceiling along with provision to install diffuser terminals and filters (Hepa & others)
2. Layout of Ducting and Location of Air Inlets/Outlets
3. Classification of Area
4. Differential indication of person/material
5. Humidity Level
6. Air Pressure Zones
7. Air Curtains/Buffers placement
8. Position of Air Shower
9. Types and Location of Air Locks
10. Indication of Segregated Area, If any

ii. Zone Classification for Design Selection

S.No	Section/Room Name	Required Temp	Relative Humidity	Air Changes	Class	Pressure	Dust of Vapour Present	Remarks
A	**General Tablet Etc.**							
	i) Granulation General	25 ⇌ 27 ºC	35 ⇌ 45%	16 ⇌ 18	D	Negative	H Dt	++ Buffer
	ii) MixingGeneral	25 ⇌ 27 ºC	35 ⇌ 45%	16 ⇌ 18	D	Negative		+++ Buffer
	iii) Drying	35 ⇌ 40 ºC	35 ⇌ 45%	16 ⇌ 18	D			
	iv) Compression	25 ⇌ 27 ºC	30 ⇌ 35%	16 ⇌ 18	D	Negative	H Dt	+++ Buffer
	v) Coating	25 ⇌ 27 ºC	35 ⇌ 45%	16 ⇌ 18	D	Negative	H Vp	+++ Buffer
B	**General Capsule Etc.**							
	i) Filling Polishing	25 ⇌ 27 ºC	35 ⇌ 45%	16 ⇌ 18	D	Positive		+ Buffer
	ii) General Mixing	25 ⇌ 27 ºC	30 ⇌ 35%	16 ⇌ 18	D	Negative	H Dt	++ Buffer
C	**Susp. Antiblotic Etc**							
	i) Antibiotic Susp. Filling	25 ⇌ 27 ºC	30 ⇌ 35%	16 ⇌ 18	D	Positive		+ Buffer
	ii) powder Mixing	25 ⇌ 27 ºC	30 ⇌ 35%	16 ⇌ 18	D	Negative	H Dt	+++ Buffer
D	**Sachet Section Etc.**							
	i) Sachet Filling	25 ⇌ 27 ºC	30 ⇌ 35%	16 ⇌ 18	D	Positive		+ Buffer
	ii) Sachet Mixing	25 ⇌ 27 ºC	35 ⇌ 45%	16 ⇌ 18	D	Negative	H Dt	+++ Buffer
E	**General Liquid Syrup Etc.**							
	i) Liquid Syp. Prepration	35 ⇌ 40 ºC	RH<60%	16 ⇌ 18	D	Negative	H Vp	++ Buffer
	ii) Liquid Syp. Filling	30 ⇌ 35 ºC	RH<60%	16 ⇌ 18	D	Positive		+ Buffer
F	**General Cream Etc.**							
	i) General Cream Mixing	35 ⇌ 40 ºC	RH<60%	16 ⇌ 18	D	Negative	H Vp	++ Buffer
	ii) General Cream Filling	30 ⇌ 35 ºC	RH<60%	16 ⇌ 18	D	Positive		+ Buffer
G	**Steroid Cream Etc.**							
	i) Buffer	25 ⇌ 27 ºC	RH<60%	18 ⇌ 22	C	Positive		+ Pressure as compare to rest of production area
	ii) Dispensing	25 ⇌ 27 ºC	RH<60%	18 ⇌ 22	C			+ Buffer
	iii) Steroid Cream Prepration	35 ⇌ 40 ºC	RH<60%	18 ⇌ 22	C	Negative	H Vp	++ Buffer
	iv) Steroid Cream Filling	30 ⇌ 35 ºC	RH<60%	18 ⇌ 22	C	Positive		+ Buffer
H	**Eye Drop Etc.**							
	i) Buffer	25 ⇌ 27 ºC	RH<60%	18 ⇌ 22	C	Positive		+ Pressure as compare to rest of production area
	ii) Eye Drop Manufacturing	25 ⇌ 27 ºC	RH<60%	18 ⇌ 22	C	Negative	H Vp	++ Buffer
	iii) Eye Drop Filling	25 ⇌ 27 ºC	RH<60%	18 ⇌ 22	C	Positive		+ Buffer
I	**Ointment Section Etc.**							
	i) Buffer Zone	25 ⇌ 27 ºC	RH<60%	18 ⇌ 22	C	Positive		+ Pressure as compare to rest of production area
	ii) Oinment Prepration	25 ⇌ 30 ºC	RH<60%	18 ⇌ 22	C	Negative	H Vp	+++ Buffer
	iii) Oinment Filling	25 ⇌ 27 ºC	RH<60%	18 ⇌ 22	C	Positive		+ Buffer
J	**Liquid Syrup Sterio Etc.**							
	i) Mixing	35 ⇌ 40 ºC	RH<60%	18 ⇌ 22	C	Negative	H Vp	++ Buffer
	ii) Sterio Filling	30 ⇌ 35 ºC	RH<60%	18 ⇌ 22	C	Positive		+ Buffer
K	**Dry Injection (Vial Etc.)**							
	i) Washing	24 ⇌ 27 ºC	RH<60%	18 ⇌ 22	C	Negative	H Vp	+++ Buffer
	ii) Dry Heat Sterlize	35 ⇌ 40 ºC	RH<60%	18 ⇌ 22	C	Negative	H Vp	+++ Buffer
	iii) Cooling Zone	25 ⇌ 27 ºC	RH<35%	25 ⇌ 35	B			++ Buffer
	iv) Buffer	25 ⇌ 27 ºC	RH<35%	25 ⇌ 35	B	Positive		+ Pressure as compare to rest of production area
	v) Air Lock	25 ⇌ 27 ºC	RH<35%	35 ⇌ 45	A	Positive		
	vi) Vial Filling	25 ⇌ 27 ºC	30 ⇌ 35%	35 ⇌ 45	A	Positive		+ Buffer
	vii) Vial Sealing	25 ⇌ 27 ºC	30 ⇌ 35%	35 ⇌ 45	A	Positive		+ Buffer
L	**Liquid Injection Etc.**							
	i) Washing	25 ⇌ 27 ºC	RH<60%		C	Negative	H Vp	+++ Buffer
	ii) Dry Heat Sterlize	35 ⇌ 40 ºC	RH<60%		C	Negative	H Vp	+++ Buffer
	iii) Cooling Zone	25 ⇌ 27 ºC	RH<60%	25 ⇌ 35	B			++ Buffer
	iv) Auto Clave	25 ⇌ 27 ºC	RH<60%	25 ⇌ 35	B			
	v) Solution Prepreation	25 ⇌ 27 ºC	RH<60%	35 ⇌ 45	A	Positive	H Vp	+ Buffer
	vi) Buffer	25 ⇌ 27 ºC	RH<60%	35 ⇌ 45	A	Positive		+ Pressure as compare to rest of production area
	vii) Air lock	25 ⇌ 27 ºC	RH<60%	35 ⇌ 45	A			
	viii) Ampule Filling	25 ⇌ 27 ºC	RH<60%	35 ⇌ 45	A	Positive		+ Buffer

Key				
	Normal	Existing	Cool	8-15 C
	Room	25-30 C	Cold	2-8 C

A=99.99%	C = 99.97%
B=99.99%	D = 95%

Key		
	H Vp	High Vapours
	H Dt	High Dust
	+++	Difference of 30 Pascals
	++	Difference of 20 Pascals
	+	Difference of 10 Pascals

Important Note:
All specification is only applied on current date which may improved upon up dated by WHO Requirement.

d. What Procedure to Follow for Testing/Validation

d. What Procedure to Follow for Testing/Validation

HVAC Test Report

Air Changes, Temperature & Humidity

Name of Client:_____ **Date:**_30-05-2006_

Address:_Rawat_ **Section: TABLET & CAPSULE-A** **Type of Equipment:**_Non-Injectable_

Section	Area C.Ft.	Required Capacity (TR)	Installed Capacity (TR)	Required CFM	Present CFM	Number of Air Changes Required	Number of Air Changes on Ground	Present Air Velocity	Grill / Diffuser Size L x W	Grill / Diffuser Size Sq. In.	Required Temp. (°C)	Present Temp. (°C)	Required Humidity	Present Humidity	Filtration Class	Remarks
A Tablet & Capsule Section																
Granulation	350	0.29		116	211		23	1.3	7"x17"	119		25		30%		
Mixing/Gran	1495	1.232		500	662		26	2.1	11"x21"	231		26		31%		
Dryer	938	0.82	4	328	428	16/Hr	27	1.5	11"x19"	209	27	24	35%	30%	95% D	
Inprocess Qurantine	566	0.6		240	374		40	1.4	14"x14"	196		23		30%		
Total	**3349**	**2.942**	4	**1184**	**1675**											

Testing Engineer

Witness of Factory Rep.

e. Air Distribution

Class-A : Luminar Flow Diffuser

Class-B : Luminar / Swirl Diffuser

Class-C : Swirl Diffuser

Class-D : Swirl / Side Grill

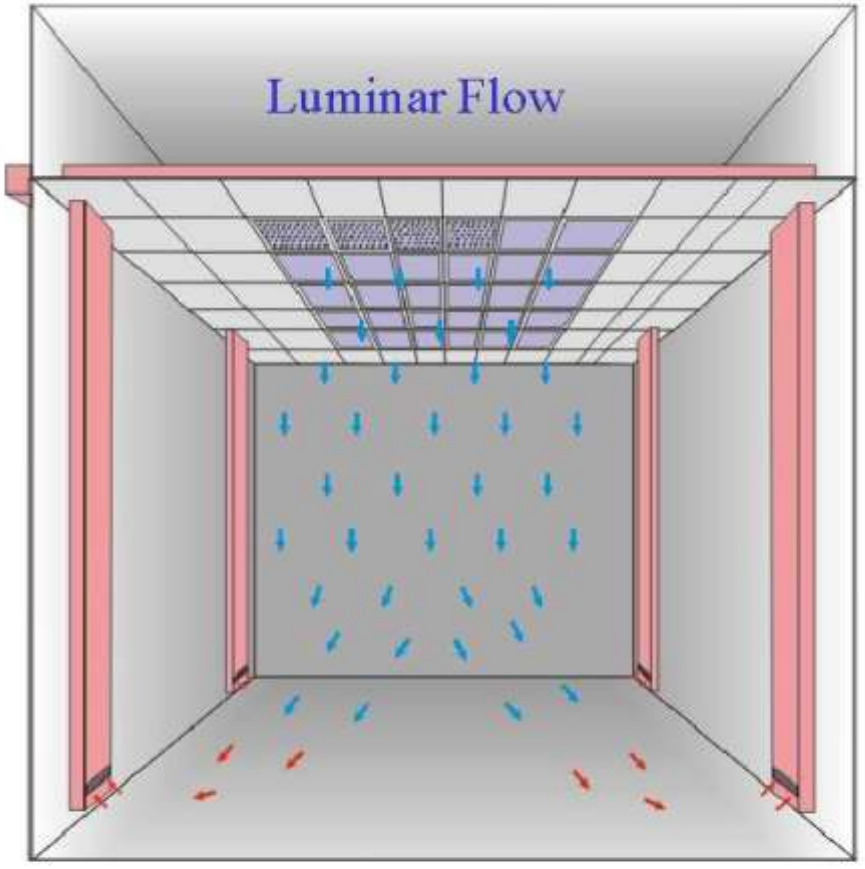
Class-E : Standard Diffuser / Side Grill

e. Air Distribution

Class-A : Luminar Air Flow

Up to 80% Area

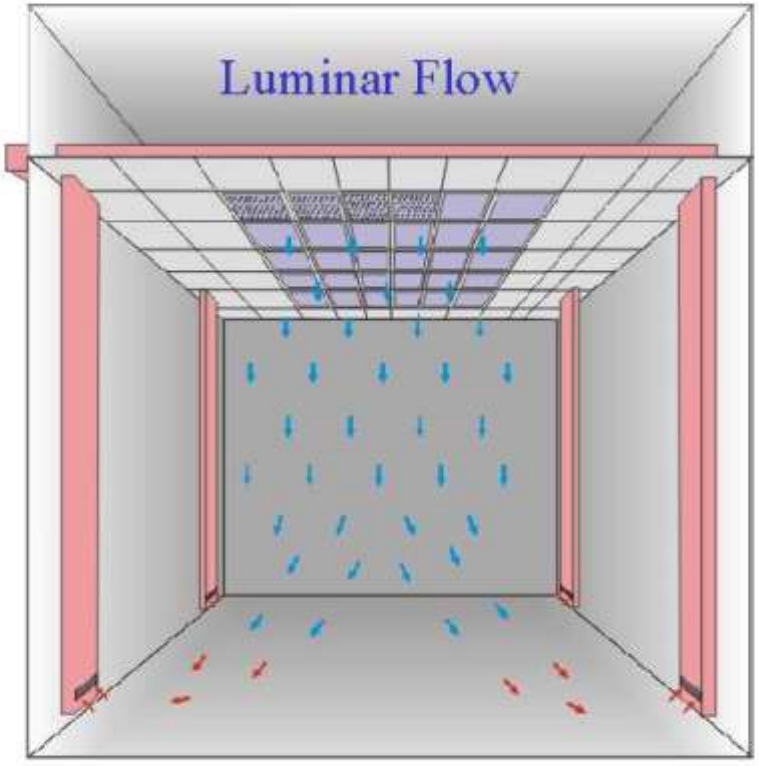
Number of air changes 40 to 100

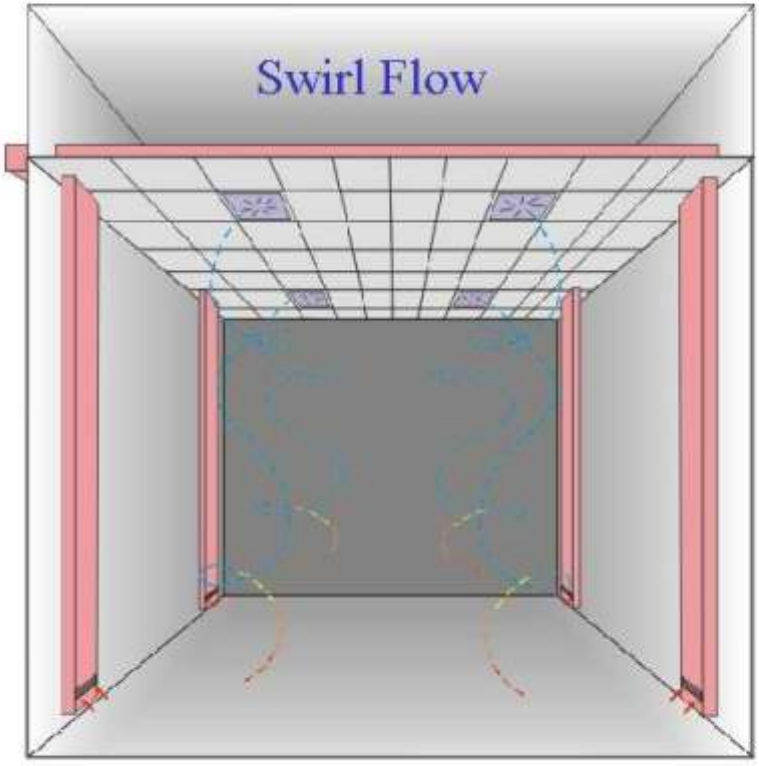


e. Air Distribution

Class-B : Luminar / Swirl Air Flow

Number of air changes 27 to 35

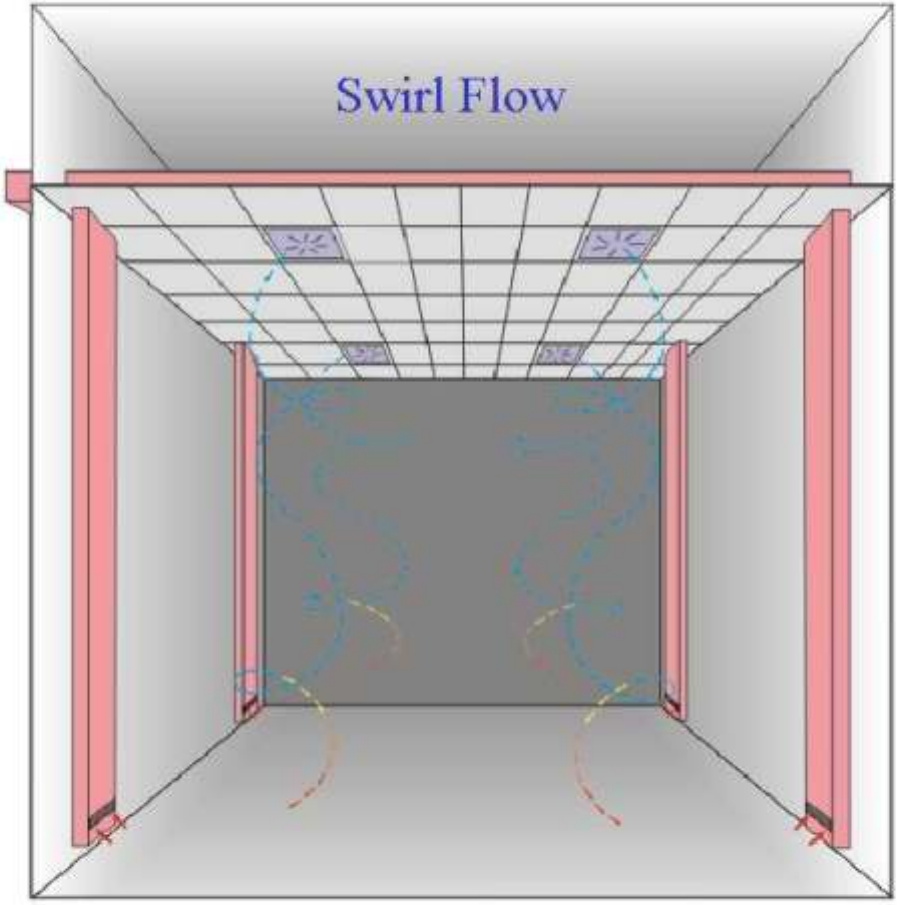




e. Air Distribution

Class-C : Swirl Air Flow

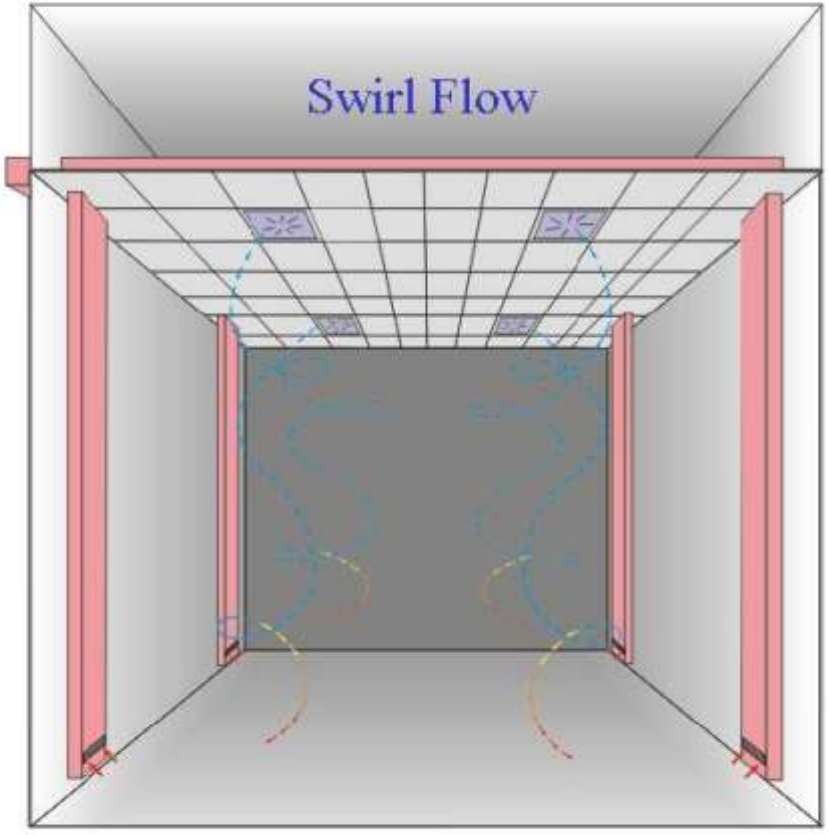
Number of air changes 22 to 27

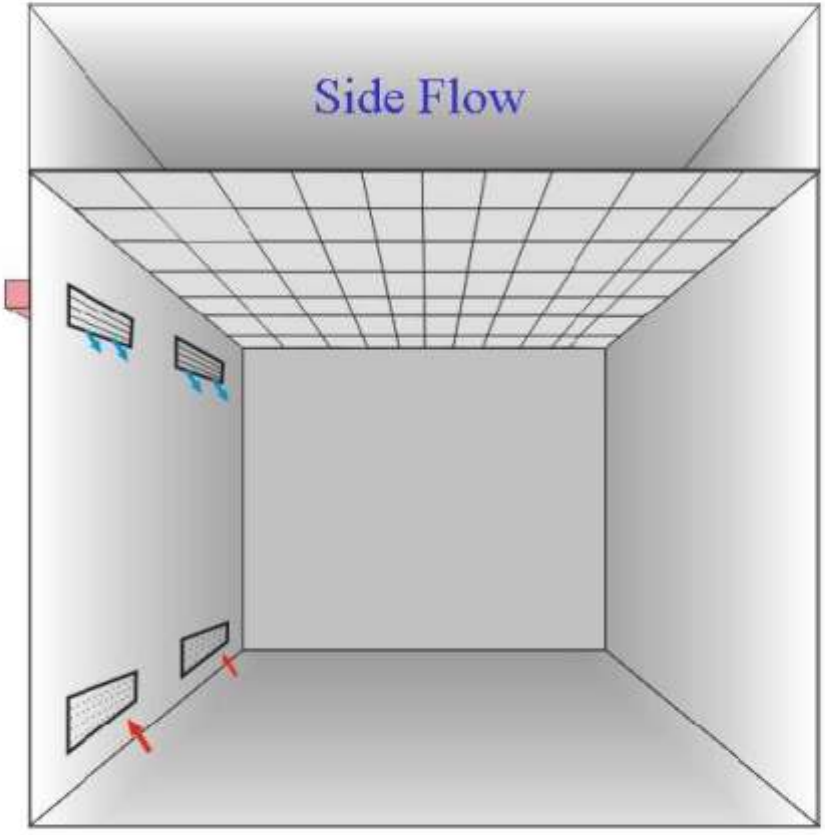


e. Air Distribution

Class-D **:** Swirl / Side Air Flow

Number of air changes 16 to 18

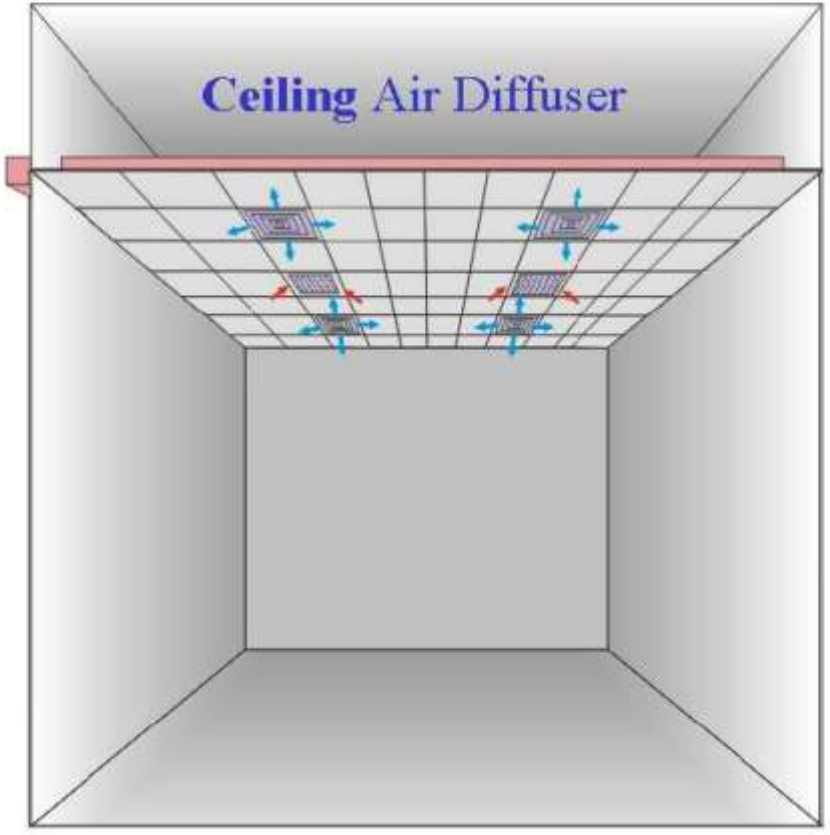


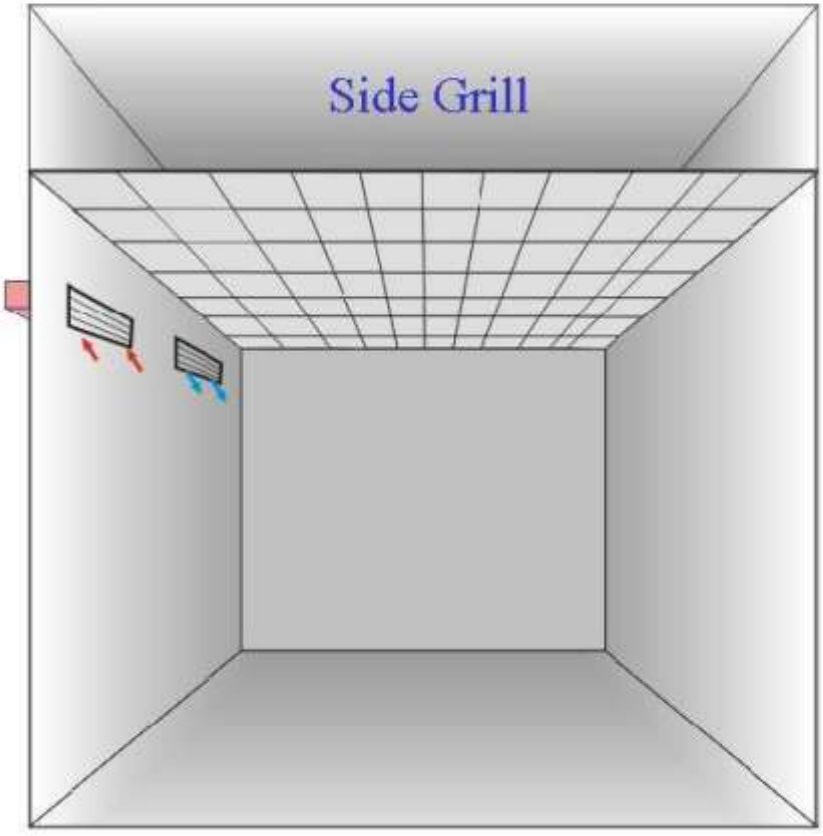


e. Air Distribution

Class-E **:** **Ceiling** Air Diffuser / Side Grill

Number of air changes 10 to 16



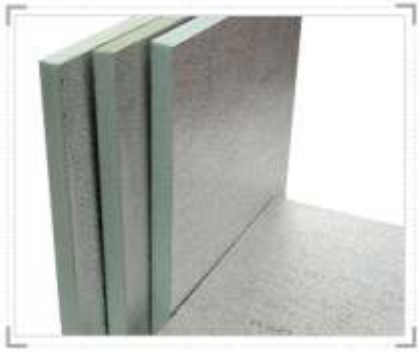


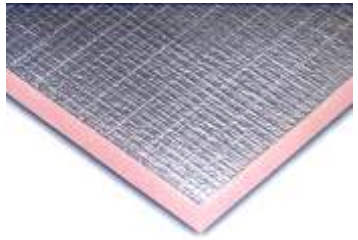
f. Recommended Ducting PIR / PU Pre-insulated Duct Panel

Recommended Ducting for Class A & B Pre-Fabricated Insulated Ducting

Detailed Product Description

This product is made of a layer of silicate modified fireproof rigid polyurethane. It is Foam coated with aluminum foils and is a new **alternative to galvanized ducts**. Easy to install, it has a high density, good insulation, low air leakage (which saves energy), it's easy to clean, environmentally friendly, non-itchy, and Freon free.





Features:

1) Specification: 3, 600 x 1, 200 x 20mm
2) 80/80um aluminum foil, both sides embossed
3) Density: 50-60kg/m^3
4) Compressive strength: 200N/mm^2
5) Thermal conductivity: 0.021 W/m.K
6) Flame retardancy: B1
7) Friction coefficient: 0.0135
8) Light Weight 15% of G.I Sheet
9) Durable, No Rust, Hygienic

Clean Rooms and HVAC System for Pharmaceuticals

By: Daud Abdullah (B.Sc Eng.)

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Clean rooms are defined as a specially constructed enclosed area, environmentally controlled with respect to airborne particulates, temperature, humidity, air pressure, air flow patterns, air motion, vibration, noise, viable (living) organisms, and lighting.

Airborne particles occur in nature as dust, pollen, bacteria, miscellaneous living and dead organisms. Industry generates particles from combustion processes, chemical vapors, and friction in manufacturing equipment. People in the workspace generate particles in the form of skin flakes, lint, cosmetics, and respiratory emissions. All these particulates are either to be eliminated, diluted or prevented from settling on to the product surfaces.

The complete HV AC installation is therefore of vital importance, in order to obtain a certain level of clean room. The purpose of the HVAC system is to supply airflow in sufficient volume and cleanliness to support the cleanliness rating of the room. Air is introduced into the clean room in a manner to prevent stagnant areas where particles could accumulate. The air must also be conditioned to meet the clean-room temperature and humidity requirements. In addition, enough conditioned makeup air must be introduced to maintain the specified positive pressurization.

The most frequently used standard is the Federal Standard 209E & ISO 14644-1. These standard are documents that establishes standard classes of air cleanliness for airborne particulate levels in cleanrooms and clean zones.

Maximum allowable particles

ISO	FED STD 209	0.1	0.2	0.3	0.5	5
CLASS 5	100	100,000 / 3,450	750	300	3520 / 100	0
CLASS 6	1,000	1,000,000 / 34,500	N / A	N / A	35,200 / 1,000	7
CLASS 7	10,000	345,000	N / A	N / A	352,000 / 10,000	70
CLASS 8	100,000	3,450,000	N / A	N / A	3,520,000 / 100,000	700

ISO 14644-1 (per cubic meter)
Fed Std. 209 E USA (per cubic foot)
ISO standard requires results to be shown in cubic meters
(l cubic meter = 35.314 cubic feet)

The only way to control contamination is to control the total environment. Air flow rates and direction, pressurization, temperature, humidity and specialized filtration all need to be tightly controlled. And the sources of these particles need to controlled or eliminated whenever possible. There is more to a clean room than air filters. Cleanrooms are planned and manufactured using strict protocol and methods.

Sources of Contamination

This is a partial list of some of the commonly known contaminants that can cause problems in some cleanroom environments. It has been found that many of these contaminants are generated from five basic sources. The facilities, people, tools, fluids and the product being manufactured can all contribute to contamination. Review this list to gain a better understanding of where contamination originates.

1. Facilities

Walls, floors and cielings
Paint and coatings
Construction material (sheet rock, saw dust etc.)
Air conditioning debris
Room air and vapors
Spills and leaks

2. People

Skin flakes and oil
Cosmetics and perfume
Spittle
Clothing debris (lint, fibers etc.)
Hair

3. Tool Generated

Friction and wear particles
Lubricants and emissions
Vibrations
Brooms, mops and dusters

Clean Rooms and HVAC System for Pharmaceuticals

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4. Fluids

Particulates floating in air
Bacteria, organics and moisture
Floor finishes or coatings
Cleaning chemicals
Plasticizers (outgasses)
Deionized water

5. Product generated

Silicon chips
Quartz flakes
Cleanroom debris
Aluminum particles

People are a major source of contamination in the cleanroom. Look at the people activities listed below. Notice the number of particles produced per minute during these activities.

PEOPLE ACTIVITY	PARTICLES/MINUTE (0.3 microns and larger)
Motionless (Standing or Seated)	100,000
Walking about 2 mph	5,000,000
Walking about 3.5 mph	7,000,000
Walking about 5 mph	10,000,000
Horseplay	100,000,000

The HVAC system Pharmaceutical is Design on following basis:

Class 100

- 400 to 480 air changes per hour (60-80% ceiling coverage)
- 99.99% HEPA filters
- Raised floor assures optimal performance. Low wall returns work when they are no further than 12' from the center of the room
- Gasketed ceiling grid

Class 1,000

- 120 to 150 air changes per hour (40-50% ceiling coverage)
- 99.99% HEPA filter
- Gasketed ceiling grid
- Raised floor delivers best performance, but low wall returns are very common

Class 10,000

- 45 to 60 air changes per hour (10-20% ceiling coverage)
- 99.97% or 99.99% HEPAs
- Low wall or ceiling returns acceptable in most applications

Class 100,000

- 20 to 30 air changes per hour (5% ceiling coverage)
- HEPA filters or 95% HEPAs (95%) located downstream of the HV AC unit
- Cooling load may require more air changes

Recommended Tests per Class

Class	100	1,000	10,000	100,000
Floor Count	Required test	Required test	Required test	Required test
Velocity	Required test	Required test	Recommended test	Recommended test
Static Pressure	Required test	Required test	Required test	Required test
Face Scan	New projects only	New projects only	New projects only	N/A
Laminarty	New projects only	Raised floor designs only	N/A	N/A
Parallelism	New projects only	Raised floor designs only	N/A	N/A
Recovery	Required test	New projects only	New projects only	New projects only
Temperature Humidity Light Sound	Customer/ manufacturer dependent	Customer/ manu facturer dependent	Customer/ manufacturer dependent	Customer/ manufacturer dependent

Floor Count: Air samples taken by a particle counter at a height of 32" to 40" above the floor (sample times and air volume typically are 1 minute and 1 CFM)

Velocity: The speed of the air coming out of a filter

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(FPM feet per minute) assures even airflow through a room and gives you air change ratios.

Static Pressure:

- **Filter:** The amount of force it takes for air to pass through a filter
- **Room:** The pressure difference of one room to another. Ex. main cleanroom vs. a gowning room vs. a hallway

Face Scan: Testing the filter by passing a particle sample probe across its face looking for small pin hole leaks.
Laminarty: Airflow patterns within a room.
Parallelism: Indicates how straight the airflow is over a given distance.
Recovery: How quickly the room or area will clean itself up and return to normal.
Temperature, Humidity, Light, and Sound: The rated performance of each item at specified locations (typically 4'-10' on center).
As Built: A functioning room with no furniture, process equipment, or personnel. Normally found only on new rooms. "Very easy to pass"
At Rest: Fully operational room with furniture, process and support equipment in place but not operating. The most common tested condition, also easy to pass, because no particles are being generated within the room.
Ceiling grid: Type or style of prefabricated ceiling system used in a cleanroom.
HEPA Filters: Class of air filters which meet a minimum performance level of 99.97% on 0.3 microns efficiency. (This is only an efficiency test and may not show small pin holes or leaks.) In the cleanroom market HEPA is normally rated at 99.99% and an additional face scan test is performed to assure no pin holes or leaks are found.

Operational: Mode the room is fully operating at with furniture, equipment, and staff. This is the most difficult level to pass. Here we find the dirtiest source in your room, your personnel. A single person can shed hundreds of thousands of particles an hour.

Buffer Zone
A "Buffer Zone" in the simplest form, is an environment that separates the compounding room from the surrounding ambient (unrated) area and is to be constructed from low-particle-generating materials that can withstand continuous cleaning. ISO standards require that the buffer zone be maintained under positive pressure and that airborne particles be limited in compliance with ISO 8 requirements.

Cleaning Procedures for Clean Rooms What follows are some recommended procedures for cleaning cleanrooms. It is important to emphasize that these procedures are guidelines and not standards or rules. The procedures listed here are routine cleaning tasks. Local cleanroom cleaning procedures may supercede the ones listed here. It is important for cleaning managers to review all cleaning procedures to be used in a cleanroom with the cleanroom management. A detailed cleaning schedule should be prepared for every cleanroom. Here are some procedures to be completed when cleaning a Class 10,000 cleanroom:

Cleaning Procedures for a Class 10,000 Cleanroom

Housekeeping maintenance of the cleanroom and restricted areas is essential to assure quality. Cleaning of a cleanroom should be performed on a daily basis. Improper cleaning of the cleanroom can lead to contamination and a loss in end user product quality. Proper selection of equipment and materials is important for proper cleaning. Only products that have proven cleanroom performance records should be considered for use in cleanrooms. These products should be listed and all vendors should be informed about the strict policies of how products are qualified. All procedures should be strictly enforced. Below are some examples of how to organize the cleaning to be done in a cleanroom. These are NOT schedules or exact procedures. They are guidelines for preparing work procedures and schedules. Local requirements must be included in any cleaning program.

List of Some of Equipment and Supplies Needed to Clean the Cleanroom

(All supplies must meet the Class 10,000 minimum requirements)

1. Cleaning and disinfecting solutions

2. Cleanroom mops

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3. Cleanroom vacuum cleaner (if allowed)

4. Cleanroom wipers

5. Cleanroom mop bucket and wringer

List of Cleaning Tasks to be Completed in the Cleanroom

(Frequency may vary depending upon local requirements)

1. Cleaning of all work surfaces in the controlled environment.

2. Vacuuming (if allowed) of the floors and work surfaces.

3. Emptying of appropriate trash and waste.

4. Cleaning of the doors, door frames and lockers in the pre-staging area and gowning areas using the approved cleaning solution.

5. Mop gowning and cleanroom floors.

Cleaning Procedures for a Class 1000 Cleanroom

Below is a sample of a cleaning program in a Class 1000 Cleanroom. This is only a sample of a program. Local standards and requirements must be followed.

Description of Work	Frequency
Change tacky mats	Every 2 hours
Wet mop with approved mop, cleaner & DI water	2 times per shift
Dust mop (if allowed)	2 times per shift
Remove trash, sweep, mop with appropriate cleaner wipe down tables and coffee area, clean walls and recycle can	1 time per shift
Vacuum entry mats, sweep and mop floors	1 time per shift
Mop floor with pre-burnish cleaner and tap water	1 time per shift
Remove trash. Always wear gloves. Never take waste containers inside cleanrooms.	1 time per shift
Wet mop floors	1 time per shift
Remove acid and solvent trash	1 time per shift
Clean and replenish dispenser in all restrooms	3 times per week
Vacuum floor (if allowed)	2 times per week
Clean stainless steel pass throughs with s/s cleaner and appropriate wipes	1 time per week

The list above is a sample of some of the common tasks that need to be performed in a Class 1000 cleanroom. The list is not exhaustive. But gives some ideas of how to prepare work schedules and procedures. An assessment of the cleanroom in conjunction with cleanroom management will help define these tasks and frequencies.

Cleaning Procedures for a Class 100 Cleanroom

Procedure	Frequency
Trash removal	Once daily
Mop walkways	Once a week
Wipe down horizontal surfaces	Once monthly
Pull tacky mats	Every 2 hours
Mop and trash removal	Once daily
Wipe down walls and trim	Once a week
Mop and trash removal	Once daily
Wipe down walls and trim	Once a week
Mop	Twice a shift
Wipe down walls and trim	Once a week
Vacuum	Once monthly
Mop and trash removal	Once per shift
Wipe down walls, windows, doors, trim, showers, passthroughs and fire extinguishers.	Once a week

The list above is a sample of some of the common tasks that need to be performed in a Class 100 cleanroom. The list is not exhaustive. But gives some ideas of how to prepare work schedules and procedures. An assessment of the cleanroom in conjunction with cleanroom management will help define these tasks and frequencies.

Thank You