



S45: Design and Construction Considerations  
For  
Cleanroom Facilities  
For  
Nanotechnology Research

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# Agenda

- ❑ Introduction
- ❑ Traditional Cleanroom Design Considerations
- ❑ Specific Design Considerations
- ❑ Questions



# AdvanceTEC

*AdvanceTEC is a cleanroom contractor specializing in the microelectronics and semiconductor markets. We have extensive staff experience in designing, constructing, and installing process systems and tools for wafer fabs and related technologies.*



# Traditional Design Concerns

Concerns that are prevalent designing any cleanroom facility:

- ❑ The 3 Most Important Steps to successfully execute a cleanroom design are:
  1. Assembling an Equipment Data Base
  2. Creating a Utility Summary (Matrix)
  3. Developing an Equipment/Tool Layout



# Traditional Design Concerns

What does the utility list and layout provide in terms of answers that will help us properly design the cleanroom:

- Exhaust Requirements
- Heat Loads
- Process Cooling Loads
- DI Water Requirements
- Spec Gas Requirements
- Process Gas Requirements
- Utility Space Requirements
- Material and Personnel Egress Requirements



# Traditional Design Concerns

From the values summarized by the utility list we can size the utility equipment that dictates utility requirements:

- ❑ Make Up Air Requirements
- ❑ Humidifier Requirements
- ❑ Boiler Requirements
- ❑ Chiller Requirements
- ❑ Electrical Loads
- ❑ Process Utility Loads



# Specific Nanotechnology Concerns

## What is Nanotechnology:

- Technology developed at the atomic or molecular level
- Ability to control or manipulate at that level
- Creating or using structures that have novel properties due to their size



# Specific Nanotechnology Concerns

## Nanotechnology Applications:

- Creation of new materials with superior strength, conductivity, or resistance
- Microscopic machines or probes that can be injected into the body for diagnosis or repair
- Creation of bio-chips that detect contamination or dangerous substances in the body or air





# Specific Nanotechnology Concerns

## Size of Nanometer:

- 1 Nanometer= One-Billionth of a meter
- DNA is in the 2.5 Nanometer range
- Smaller than a living cell requiring microscopes that present unique design challenges



# Specific Nanotechnology Concerns

Some Items are of greater concern to Nanotechnology cleanroom design:

- Noise
- Electromagnetic Interference
- Vibration
- Airflow
- Cleanliness Classification



# Specific Nanotechnology Concerns

## Noise Concerns

- ❑ Noise and Vibration Interrelate
- ❑ SEM Equipment- prevalent in Nano Rooms- requires background noise as low as NC-45.
- ❑ Moving air and minimizing noise are diametrically opposed forces.
- ❑ Specific Air Delivery treatment should be considered.



## Air Delivery Treatment Methods:

- Sound Attenuation
- Some Sound attenuating treatments are directly contradicting to cleanroom design.
- Co-Planer & Fan Wall Technology helps address noise with the added benefit of reducing EMI concerns in cleanroom air delivery systems



# Specific Nanotechnology Concerns

## Electromagnetic Interference (EMI) Sources:

- ❑ Geomagnetic- Earth, Steel, Building Elevators
- ❑ Construction- Electrical and MEP Equipment
- ❑ Equipment- CRT's, ballasts, internal process equipment
- ❑ Stray RF Sources- Marine, mobile, broadcast, cell, microwave



# Specific Nanotechnology Concerns

## EMI Solutions:

- ❑ Passive Shielding
- ❑ Active Field Cancellation
- ❑ Address issues in the design process.
- ❑ Place generating sources as far from the process as possible.



# Specific Nanotechnology Concerns

## Vibration Concerns & Sources:

- ❑ Nano objects require stable environments with active vibration control.
- ❑ Thresholds are 4 times more sensitive than normal laboratory design concerns.
- ❑ External foot traffic can cause vibration that is of concern



# Specific Nanotechnology Concerns

## Vibration Abatement Techniques:

- ❑ Isolated slabs.
- ❑ Strategic location of the most sensitive laboratories.
- ❑ Decoupling of fan decks and HVAC equipment from laboratories.
- ❑ Active control utilizing air cushioned slabs.
- ❑ Point of use isolation.





# Specific Nanotechnology Concerns

## Airflow Concerns:

- ❑ Moving air to achieve cleanliness and reducing sound and vibration are diametrically opposed forces.
- ❑ We tend to have to reduce velocity to achieve our sound and vibration concerns.
- ❑ We then need to consider design features that will allow us to achieve the cleanliness goals with reduced airflow.



# Specific Nanotechnology Concerns

## Cleanliness Classifications Required for Nanotechnology Research:

- ❑ Economics dictate cleanliness class more than any other single factor.
- ❑ Yields are not of utmost concern in the research arena.
- ❑ The actual cleanliness requirements for commercialized nanotechnology devices are unrealized. Gas phase filtration will be of utmost concern.
- ❑ We are dealing with particles no more than 4 atoms in dimension.
- ❑ 90 nm is the current leading edge line width.



# Specific Nanotechnology Concerns

What are the design concerns of a NanoBio Cleanroom?



# Specific Nanotechnology Concerns

Integrating Semiconductor, Chemistry, and Bio design features into one facility:

- ❑ Dedicated Gowning Facilities
- ❑ Particulate levels vs. Bio burden
- ❑ Positive vs. Negative Pressurization Schemes
- ❑ Architectural Features
- ❑ Safety/Isolation



# SUMMARY

How do we insure all the concerns we have are addressed?

- ❑ Utilize specialized consultants
- ❑ Incorporate case studies from previous facilities
- ❑ Create design teams that can achieve all the facility goals.
- ❑ Capitalize on the community's willingness to share experiences
- ❑ Incorporate construction team in the design review



# SUMMARY

## Questions/Comments

- What are your concerns?
- What are your experiences?

