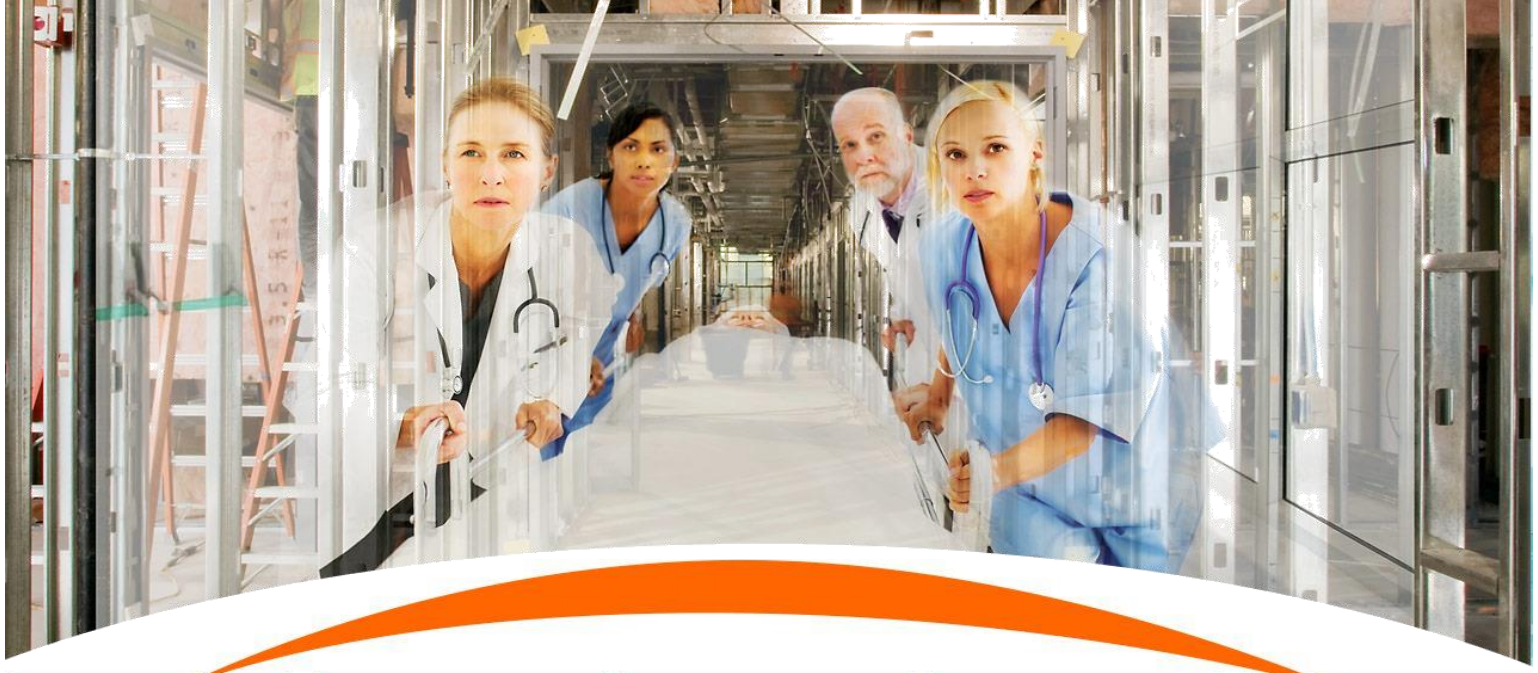

CONSTRUCTION INFECTION CONTROL TRAINING INSTITUTE

Infection Prevention and Construction

Highlights for IP's

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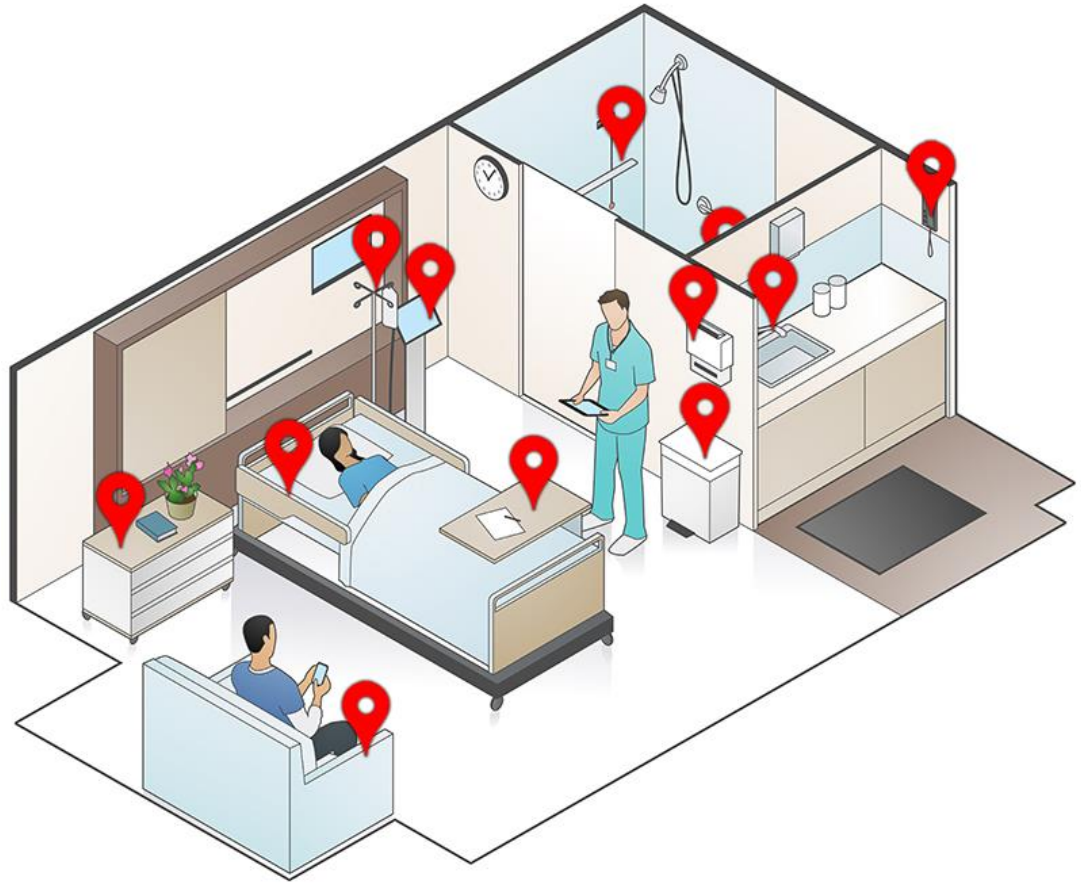
ICRA OVERVIEW

- Biological Build-Up in All Buildings
- Concentrated in Healthcare Structures
- Occupants ‘Ripe’ for Infection
- Building Modification -> Disturbance
- Increased Risk



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HVAC and Infection Prevention

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MICROBIAL MODES OF TRANSMISSION – AIR

- Outdoor Air
- HVAC Systems
- Indoor Air
- Respiration (People)

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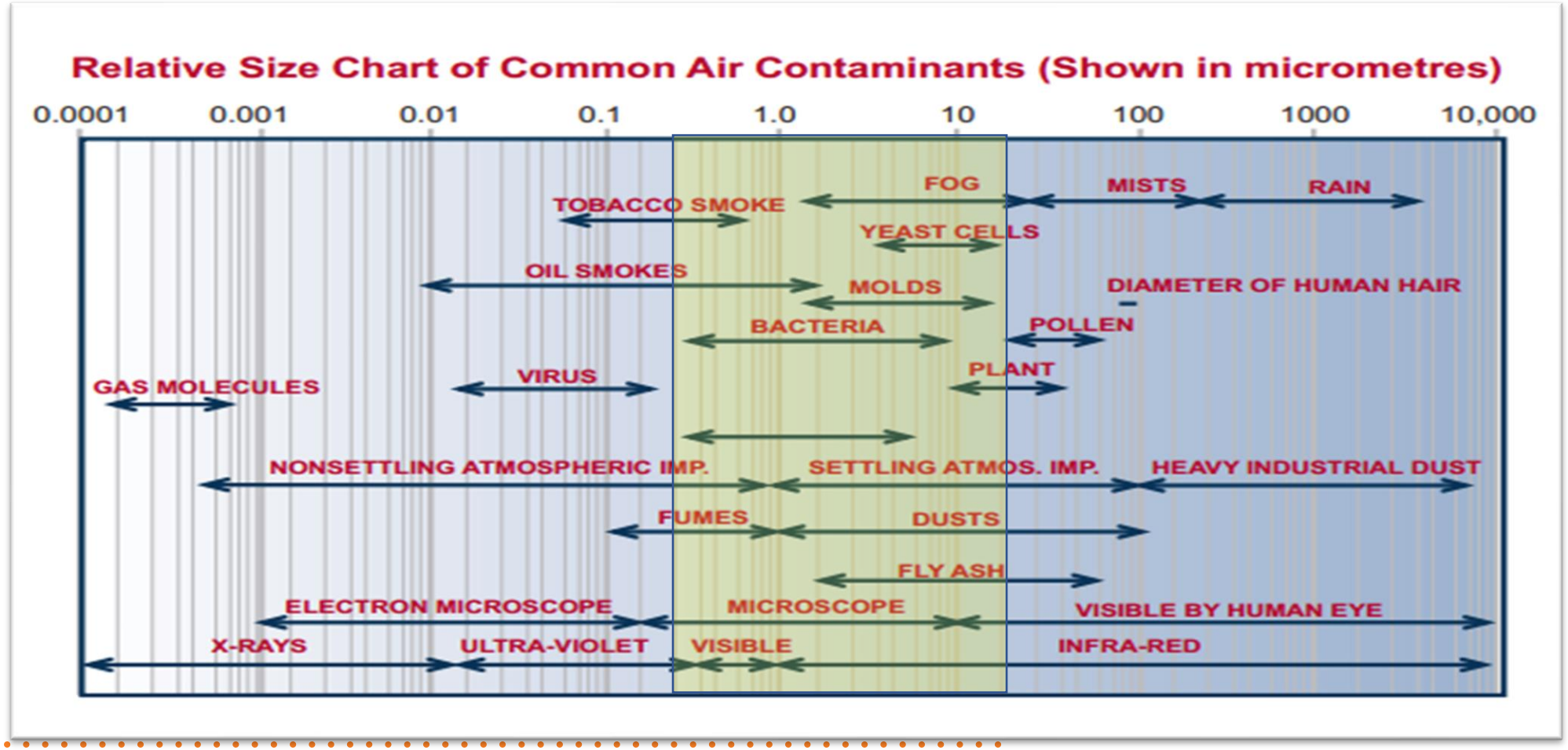
AIRBORNE PARTICLES



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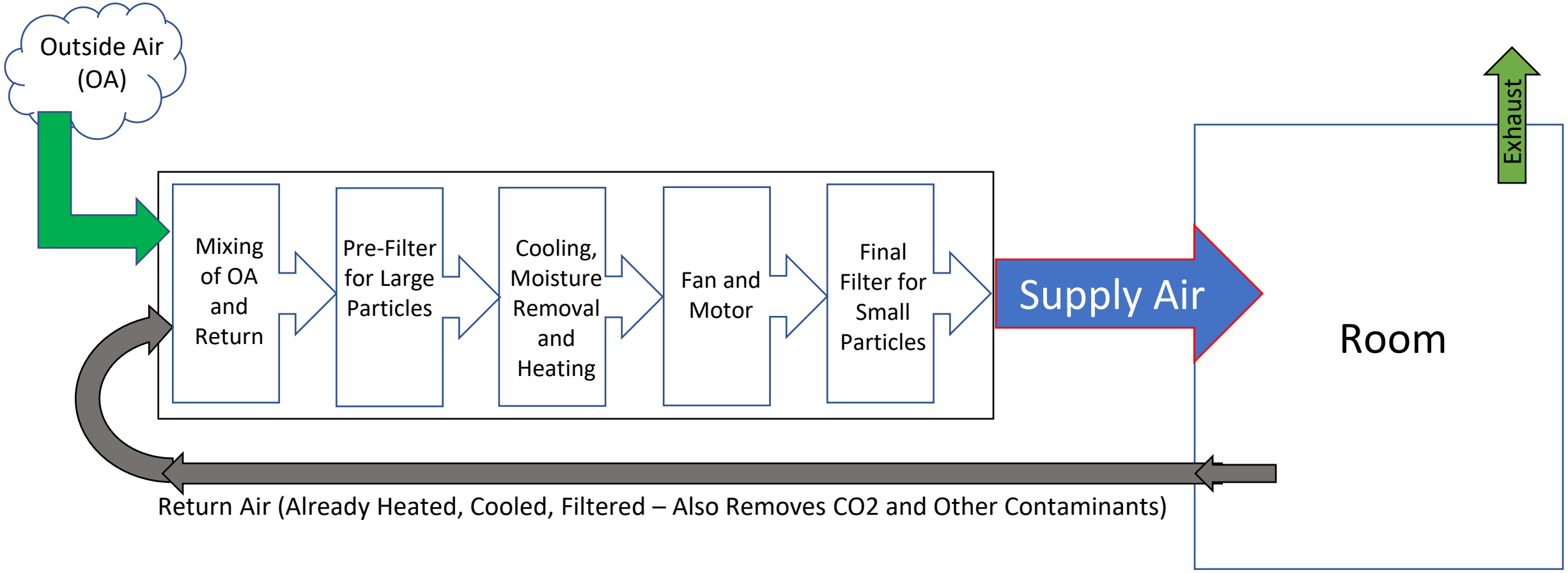
BUILDING SYSTEMS – AIR HANDLING UNITS



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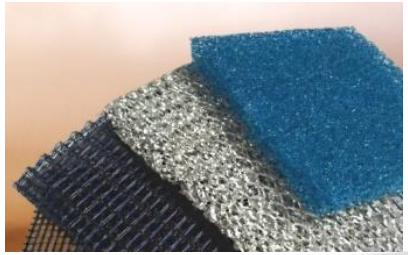
FILTER RATINGS - MINIMUM EFFICIENCY REPORTING VALUE (MERV)

MERV Value	Filter efficiency: Average percentage of particles trapped — Particle size: 0.3 - 1.0 microns	1.0 - 3.0 microns	3.0 - 10.0 microns	Typical particles trapped by filter
MERV 1	-	-	Less than 20%	Pollen, dust mites, standing dust, spray paint dust, carpet fibers
MERV 2	-	-	Less than 20%	
MERV 3	-	-	Less than 20%	
MERV 4	-	-	Less than 20%	
MERV 5	-	-	20% - 34%	Mold spores, hair spray, fabric protector, cement dust
MERV 6	-	-	35% - 49%	
MERV 7	-	-	50% - 69%	
MERV 8	-	-	70% - 85%	
MERV 9	-	Less than 50%	85% or better	Humidifier dust, lead dust, auto emissions, milled flour
MERV 10	-	50% - 64%	85% or better	
MERV 11	-	65% - 79%	85% or better	
MERV 12	-	80% - 89%	85% or better	
MERV 13	Less than 75%	90% or better	85% or better	Bacteria, most tobacco smoke, proplet nuceli (sneeze)
MERV 14	75% - 84%	90% or better	85% or better	
MERV 15	85% - 94%	90% or better	85% or better	
MERV 16	95% or better	90% or better	85% or better	



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FILTERS AND DUST LOADING

- Initial MERV Rating
- Improved Efficiency with Dust Loading
- Static Pressure Builds as Dust Loads
- Reduces Airflow due to Motor Strain
- Change Filters when Pressure Build Meets Manufacturer Recommendations
- Change Filters when Loaded with Known Contaminants

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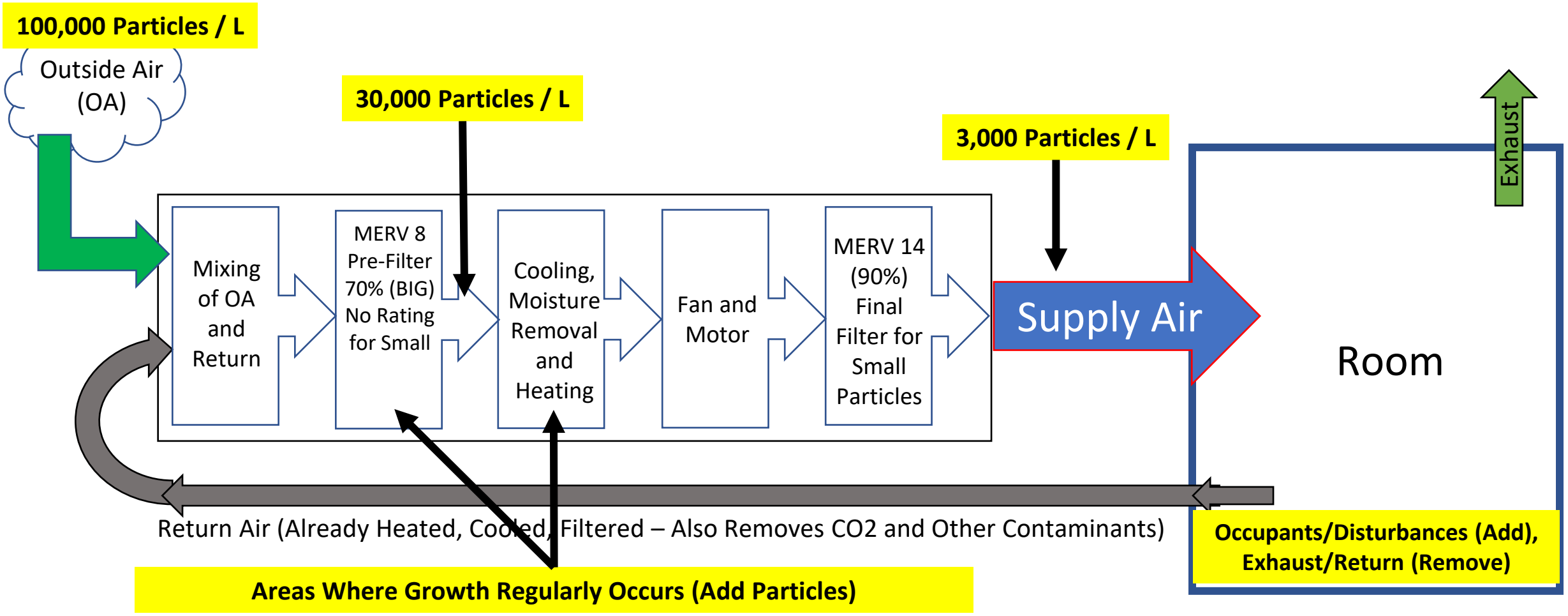
AIR HANDLING UNITS AND FILTRATION



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PROTECTING OUTSIDE AIR INTAKES

- Filters???
- Misting Systems
- Redirect Intake
- Stand Alone HEPA Units

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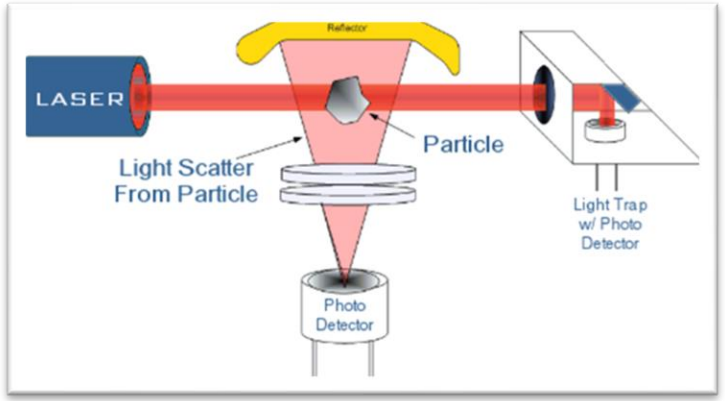
MONITORING DUST

Laser Particle Counters

- Measures Dust Concentrations in Air
- Concentration per Unit of Air
- Compare Outdoor Air to Facility Indoor Air
- Actual Numbers are Relatively Meaningless
- Relationship or **% Difference** IS Important !!!
- **Tied to MERV Rating on AHU Filters (MERV 16 = 95%)**



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MONITORING – PARTICLE COUNTERS

- Used to Assess Baseline Conditions
  - Baseline Conditions Acceptable (Within 10% of MERV Expectation)
  - Baseline Questionable (Within 30% of MERV Expectation)
  - Baseline Conditions Warrant Immediate Action (> 30% Variance in Expectation)
- If Baseline Relationships Maintained = No Extra Dust
- Construction Breakdowns Are UNMISTAKABLE (100-1000% Swings)

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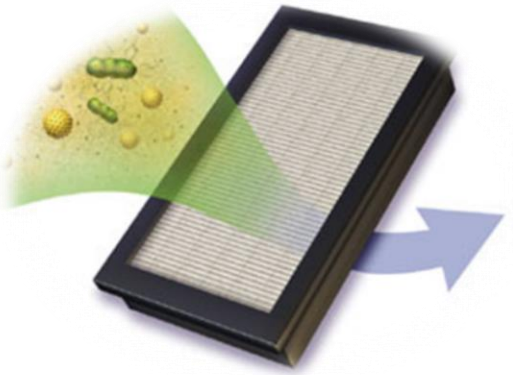
HEPA FILTERED AIR SCRUBBERS

- Pre-Filters
- HEPA Filter = 99.97% @ 0.3 µm
- Flowrates 100 – 5,000 cfm (ft^3/min)
- Fan Speeds – High/Low or Variable
- Fan / Filter Positioning



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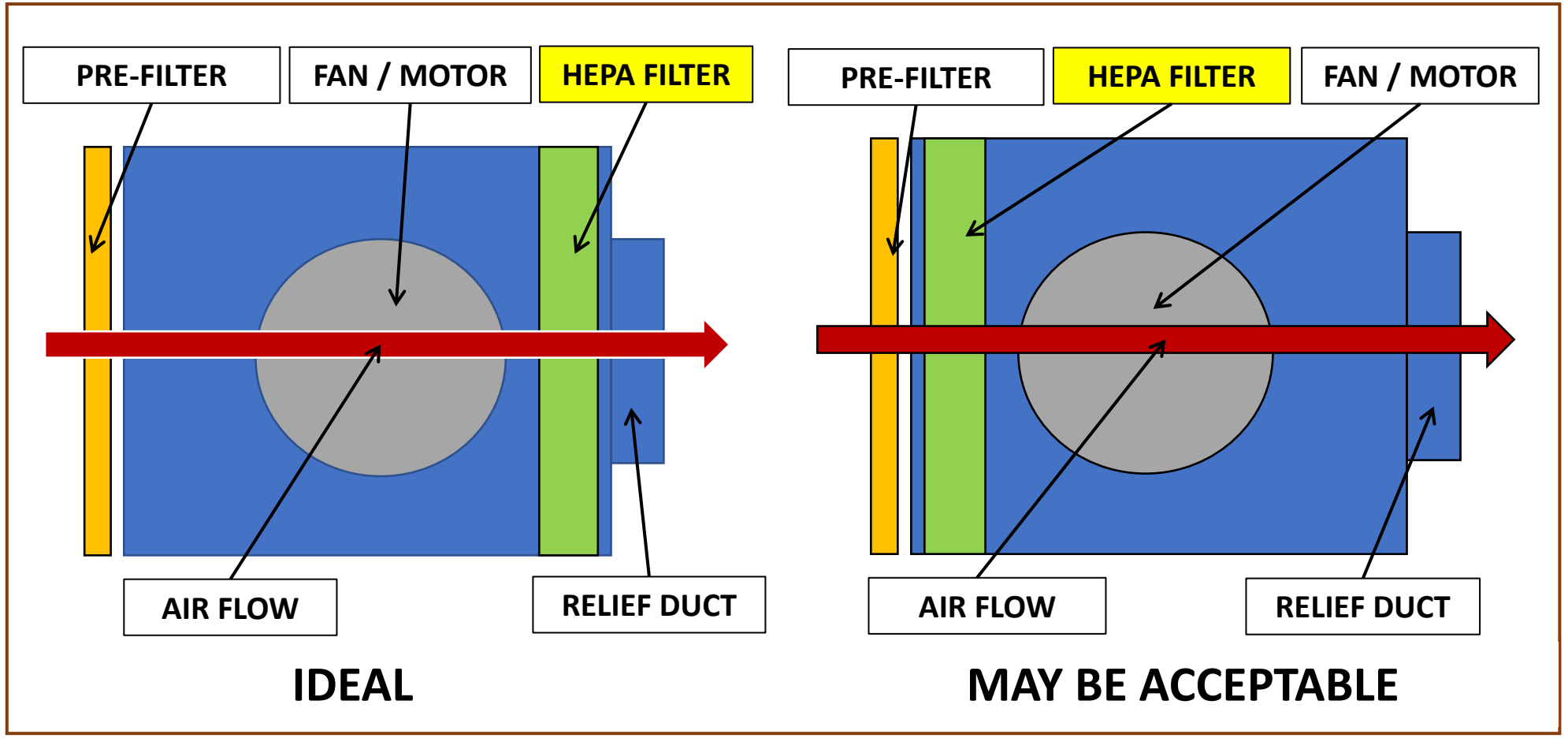
HEPA FILTERED AIR SCRUBBERS



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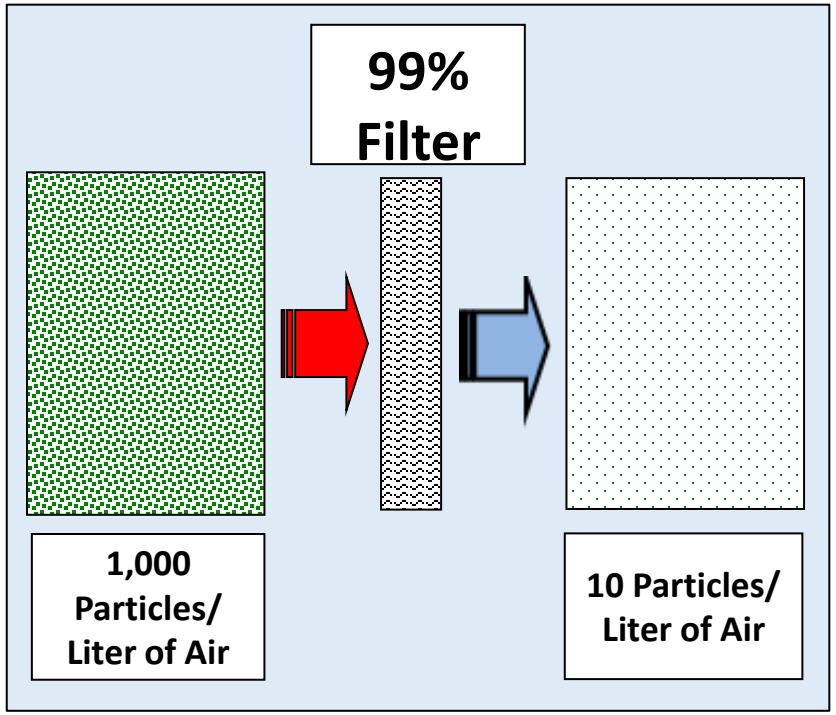
EXERCISE: HEPA TESTING

- How Much Dust Entering System?
- How Much Dust Leaving System?
- Can We Demonstrate >99% Removal?
- This is EXTREMELY Important if Exhausting into Hospital Spaces



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HEPA FILTERED AIR SCRUBBERS

- Recirculating
  - Reduces Dust / Contaminants inside Construction
  - No pressure difference
- Ducting for Negative Pressure
  - To the Outside! – The Safest Strategy!
  - Through A Construction Barrier, Option 2
  - Routed through Ceiling for Top/Down Exhaust
  - NOT INTO RETURN GRILLS OR ABOVE CEILING PLENUMS

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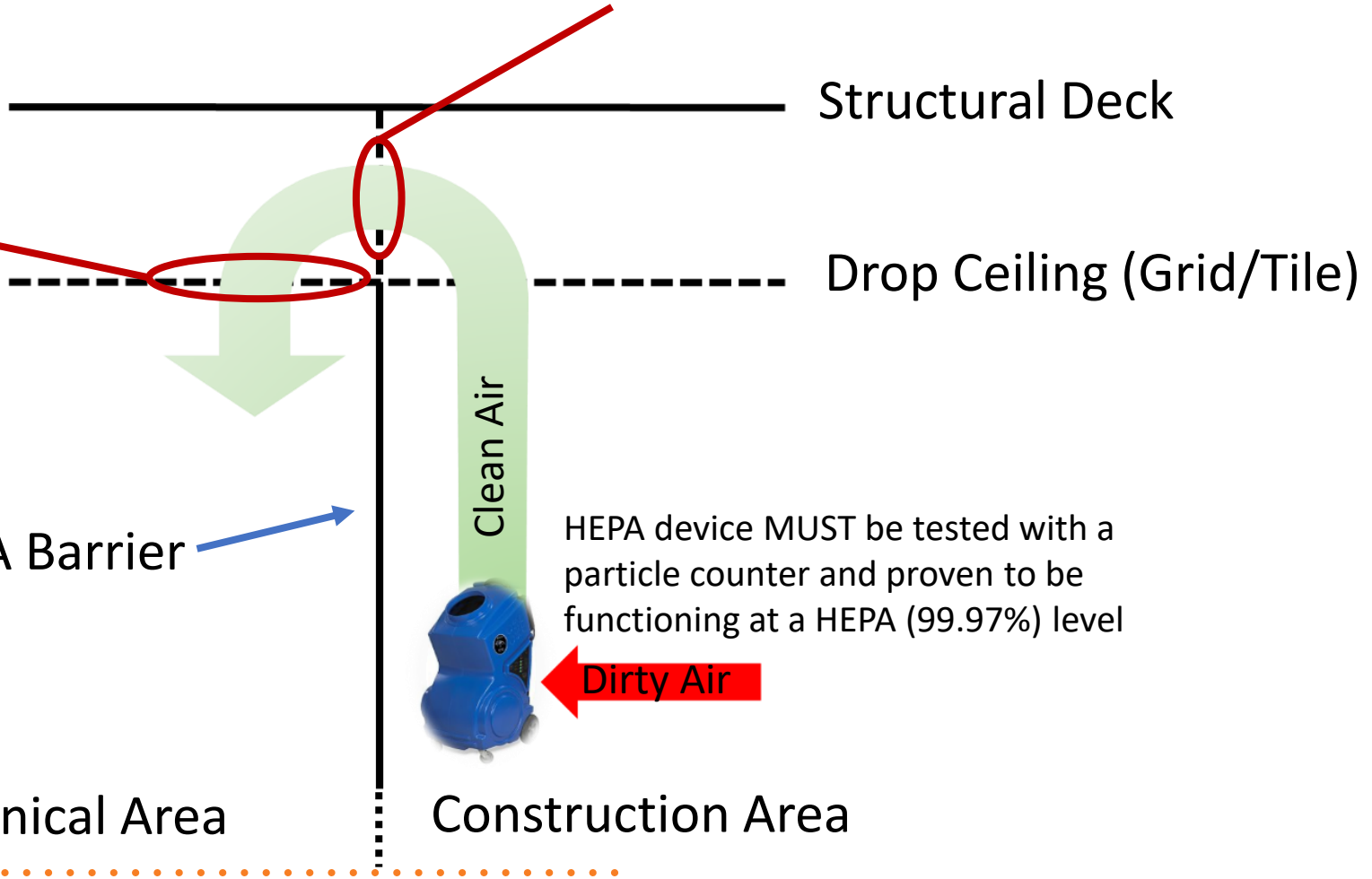
EXHAUSTING INTO OCCUPIED SPACE

Maximum 1,200 cfm exhaust per grill, more than one exhaust point may be prudent



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Anterooms

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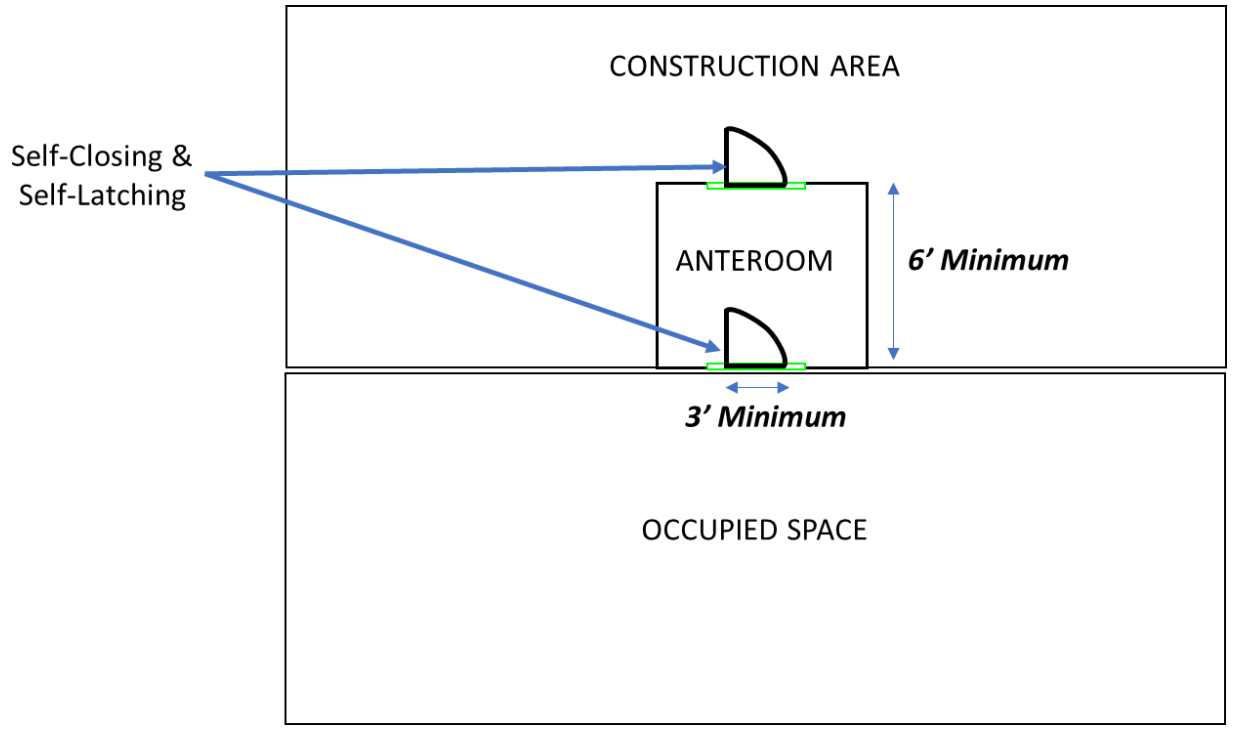
ANTEROOMS

- Between Occupied and Construction
- Function as Air-Lock
- Double Doors (Both Self-Latching)
- High Risk Projects (Level V ICRA)
- Ceiling Intact
- Airflow Clean -> Dirty
- **Adequately Sized (> 6’)**



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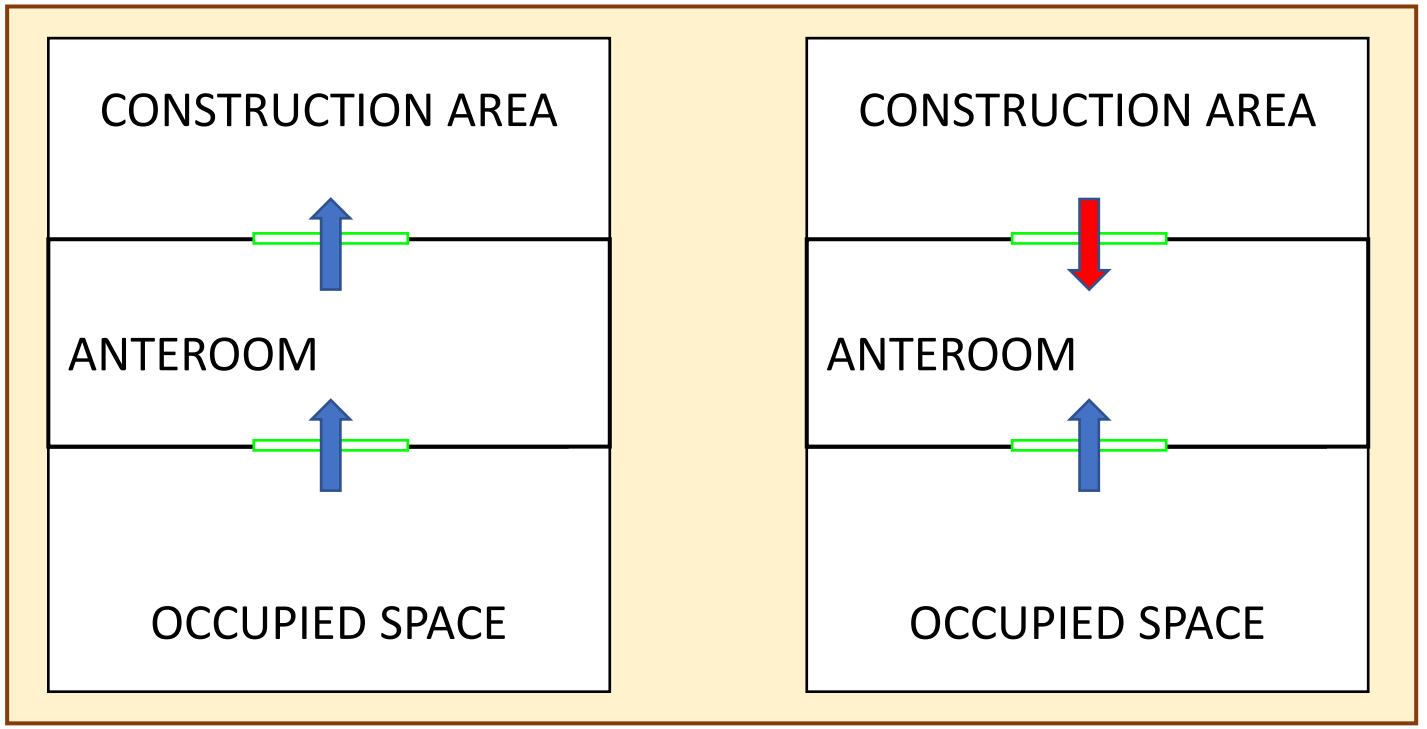
ANTEROOMS - AIRFLOW



YES **NO**

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ANTEROOMS

An Anteroom Less than

6’ Deep

IS NOT AN ANTEROOM!

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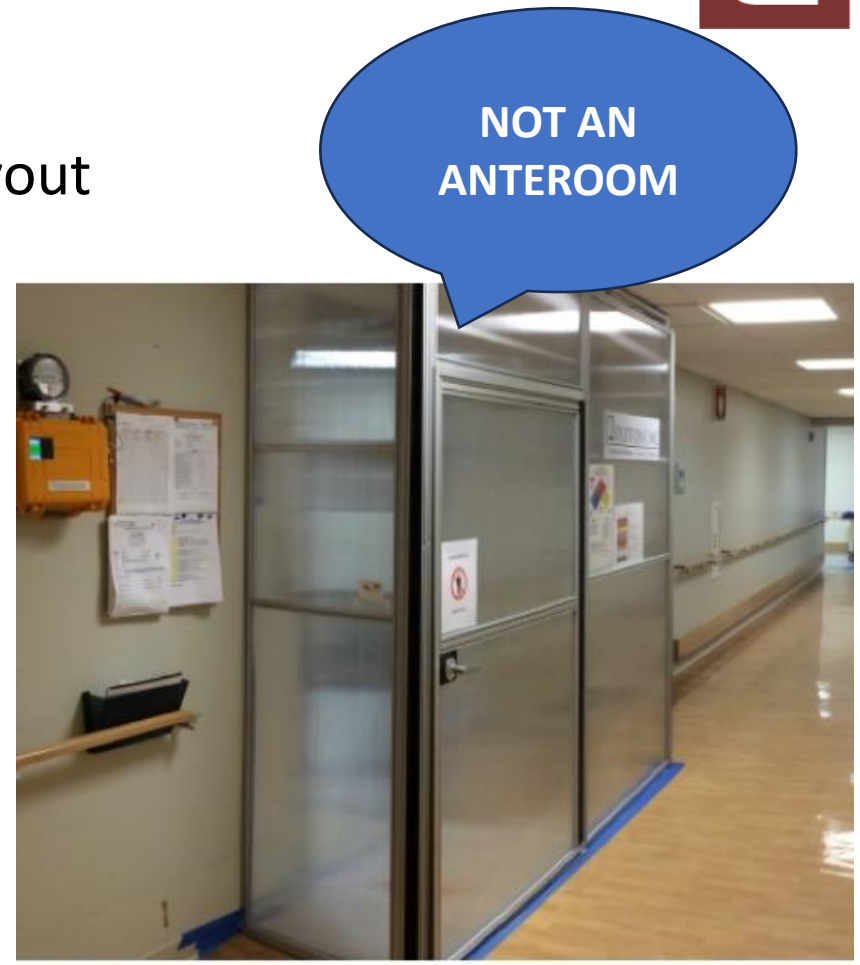
ANTEROOMS

- Anterooms Must Be Considered During Project Phase Layout
- May Only Be Feasible During Demo
- May Need to be Relocated as Work Progresses
- Extremely Challenging in Small Footprint of Work
- Plastic Sheeting Not Appropriate Given the Risk Level



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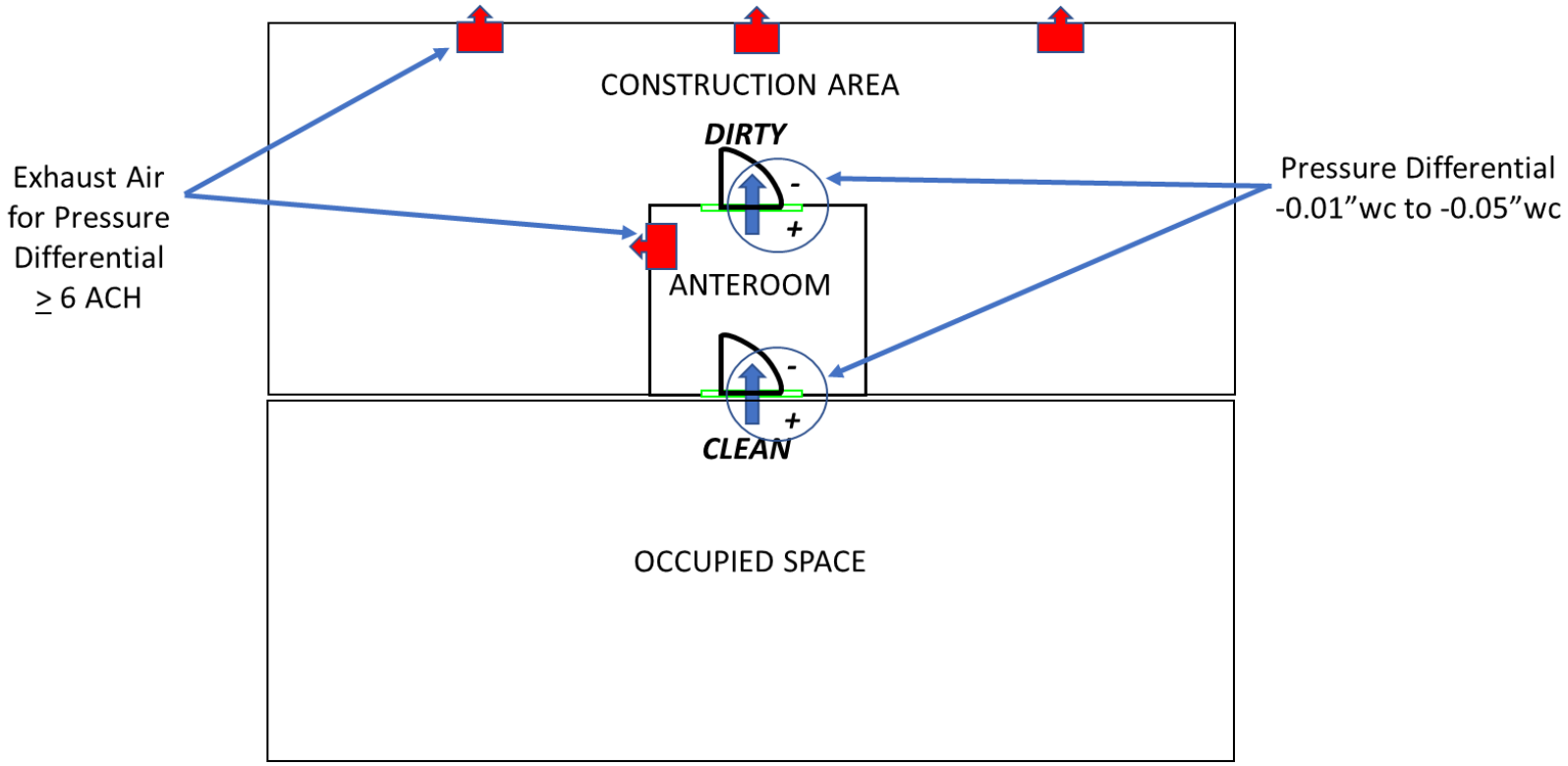
ANTEROOMS - PRESSURE

- Manometer: Occupied vs Construction MOST Important
- Occupied vs Anteroom FAR LESS Important
- Beware False Sense of Security
- Purpose of 2 Distinct Devices



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ANTEROOMS – ADDED COMPONENTS

- **Floor Mats To Minimize Shoe Tracking**

The preferred configuration is disinfectant dampened walk-off mat > dry walk-off mat > sticky mat > door to occupied. Sticky mats are not recommended on the occupied side of a barrier as they hold visible dust on the "clean" side and may be a trip hazard to occupants.

- **HEPA Vacuum For Cleaning Workers**

True HEPA vacuums of sufficient quantity with respect to the number of simultaneous workers needing to utilize said vacuums.

- **PPE Supplies**

Bunny suits, shoe covers, hair/beard covers may be required by the local ICRA.

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ANTEROOMS – ADDED COMPONENTS

- **Clean Polyethylene Sheeting**

Covering of tool carts or equipment may be required by the local ICRA.

- **Hospital Grade Disinfectant**

Used for cleaning the outside of trash buggies other appropriate surfaces

- **Microfiber Cloths**

Cotton cloths are inappropriate for this application

- **Full Length Mirror**

Workers can see if there is dust on their fronts or backs that needs to be removed

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Water Events

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FUNCTIONAL THINGS TO KNOW ABOUT MOLD

- Purpose – Breaks Down Organics
- Viable > 10 Years
- NO MOLD EXPOSURE LIMITS!
- Mold Spores are Everywhere
- What Kind of Mold is that? … Who Cares!
- **Control the Moisture = Control the Mold**

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SOURCES OF WATER

- Water Intrusion
- Utility / Equipment Leaks
- Humidity > 60% at Room Temp
- Condensation

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CONDENSATION

- Surface's temperature ≤ dew point temperature
- Dew point always < the ambient temperature (Same = Rain)
- Therefore condensation occurs on the "colder" surfaces
- Higher temperatures can hold more moisture

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MOISTURE AND BUILDING MATERIALS

- Absorbent Materials – Dry or Replace?
- Non-Absorbent Materials – Disinfect or Discard?
- 48-72 Hour Drying Window (< 19%)
- “Clean” Water

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Questions to Ask and Rounding Insight

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Questions Before Construction

- Where and What?
- How much demo?
- How will containment be achieved both below and above ceiling grid?
- Has HVAC isolation been coordinated with Facilities Management?
- Who will verify that HVAC Isolation and Negative Pressure do not undermine air balance and requisite pressures?

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Questions Before Construction

- How will negative pressure be monitored?
- What is the plan to keep new ductwork and air handling equipment clean?
- What is the plan for keeping the floor clean?
- Tell me about your filter management?

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Focus Items During Rounding

- Can you confirm negative pressure (hand/tissue test/etc)?
- Does the manometer represent reality?
- Dust tracking at entrance? Floor Dirty?
- Containment condition?
  - Door self-closing and latching?
  - Edges of containment well sealed?
  - No ceiling tiles dislodged?
  - Containment above grid intact?

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Focus Items During Rounding

- Anteroom (if present)
  - Cleanliness?
  - Serving as an airlock?
  - Ceiling Intact?
  - Pressure being monitored correctly?
  - Clean towards dirty airflow?
- Supply and Return Isolated? – NO FILTERS!
- Debris transport effectively controlled?

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ICRA 2.0 Changes and Impacts

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ICRA 2.0 - CLASS I MITIGATION ACTIVITIES

1. Perform noninvasive work activity as to not block or interrupt patient care.

2. Perform noninvasive work activities in areas that are not directly occupied with patients.

3. Perform noninvasive work activity in a manner that does not create dust.

4. Immediately replace any displaced ceiling tile before leaving the area and/or at end of noninvasive work activity.

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ICRA 2.0 - CLASS II MITIGATION ACTIVITIES

1. Perform only limited dust work and/or activities designed for basic facilities and engineering work.

2. Perform limited dust and invasive work following standing precautions procedures approved by the organization.

3. This Class of Precautions must never be used for construction or renovation activities

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ICRA 2.0 - CLASS III MITIGATION ACTIVITIES

1. Provide active means to prevent airborne dust dispersion into the occupied areas.

2. Means for controlling minimal dust dispersion may include hand-held HEPA vacuum devices, polyethylene plastic containment, or isolation of work area by closing room door.

3. **Remove or isolate** return air diffusers to avoid dust from entering the HVAC system.

4. **Remove or isolate** the supply air diffusers to avoid positive pressurization of the space.

5. If work area is contained, then it must be **neutrally to negatively** pressurized at all times.

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ICRA 2.0 - CLASS III MITIGATION ACTIVITIES

6. Seal all doors with tape that will not leave residue.

7. Contain all trash and debris in the work area.

8. Nonporous/smooth and cleanable containers (**with a hard lid**) must be used to transport trash and debris from the construction areas. These containers must be **damp-wiped cleaned** and free of visible dust/debris before leaving the contained work area.

9. Install a sticky (dust collection) mat at entrance of contained work area based on facility policy. Sticky mats must be changed routinely and when visibly soiled.

10. Maintain clean surroundings when area is not contained by **damp mopping or HEPA vacuuming** surfaces.

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ICRA 2.0 - CLASS IV MITIGATION ACTIVITIES

1. Construct and complete critical barriers meeting **NFPA 241** requirements. Barriers must extend to the ceiling or if ceiling tile is removed, to the deck above.

2. All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release. Plastic barriers must be effectively affixed to ground and ceiling and secure from movement or damage. Apply tape that will not leave a residue to seal gaps between barriers, ceiling or floor.

3. Seal all penetrations in containment barriers, including floors and ceiling, using approved materials (UL schedule firestop if applicable for barrier type).

4. **Containment units or environmental containment units (ECUs)** approved for Class IV precautions in small areas totally contained by the unit and that has **HEPA-filtered exhaust air**.

5. Remove or isolate return air diffusers to avoid dust entering the HVAC system.

6. Remove or isolate the supply air diffusers to avoid positive pressurization of the space.

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ICRA 2.0 - CLASS IV MITIGATION ACTIVITIES

7. Negative airflow pattern must be maintained from the entry point to the anteroom and into the construction area. The airflow must cascade from outside to inside the construction area. **The entire construction area must remain negatively pressurized**.

8. Maintain negative pressurization of the entire workspace by use of HEPA exhaust air systems directed outdoors. Exhaust discharged directly to the outdoors that is **25 feet or greater** from entrances, air intakes and windows **does not require HEPA-filtered air**.

9. If exhaust is **directed indoors**, then the system must be HEPA filtered. Prior to start of work, **HEPA filtration must be verified** by particulate measurement as no less than 99.97% efficiency and must not alter or change airflow/pressure relationships in other areas.

10. Exhaust into **shared or recirculating HVAC systems**, or other shared exhaust systems (e.g., bathroom exhaust) is **not acceptable**.

11. Install device (e.g., magnehelic, manometer, or digital monitoring) on exterior of work containment to continually monitor negative pressurization. The “ball in the wall” or similar apparatus are not acceptable.

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ICRA 2.0 - CLASS IV MITIGATION ACTIVITIES

12. Contain all trash and debris in the work area.

13. Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area.

14. Worker clothing must be clean and free of visible dust before leaving the work area. HEPA vacuuming of clothing or use of cover suites is acceptable.

15. **Workers must wear shoe covers prior to entry into the work area. Shoe covers must be changed prior to exiting the anteroom to the occupied space (non-work area). Damaged shoe covers must be immediately changed.**

16. Install a sticky (dust collection) mat at entrance of contained work area based on facility policy. Sticky mats must be changed routinely and when visibly soiled.

17. **Consider collection of particulate data during work** to monitor and ensure that contaminates do not enter the occupied spaces. Routine collection of particulate samples may be used to verify HEPA filtration efficiencies.

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ICRA 2.0 - CLASS V MITIGATION ACTIVITIES

1. Construct and complete critical barriers meeting NFPA 241 requirements. Barriers must extend to the ceiling or if ceiling tile is removed, to the deck above.

2. All (plastic or hard) barrier construction activities must be completed in a manner that prevents dust release. Plastic barriers must be effectively affixed to ground and ceiling and secure from movement or damage. Apply tape that will not leave a residue to seal gaps between barriers, ceiling or floor.

3. Seal all penetrations in containment barriers, anteroom barriers, including floors and ceiling using approved materials (UL schedule firestop if applicable for barrier type).

4. Construct anteroom large enough for equipment staging, cart cleaning, workers. The anteroom must be constructed adjacent to entrance of construction work area.

5. Personnel will be required to wear coveralls at all times during Class V work activities. Coveralls must be removed before leaving the anteroom.

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ICRA 2.0 - CLASS V MITIGATION ACTIVITIES

6. Remove or isolate return air diffusers to avoid dust entering the HVAC system.

7. Remove or isolate the supply air diffusers to avoid positive pressurization of the space.

8. Negative airflow pattern must be maintained from the entry point to the anteroom and into the construction area. The airflow must cascade from outside to inside the construction area. The entire construction area must remain negatively pressurized.

9. Maintain negative pressurization of the entire workspace using HEPA exhaust air systems directed outdoors. Exhaust discharged directly to the outdoors that is 25 feet or greater from entrances, air intakes and windows does not require HEPA-filtered air.

10. If exhaust is directed indoors, then the system must be HEPA filtered. Prior to start of work, HEPA filtration must be verified by particulate measurement as no less than 99.97% efficiency and must not alter or change airflow/pressure relationships in other areas.

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ICRA 2.0 - CLASS V MITIGATION ACTIVITIES

11. Exhaust into shared or recirculating HVAC systems, or other shared exhaust systems (bathroom exhaust) is not acceptable.

12. Install device (e.g., magnehelic, manometer, or digital monitoring) on exterior of work containment to continually monitor negative pressurization. The “ball in the wall” or similar apparatus are not acceptable.

13. Contain all trash and debris in the work area.

14. Nonporous/smooth and cleanable containers (with a hard lid) must be used to transport trash and debris from the construction areas. These containers must be damp-wiped cleaned and free of visible dust/debris before leaving the contained work area.

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ICRA 2.0 - CLASS V MITIGATION ACTIVITIES

15. Worker clothing must be clean and free of visible dust before leaving the work area anteroom.

16. Workers must wear shoe covers prior to entry into the work area. Shoe covers must be changed prior to exiting the anteroom to the occupied space (non-work area). Damaged shoe covers must be immediately changed.

17. Install a sticky (dust collection) mat at entrance of contained work area based on facility policy. Sticky mats must be changed routinely and when visibly soiled.

18. Consider collection of particulate data during work to monitor and ensure that contaminates do not enter the occupied spaces. Routine collection of particulate samples may be used to verify HEPA filtration efficiencies.

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ICRA 2.0 – PRECAUTIONS FOLLOWING WORK COMPLETION

CLASS I, II & III

Cleaning:

1. Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials.
2. Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces.

HVAC Systems:

1. Remove isolation of HVAC system in areas where work is being performed. Verify that HVAC systems are clean and operational.

2. Verify the HVAC systems meet original airflow and air exchange design specifications.

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ICRA 2.0 – PRECAUTIONS FOLLOWING WORK COMPLETION (III, IV, V)

Class III (Type C Activities only), IV, and V precautions require inspection and documentation for downgraded ICRA precautions.

Construction areas **must be inspected by an infection preventionist or designee** and engineering representative for discontinuation or downgrading of ICRA precautions.

Work Area Cleaning:

1. Clean work areas including all environmental surfaces, high horizontal surfaces and flooring materials.

2. Check all supply and return air registers for dust accumulation on upper surfaces as well as air diffuser surfaces.

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ICRA 2.0 – PRECAUTIONS FOLLOWING WORK COMPLETION (III, IV, V)

Removal of Critical Barriers:

1. Critical barriers must remain in place during all work involving drywall removal, creation of dust and activities beyond simple touch-up work. The barrier may NOT be removed until a work area cleaning has been performed.

2. All (plastic or hard) barrier removal activities must be completed in a manner that prevents dust release. Use the following precautions when removing hard barriers:

    i. Carefully remove screws and painter tape.

    ii. If dust will be generated during screw removal, use hand-held HEPA vacuum.

    iii. Drywall cutting is prohibited during removal process.

    iv. Clean all stud tracks with HEPA vacuum before removing outer hard barrier.

    v. Use a plastic barrier to enclose area if dust could be generated.

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ICRA 2.0 – PRECAUTIONS FOLLOWING WORK COMPLETION (III, IV, V)

Negative Air Requirements:

1. The use of negative air must be designed to remove contaminates from the work area.

2. Negative air devices must remain operational at all times and in place for a period after completion of dust creating activities to remove contaminants from the work area and before removal of critical barriers.

HVAC systems:

1. Upon removal of critical barriers, remove isolation of HVAC system in areas where work is being performed.

2. Verify that HVAC systems are clean and operational.

3. Verify the HVAC systems meets original airflow and air exchange design specifications.

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Infection Prevention and Construction

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