



An Energy Efficiency Workshop & Exposition

Palm Springs, California

Protecting Air Quality in the Workplace



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<http://www.flenergy.com>

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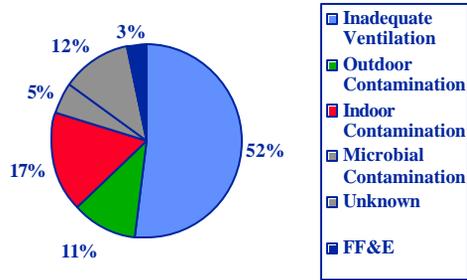
Indoor Air Quality

("Environmental" or "Air" Quality issues?)

- Environmental Quality
 - Air Quality
 - Lighting
 - frequency
 - glare etc
 - Noise
 - Workplace conditions
 - Workplace Layout
 - Interior Design
 - Other
- Air Quality Issues
 - Temperature
 - Humidity
 - Contaminants, odors, pollutants etc.
 - Visible deposits
 - Mold mildew
 - Air movement



Causes of IAQ Problems NIOSH Study



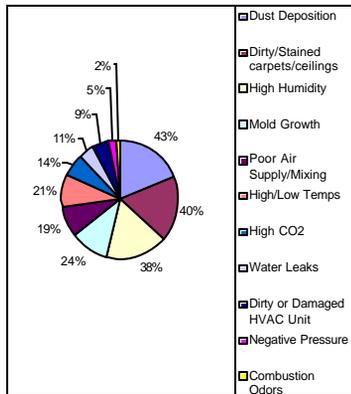
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Findings in Buildings with Reported "IAQ" Problems



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Major Contributors to IAQ Problems

- **Building envelope & maintenance**
 - > air leaks (uncontrolled entry of outdoor air)
 - > water or moisture intrusion
 - > Housekeeping & HVAC maintenance procedures
- **Contamination**
 - > indoor or outdoor sources
 - > build up of contamination
- **HVAC System**
 - > air distribution
 - > humidity control
 - > filtration
 - > insufficient ventilation (air turnover)

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Findings in Buildings with “IAQ” Problems

- Humidity extremes resulting in mold and mildew
- Poor Air Distribution
- Building envelope problems
- Indoor pollutants and/or off-gassing of materials
- Not enough, or poor quality of, fresh air
- Contamination from exterior sources
- Housekeeping and maintenance issues
- Incidents

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What should we do to address IAQ Problems?

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Focus on Humidity, Contaminants and Air Quality

- **Improve (Lower) humidity levels**
 - Address water leaks in, or into, building **immediately**
 - Prevent or reduce infiltration of humid air
 - Add Controls for humidity
 - Precondition (dehumidify) fresh air before it enters HVAC
- **Reduce contaminants**
 - Improve filtration and ventilation (ACH)
 - Improve housekeeping & maintenance
 - Monitor what's brought inside
- **Check air distribution and fresh air**
 - Sufficient air movement throughout space
 - Sufficient fresh air to meet ASHRAE 62 and pressurization

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Most Serious IAQ Problems are Moisture Related

- Air leaks in building envelope or ductwork results in the entry of moist unconditioned air
- Water intrusion and/or moisture migration through the building envelope
- Oversized AC system limits moisture removal
- Spores are everywhere in our environment

Humidity levels above 60%-70%
will result in microbial growth!

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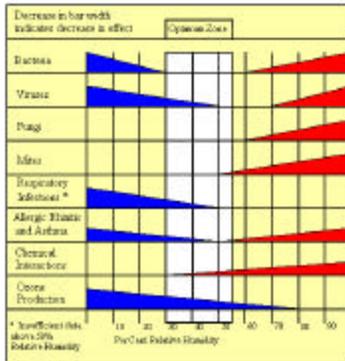
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***To Ensure Good IAQ
Relative Humidity Levels
Must be Maintained
within an Acceptable Range***

Optimum Range: 40%-60% RH



Optimum Relative Humidity Levels



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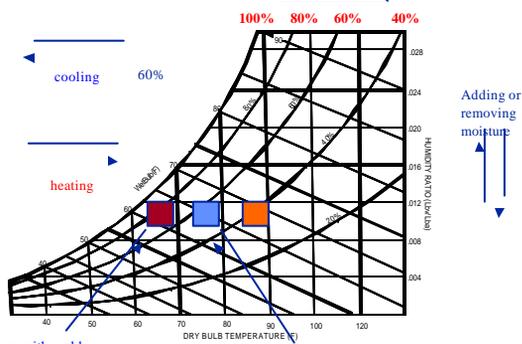
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Psychrometric Chart

Moisture Content of Air

temperature Vs. relative humidity



Your space with mold and poor IAQ

Temperature

Your space with good IAQ

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Address Humidity Levels

- Why do we have high Humidity in buildings?
 - air or water leaks into building
 - poorly performing HVAC system
 - no real control of humidity
 - Improper operation of HVAC system
 - Oversized unit
 - etc.
- How can address high humidity levels easily?
 - Eliminate water or air leaks or intrusion immediately
 - Add humidity control & reheat strategy
 - Reduce or eliminate the moisture load from the building

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Reduce Contaminants

- By cleaning and exchanging indoor air
 - Proper Filtration
 - Appropriate for the contaminants
 - Good Air Distribution
 - Adequate air movement throughout Work Area
 - Adequate turn-over of indoor-outdoor air (ACH)

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Proper Filtration

(filters come in all shapes all sizes)



Pleated Filter



If you can see through a filter -
it's not a filter



Roll Filter Media



Blue Pleat Filter Synthetic Pleated Filter



HEPA Filter
99.97% of 0.3u

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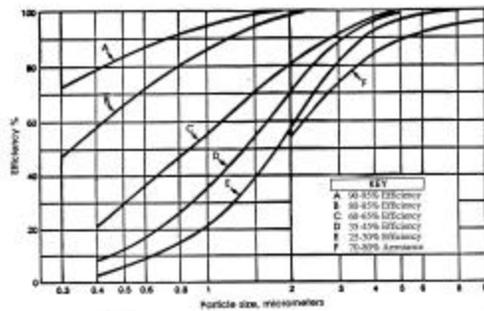
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Relative Performance

Efficiency vs. Particle Size



¹Notes:
1. Composite and averaged data distributed by manufacturers.
2. Efficiency and amenity per ASHRAE standard 55-90 test methods.
3. Canister. Canister not appropriate only for general public use. Values derived from data were previously by used to (SPU) air filter class A.

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Filter Efficiency Rating

(Minimum Efficiency Rating Value-MERV)

Minimum Efficiency Reporting Value (MERV)				
MERV	ASHRAE	P Dp	Contamnts	Application
1	<65%A	0.3	Poln Moss	Min Filtr
2	65-70%A	0.3	D Mites	W AC
3	70-75%A	0.3	T Fibers	Res
4	>75%A	0.3	Carpet fbr	Res
5	80-85%A	0.6	Pdr milk	Paint Booth
6	>90%A	0.6	Dust	Industrl
7	>90%A	0.6	H Spray	B Res
8	>90%A	0.6	M spores	Coml
9	40-45%DS	1	tumes	Coml
10	50-55%DS	1	coal dust	S Res
11	60-65%DS	1	flour	Btr Cml
12	70-75%DS	1	Legionella	Labs
13	80-90%DS	1.4	Copiers	Sup Cml
14	90-95%DS	1.4	smoke	Smokg A
15	>95%DS	1.4	sneezing	Surgery
16	N/A	1.4	bacteria	Hosptl

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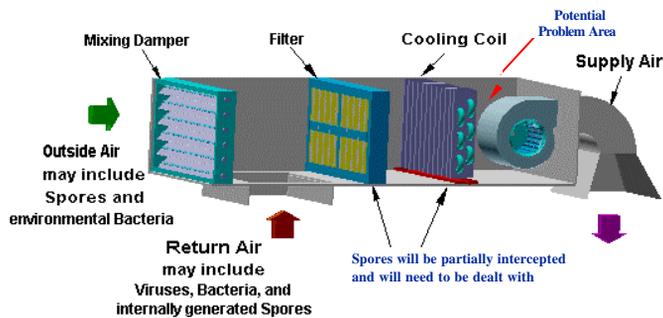
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HVAC Equipment

(potential source of contamination)



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HVAC System Contamination

Cooling Coil With Microbial Growth



Drain Pan With Microbial Growth



- Cooling coils and drain pans provide ideal growth conditions for microbes.
- Cooling Coil surfaces are coated with this “biofilm” that reduces heat exchange efficiency thus consuming more energy.

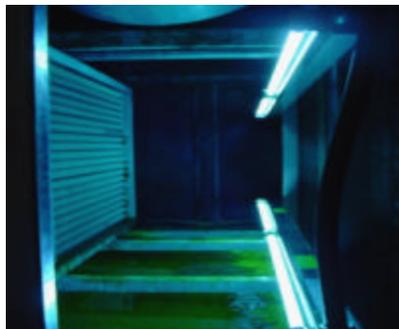
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UVGI Installation



Typical UV Light Installation In Air Discharge Plenum Cooling Coil located to work on both the cooling coil and the drain pan

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UV Recommendations

- Suitable for keeping problem drain pans, interior of AHU, and coils clean
- Can combine with filtration to increase effectiveness against biological contaminants

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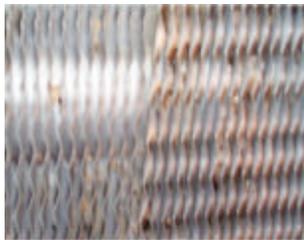
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UVGI Treatment

Before installation of UV



After UV Installation



Installation of UV resulted in the elimination of virtually all the organic matter embedded within a coil restoring the coil surface for increased heat exchange efficiency. The installation also eliminated growth in drain pan.

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Good Air Distribution

- Adequate air movement throughout the space
 - Air Flow in the Workspace (cfm/sf)
 - Distribution System (supply/return layout)
- Adequate turn-over of indoor-outdoor air (ACH)
 - Ventilation Rate-amount of fresh air (ASHRAE 62)
- Building pressurization

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Adequate Fresh Air

(without getting in a bind)

- Sufficient for Air Change Rate (ACH) & occupants
 - ASHRAE (Code) requirements
- Sufficient to offset air losses
 - Exhaust fans
 - leakage through doors, windows, cracks etc.
- Sufficient for appropriate pressurization
 - Climate specific
 - Positive in warm/humid climates
 - Neutral or slightly negative in cool climates
- Eliminate or reduce fresh air when not required
- Simply adding fresh air may be problematic

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Pre Treating Outdoor Air

- Preconditioning, dehumidifying and filtering, the Outdoor Air is a simple, energy efficient solution to the humidity and comfort problems faced by most building managers today.
- This approach essentially removes moisture in the outdoor air, and its associated impact on internal humidity levels, as an issue and promotes efficient operation of a buildings HVAC system

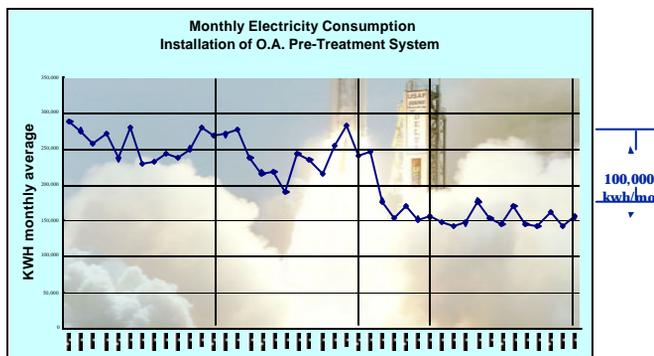
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Energy Savings from OA Pre-Treatment Installation



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Indoor Air Quality and Energy Conservation

Are Not Mutually Exclusive!
We Can Improve IAQ, Save Energy and
Protect the Building's Occupants



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Protection of Air Quality in the Workplace



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***Protecting
Workplace Air Quality
Today-Post 9/11***

Considering Bioterrorism
and other
Extraordinary Incidents



Bioterrorism

***Has raised the issue of
Air Quality in Buildings to a whole new level***

Building Security, Health & Safety Programs today
must include provisions for
***Protecting and reacting to threats
to the Indoor Air from
Biological & Chemical Terrorism & other
Extraordinary Incidents***



Bioterrorism

Use of biological agents including
bacteria, viruses and toxins
against the general population

- Anthrax
- Smallpox
- Plague
- Botulism
- Terramin
- Others



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Extraordinary Incidents That Impact IAQ

- Accidents
 - Toxic Clouds or Releases
 - Hazardous Spills
 - Sudden Explosions
- Forest Fires
- Air Pollution Alerts
- Natural Disasters

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Safety & Security of Building Air Quality

Must Protect Building Occupants from Airborne Biological, Chemical or Toxic Releases Outside or Inside a Building Caused by Terrorism, Accidents or Natural Disasters

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Protecting Building Occupants from Airborne Biological or Chemical Releases Outside or Inside a Building

- **Hazards include:**
 - Hazardous fumes
 - smoke from fires
 - chemicals from explosions or other incidents
 - Noxious chemicals
 - spills or releases
 - Biological aerosols or particles
 - incidents
 - intentional release

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Bioterrorism Incident

- No immediate impact or detection
- Hours of potential exposure
- Delay between exposure and illness
 - Anthrax symptoms takes days
 - smallpox takes longer-weeks
- Requires advanced and emergency planning
 - to increase security of a buildings air supply
 - to control and/or minimize impact of incident

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Personal Observations

(a matter of being in the wrong place at the wrong time)

- Suspicious package found
- Put in envelope to contain contents
- Called Emergency personnel
- Building Locked down until Responders on site
- Occupants rather edgy
- HVAC left running
- Two hours later Darth Vader appears in building
- Testing initiated -Field Test Negative (lab test within 24 hrs)
- Occupants allowed to leave & shower
- Not happy campers

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Personal Observations on Bioterrorism Training

- Responder Training Great
- Most Training focused on Response Actions & Procedures, Testing, Detection and Disinfection
- Little Effort in Awareness and Safety Training for Building Managers and Occupants
- Development of Building Air Quality Protective Systems progressing very slowly

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Anthrax Incidents Lessons Learned

- Airborne materials can easily spread
- Appropriate Cleanup Procedures should be used
- There is a lot of readily available strategies that can be used to limit exposure and/or impact
- Quick action by those on site can make a difference

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Anthrax Incidents

Explosive dispersal into Return or Outdoor air intake



Release

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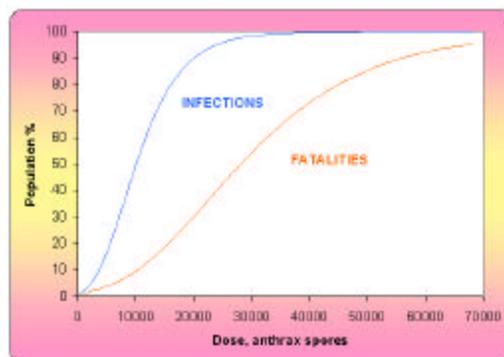
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Exposure

Infection Dose-10,000
Lethal Dose-28,000 (50%)



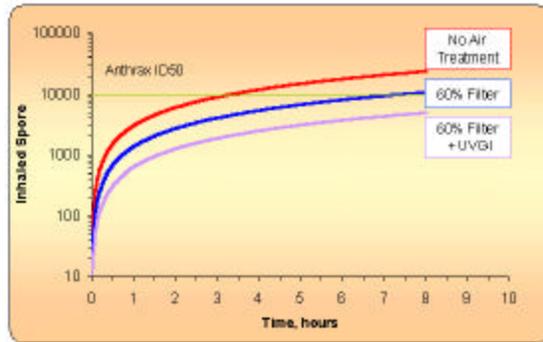
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Level to infect 50% of those Exposed



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Lethal dose for 50%-28,000 spores
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Airborne Hazards

(Biological, Chemical or Other Incidents)

- Biological & Chemical
 - Detectors not available that can rapidly detect the range of Chemical or Biological hazards possible
 - Biological agents imperceptible, difficult to detect
- Extraordinary Incidents
 - Sudden & unexpected
 - often perceptible at occurrence
- Protection needs to be in place
 - Standard approaches
 - filtering air into a building
 - emergency air distribution controls
 -other

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Reduce the Terror with Planning

- Develop a **BAQ Safety Program** with appropriate policies and procedures
- Train occupants and facility managers
 - proactive security measures
 - safety procedures
 - response actions
 - appropriate work & cleanup procedures
- Implement “engineering controls” to secure and protect building air quality
- Use PPE as required in critical areas

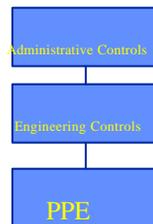
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BAQ Safety Program



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Safety Program Plan

- Identify potential hazards and air quality problems
- Asses buildings vulnerability to airborne threats
 - Internal releases
 - External releases
- Develop appropriate response actions and training
- Evaluate use of engineering controls to reduce threats
- Identify appropriate PPE as required

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Assessing BAQ Safety & Security

- Assess Vulnerabilities
 - Air intakes
 - Receiving areas
 - Entry areas
 - Hazardous material labs/storage
- Ventilation System
 - Supply & return & exhaust systems
 - Make up air quality/quantity
 - Filtration
 - Operational controls
- Review existing Safety Programs

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Occupant Training

- Awareness Training on IAQ
 - Understanding IAQ and the necessity to report potential problems
 - Avoid contributing to the problems with deodorizers, chemicals etc.
 - Reporting potential problems
 - Avoid blocking ventilation pathways
- Training related to Extreme Incidents

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Conduct a Vulnerability Assessment of the Building

- Hazard assessment
 - Sources of entry
 - Areas of potential contamination
- Ventilation system and building pressurization
 - air intakes
 - exhausts
 - relative pressurization
 - areas served by HVAC units
 - HVAC system controls
- Interior safe rooms

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Engineering Controls

- Elevate/Secure Outdoor Air Intakes
- Isolate Entry and Receiving Areas
- Control Dampers to seal buildings
- Outdoor Air Pretreatment System
- Operational Control of HVAC equipment
- Enhanced filtration
- HEPA exhaust systems
- Reconfigure HVAC in hazardous work areas
- Other as appropriate for the site

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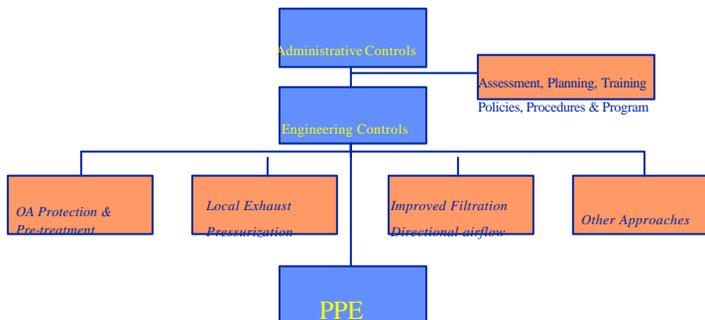
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BAQ Safety/Security Plan

pro-active BAQ



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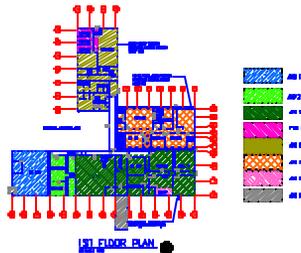
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Ventilation System

- What AHU serves the impacted area
- How can it be shut down
- Where is the closest exhaust system



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BAQ Protective Approaches

(Engineering Controls)

- Protection of fresh air intakes
- High efficiency filtration of “high risk” areas
- Building Pressurization
- Dedicated OA units
 - secure locations
 - with control dampers
- Directional airflow
 - Laboratory
 - Isolation/clean room approach

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OA Pre-Treatment System

(addresses IAQ while reducing energy)

- **Dedicated "OA" Pre-Treatment Unit**
 - 100% OA Unit(s) to provide all fresh air to a building
 - OA system will be designed to filter & dehumidify all air entering a building air and maintaining pressurization in the building to eliminate the entry of untreated outdoor air
- **OA and Exhaust Control Dampers**
 - Controllable Dampers to eliminate OA and Exhaust leaks and seal the building during unoccupied periods or in the event of threats from outside the building
 - **DDC Controls to provide**
 - for Safety and health hazard mitigation
 - operational and humidity control of building
 - centralized control of entire HVAC System
 - optimum efficiency of HVAC System

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Bioterrorism in Buildings Readily Addressed

- **Release of biological or chemical hazards in (or into) buildings**
 - Engineers and HVAC designers routinely deal with toxic materials in industrial, laboratory or medical facilities
 - Particle size in the range 1 to 5 microns
 - Filtration, containment, air flow control and pressurization are key.
 - Asbestos abatement, Laboratory Safety, IAQ and Biohazardous material handling and related programs and procedures are proven and readily available.

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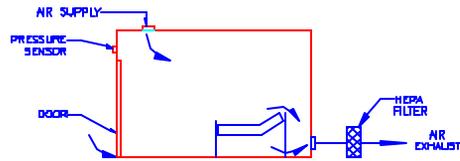
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Typical Isolation Room

(Directional airflow)



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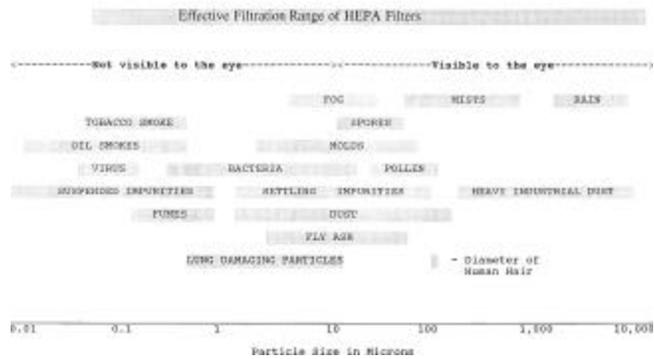
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HEPA Filtration

RELATIVE SIZE OF COMMON AIR CONTAMINANTS



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Mailroom Sorting Area Upgrade

- Isolation Room approach (negative with respect to surrounding area)
- Directional airflow (lab or cleanroom approach)
 - from above
 - over breathing zone
 - then work area
 - low exhaust (could be filtered)
- PPE readily available

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Cleanup

- Procedures appropriate for the contaminant
- Decontaminate using ACM approach (Negative Pressure Machines), Disinfectants, PPE as reqd.
- Vacuum cleaners equipped with High Efficiency Particulate Air (HEPA) filters should be standard

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Incorporating BAQ Protection into New Construction

- Outdoor Air
 - > Intakes above ground (first floor) level
 - > Pre conditioning unit with controls & dampers
 - > Security & monitoring
- HVAC
 - > upgraded filtration, UV, pressurization, zone strategy
 - > Emergency Shutoff
 - > Zone Isolation for High Risk Areas
 - Entry Areas
 - Receiving Areas
 - Mail Rooms
- Physical Location of High Risk Areas Perimeter of building

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*Building Air Quality can protect
against Bioterrorism and Extreme
Incidents (to some extent)
using readily available solutions to
IAQ*

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*I think the Time come to address IAQ
Problems and Protect Air Quality in the
Workplace!*

What do you think?

Thanks for listening

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