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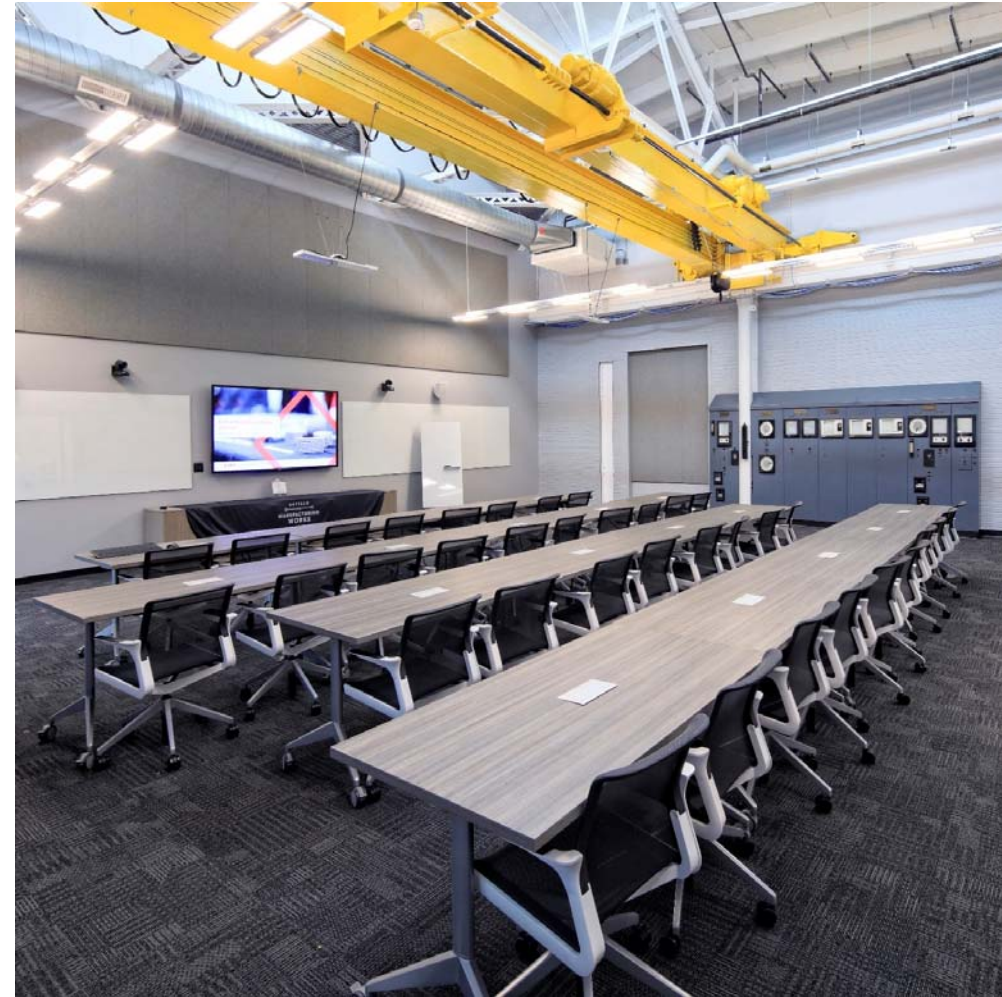
HVAC Systems and Employee Health

Presented by:
Jason Mock, P.E.



AGENDA

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- 03 HVAC Overview
- 04 Typical Machinery and Equipment
- 05 Ventilation
- 06 Filtration
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 - What are MERV ratings.
- 07 Ventilation and Filtration Methodologies to Mitigate SARS CoV-2.
 - System and building effects and considerations
- 08 Other Points to Consider
- 09 Q&A



INTRODUCTION



Jason Mock, P.E.
Associate/Mechanical Project Manager

- Graduate of SUNY at Buffalo
- 17 years experience
- 15 year member of the American Society of Heating, Refrigeration, and Air conditioning Engineers (ASHRAE)
- American Council of Engineering Companies New York Leadership Institute. (ACEC)

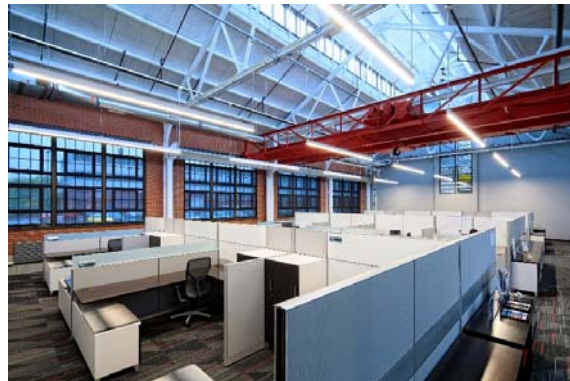


FIRM OVERVIEW

- Full service architecture, engineering, & environmental MBE firm
- Celebrating over 30 years in business
- Over 100 employees
- Diverse staff (15% minority, 27% women)
- Offices in Buffalo, Syracuse, & New York City



PROJECTS



NORTHLAND CENTRAL, Buffalo, NY



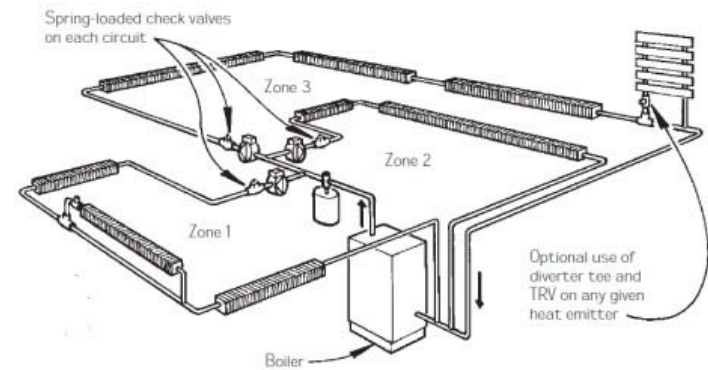
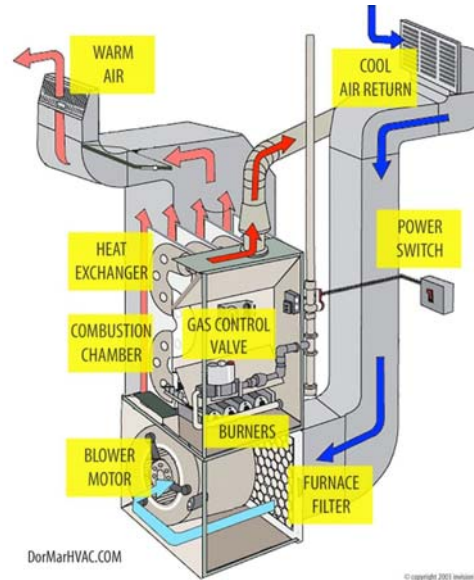
PROJECT HIGHLIGHTS

- 235,000 SF Former Factory
- Various Office Spaces
- Project Planning to Construction Administration Phases

What is HVAC?

HEATING, VENTILATION, and AIR CONDITIONING

- Heating and cooling of spaces via heat transfer through a fluid medium.
 - Hot/Chilled water (Hydronic)
 - Steam (Heating and cooling)
 - Electric Heat
 - Refrigerant
 - Tempered air



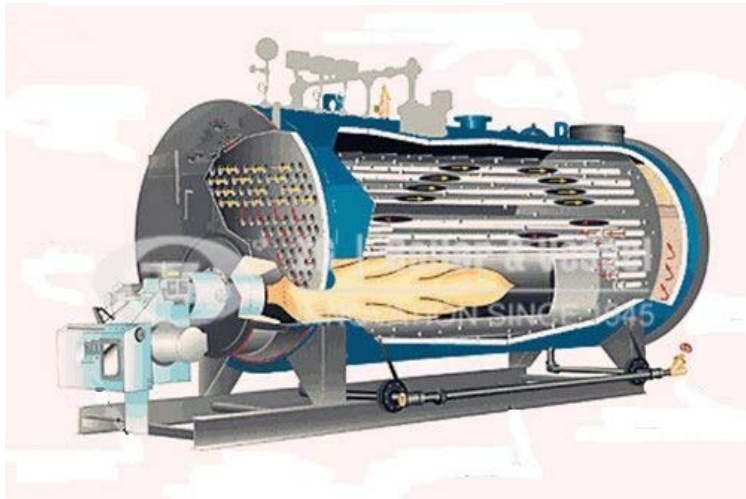
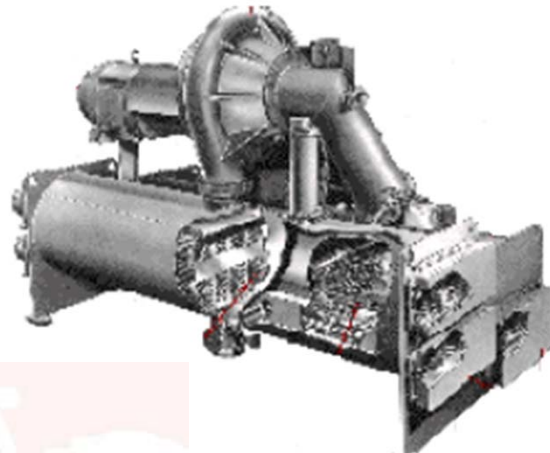
TYPICAL HVAC EQUIPMENT (AIR SIDE)



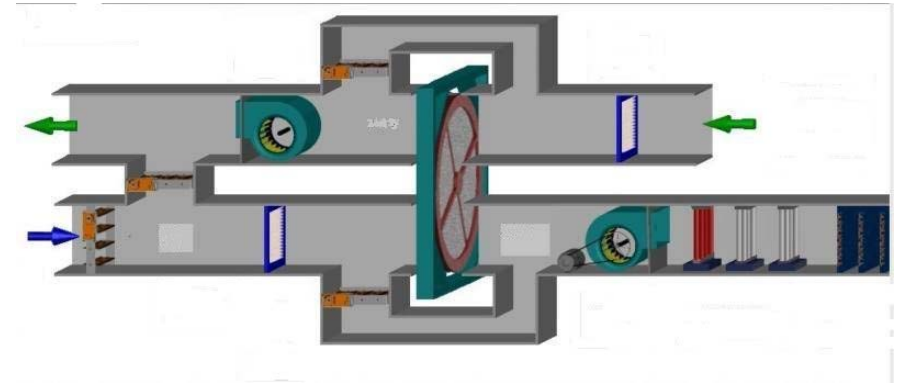
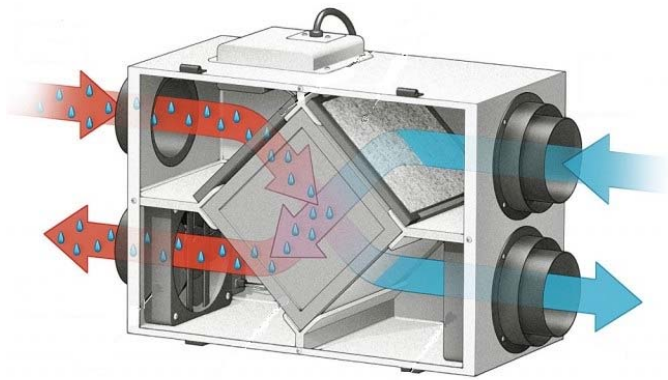
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TYPICAL HVAC EQUIPMENT (HYDRONIC)



TYPICAL HVAC EQUIPMENT (VENTILATION)



Ventilation and Code Requirements

What is Ventilation really, and why is it important?

1. Mechanical Ventilation.

Employs the use of fans or blowers to force the movement of air to and from the ventilated spaces. These systems can be dedicated to ventilation or can be part of a heating, cooling and air-conditioning system that serves the space to be ventilated.

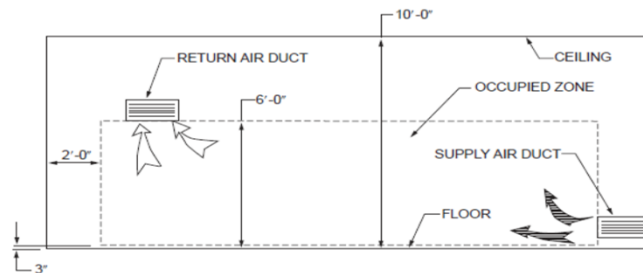
2. Natural Ventilation

Natural ventilation is the air movement through windows, doors and other gravity openings



Ventilation and Code Requirements

- Determine ventilation requirements and subsequent additional heating, cooling, and dehumidification loads utilizing the Mechanical Code and/or ASHRAE standard 62.1.
- Based on space type, space population, and calculations to determine breathing zones.



For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

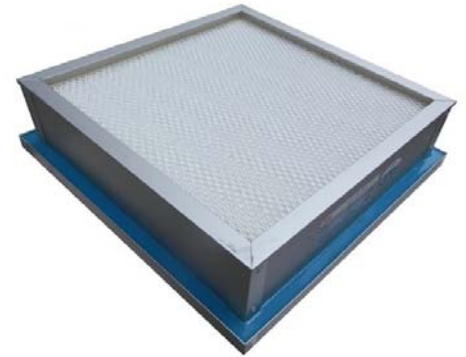
Figure 403.3.1.1
OCCUPIED ZONE

TABLE 403.3.1.1—continued
MINIMUM VENTILATION RATES

OCCUPANCY CLASSIFICATION	OCCUPANT DENSITY #/1000 FT ² ^a	PEOPLE OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _p , CFM/PERSON	AREA OUTDOOR AIRFLOW RATE IN BREATHING ZONE, R _a , CFM/FT ² ^a	EXHAUST AIRFLOW RATE CFM/FT ² ^a
Hotels, motels, resorts and dormitories				
Bathrooms/toilet—private ^b	—	—	—	25/50 ^d
Bedrooms/living room	10	5	0.06	—
Conference/meeting	50	5	0.06	—
Dormitory sleeping areas	20	5	0.06	—
Gambling casinos	120	7.5	0.18	—
Lobbies/prefunction	30	7.5	0.06	—
Multipurpose assembly	120	5	0.06	—
Offices				
Conference rooms	50	5	0.06	—
Main entry lobbies	10	5	0.06	—
Office spaces	5	5	0.06	—
Reception areas	30	5	0.06	—
Telephone/data entry	60	5	0.06	—
Private dwellings, single and multiple				
Garages, common for multiple units ^b	—	—	—	0.75
Kitchens ^b	—	—	—	25/100 ^d
Living areas ^c	Based upon number of bedrooms. First bedroom, 2; each additional bedroom, 1	0.35 ACH but not less than 15 cfm/person	—	—
Toilet rooms and bathrooms ^b	—	—	—	20/50 ^d
Public spaces				
Corridors	—	—	0.06	—
Courtrooms	70	5	0.06	—
Elevator car	—	—	—	1.0
Legislative chambers	50	5	0.06	—
Libraries	10	5	0.12	—
Museums (children's)	40	7.5	0.12	—
Museums/galleries	40	7.5	0.06	—
Places of religious worship	120	5	0.06	—
Shower room (per shower head) ^d	—	—	—	50/20 ^d
Smoking lounges ^b	70	60	—	—
Toilet rooms — public ^d	—	—	—	50/70 ^d
Retail stores, sales floors and showroom floors				
Dressing rooms	—	—	—	0.25
Mall common areas	40	7.5	0.06	—
Sales	15	7.5	0.12	—
Shipping and receiving	—	—	0.12	—
Smoking lounges ^b	70	60	—	—
Storage rooms	—	—	0.12	—
Warehouses (see storage)	—	—	—	—



FILTRATION



What are MERV Ratings?

- **Minimum Efficiency Reporting Values**
 - Scale designed by ASHRAE to report the effectiveness of air filters in 1987.
 - Ranges from MERV 1 to MERV 20.
 - Static pressure drop increases as the MERV rating increases.

MERV Rating	Air Filter will trap Air Particles size .3 to 1.0 microns	Air Filter will trap Air Particles size 1.0 to 3.0 microns	Air Filter will trap Air Particles size 3 to 10 microns	Filter Type ~ Removes These Particles
MERV 1	< 20%	< 20%	< 20%	Fiberglass & Aluminum Mesh ~ Pollen, Dust Mites, Spray Paint, Carpet Fibres
MERV 2	< 20%	< 20%	< 20%	
MERV 3	< 20%	< 20%	< 20%	
MERV 4	< 20%	< 20%	< 20%	
MERV 5	< 20%	< 20%	20% - 34%	Cheap Disposable Filters ~ Mold Spores, Cooking Dusts, Hair Spray, Furniture Polish
MERV 6	< 20%	< 20%	35% - 49%	
MERV 7	< 20%	< 20%	50% - 69%	
MERV 8	< 20%	< 20%	70% - 85%	Better Home Box Filters ~ Lead Dust, Flour, Auto Fumes, Welding Fumes
MERV 9	< 20%	Less than 50%	85% or Better	
MERV10	< 20%	50% to 64%	85% or Better	
MERV 11	< 20%	65% - 79%	85% or Better	Superior Commercial Filters ~ Bacteria, Smoke, Sneezes
MERV 12	< 20%	80% - 90%	90% or Better	
MERV 13	Less than 75%	90% or Better	90% or Better	
MERV 14	75% - 84%	90% or Better	90% or Better	HEPA & ULPA ~ Viruses, Carbon Dust, <.30 pm
MERV 15	85% - 94%	95% or Better	90% or Better	
MERV 16	95% or Better	95% or Better	90% or Better	
MERV 17	99.97%	99% or Better	99% or Better	
MERV 18	99.997%	99% or Better	99% or Better	
MERV 19	99.9997%	99% or Better	99% or Better	
MERV 20	99.99997%	99% or Better	99% or Better	

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VENTILATION, FILTRATION, AND OTHER METHODOLOGIES TO MITIGATE SARS CoV-2

- **Increase Ventilation**
 - Meet or exceed ventilation rates established by code and ASHRAE 62.1
 - Can effect existing HVAC equipment heating and cooling performance.
 - Will increase cooling discharge air and lower heating discharge air temperatures due to changes in mixed air temperatures entering the equipment.
 - Will increase the relative humidity in the space.
 - Amount of outdoor air is limited to the equipment capacity.

VENTILATION, FILTRATION, AND OTHER METHODOLOGIES TO MITIGATE SARS CoV-2

- **Control Flow Patterns**

- Moving air in a specific direction to disperse particles to help prevent inhalation of concentrated infectious particles
- Not always possible or practical in real world applications.
- Requires adjustable core supply diffusers.



VENTILATION, FILTRATION, AND OTHER METHODOLOGIES TO MITIGATE SARS CoV-2

- **Utilize Higher Efficiency Air Filters**

- Limited by existing HVAC equipment static pressure capacity and filter rack size.
- Possible decreased total airflow.
- Can cause long term damage to fans and drive motors.
- MERV-13 is a “Happy Medium” rating.
 - Large droplets larger than 5 microns do not stay suspended for long periods.
 - Droplet Nuclei are less than 5 microns and can stay suspended in air for longer periods.
 - 90% of 3-10 microns and 85% of 1-3 Micron particles



VENTILATION, FILTRATION, AND OTHER METHODOLOGIES TO MITIGATE SARS CoV-2

- **Increase Percentage of Relative Humidity (RH)**
 - Studies have shown that airborne and surface particle survival rates are decreased with an increase in ambient humidity levels.
 - Not always practical depending on existing HVAC equipment capabilities.
 - Tight building environment controls are required.
 - Mold growth and building envelope damage can occur if humidity is not controlled or is maintained at too high of a RH%.



VENTILATION, FILTRATION, AND OTHER METHODOLOGIES TO MITIGATE SARS CoV-2

- **Utilize Self Contained and Ionizing Air Purification Units**
 - Self Contained Air Purifiers are “plug and play” and over an alternative where centralized systems don’t allow for effective filtration.
 - Limited by total effective square foot capacity.
 - Ionizing Air Purification Units
 - Bi-Polar Ionization creates charged particles that attach to airborne particulate, causing them to be charged and clump together, allowing the particulate to be filtered out by less efficient filter ratings.



VENTILATION, FILTRATION, AND OTHER METHODOLOGIES TO MITIGATE SARS CoV-2

- **Ultraviolet Germicidal Irradiation.**
 - Utilizing short wave ultraviolet radiation to inactivate up to 90% of bacteria and viruses.
 - Technology is currently in use in medical facilities.
 - Does not add significant pressure drop to existing systems.
 - Effectiveness is limited by total exposure time to moving air stream. This system may not be as effective in medium and high velocity air streams.



OTHER POINTS TO CONSIDER

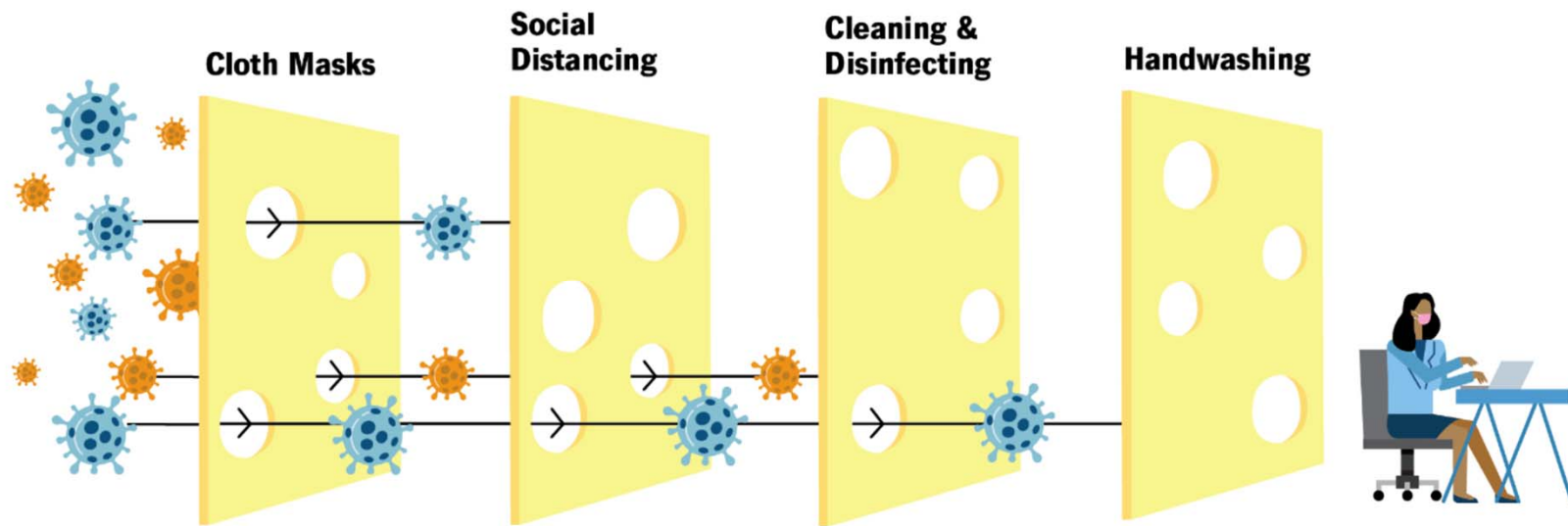
- **Retro Commissioning**

- Improves the efficiency and performance of existing HVAC systems.
- Identify existing performance issues.
 - Frozen outdoor air dampers.
 - Set points adjusted out of code or original design requirements.
- Identify undocumented system maintenance or modifications that effect the proper operation of those systems.



OTHER POINTS TO CONSIDER

- “Swiss Cheese Model”



QUESTIONS & ANSWERS

