



Maine Indoor Air Quality Council: HVAC Basics for COVID-19 Readiness

MODULE THREE: FILTRATION

Learning Objectives of this Badge Program

- An understanding of mechanical systems within a building that have significant impact on indoor air quality and our health.
- An understanding of the role of ventilation air in minimizing risk of transmission.
- An understanding of the role of filtration in minimizing risk of virus transmission.
- Recommended practices for operating and improving HVAC system to minimize risk of virus transmission.

Module Three

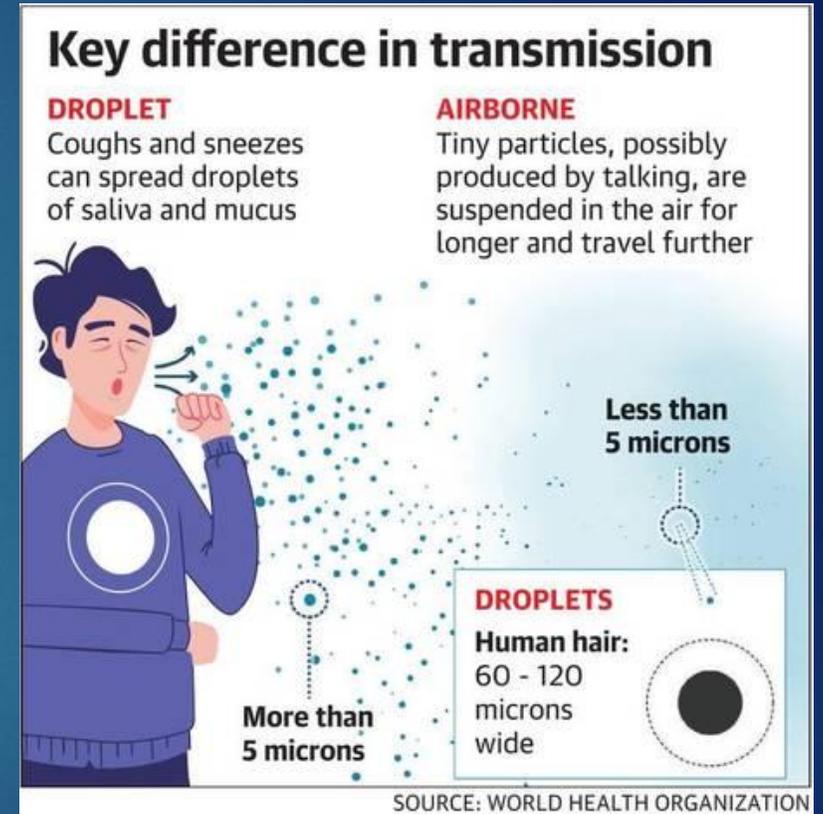
In module three we will focus on air filtration, and its role in minimizing the risk transmission of COVID-19 indoors.

This module is based on School Facilities and intended to inform facility users and operators of these facilities. Many of the recommendations and practices are applicable to other facility types.



Role of Air Filtration

- Air Filters play an important part of minimizing the risk of virus transmission by capturing particles that may be carrying the virus. The virus will settle on particles and use these particles as a vehicle to move throughout a room.
- Air filters remove these airborne particles from the airstream that can be inhaled into our respiratory system while indoors.
- Filters provide a significant reduction in particles within a space that may contain various pollutants and potential virus.
- Filters collect a range of particle sizes that are present in the airstream. The better the filter, the higher percent of particles will be removed from airstream. Particle sizes that filters are rated at range from 0.3 microns to 10 microns.



How a Filter Works

- As air moves thru a space or ductwork, it collects airborne particles that are suspended in the air. Particles contain a variety of pollutants including potential bacteria/virus.
- As the fan draws air through the equipment, the air filter will capture the various size particles and remove them from the airstream being delivered to occupied spaces.
- In addition to filtering the air being delivered to the occupied spaces, the filters will keep the heating/cooling coils clean and allow for proper heating/cooling of spaces.

Filter Ratings

- Filters are provided with a rating system “Minimum Efficiency Reporting Values”, or MERVs, that report a filter's ability to capture particles between 0.3 and 10 microns (µm).
- Filters with MERV 12 rating or less capture less than 20% of the small airborne particles. **MERV 13 provides a significant improvement in capturing these smaller particles approaching 75%.**
- HEPA filters offer the highest efficiency. HEPA filters are rated at 99.97% efficient at the @ 0.3 microns. (MERV 17-20)

MERV Rating	Will trap particle size .3 to 1.0 microns	Will trap particle size 1.0 - 3.0 microns	Will trap particle size 3 to 10 microns
MERV 1	< 20%	< 20%	< 20%
MERV 2	< 20%	< 20%	< 20%
MERV 3	< 20%	< 20%	< 20%
MERV 4	< 20%	< 20%	< 20%
MERV 5	< 20%	< 20%	20% - 34%
MERV 6	< 20%	< 20%	35% - 49%
MERV 7	< 20%	< 20%	50% - 69%
MERV 8	< 20%	< 20%	70% - 85%
MERV 9	< 20%	Less than 50%	85% or better
MERV 10	< 20%	50% - 64%	85% or better
MERV 11	< 20%	65% - 79%	85% or better
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
MERV 15	85% - 94%	90% 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

MERV Rating Table

Recommended Filter Rating – COVID 19:

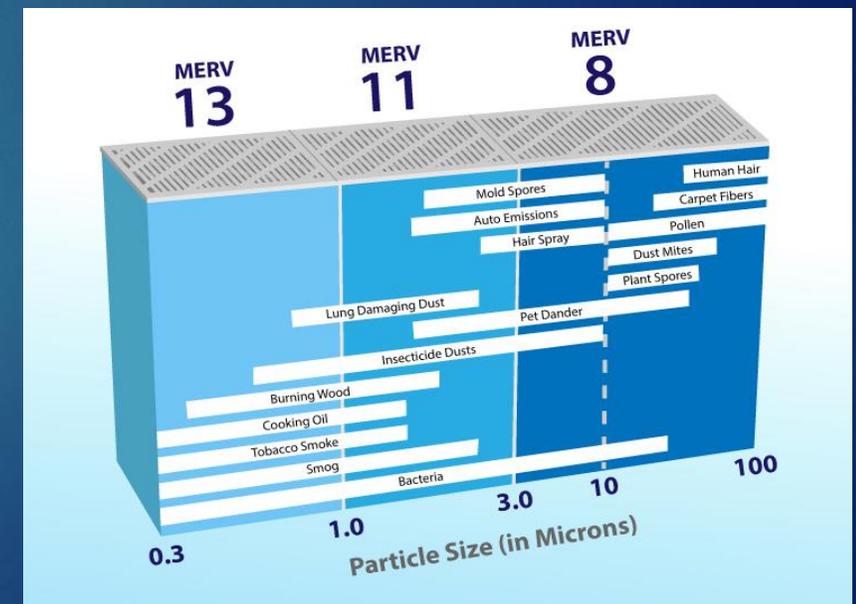
- **Current recommendations are for MERV 13 rated or higher to capture a greater amount of the smaller particle sizes in airstreams.**
- Typical filter efficiencies found in most commercial HVAC equipment range from MERV 8 – MERV 11. These are a pleated filter, not a flat panel filter.
- Flat filters are likely MERV 4 or less and are not recommended due to the very high percent of particles that pass through the filter and remain airborne. These may be common on Unit Ventilators.
- Most existing air handling units can accept a MERV 13 filter. Adjustments may be required to overcome the additional pressure drop associated with these filters and these should be reviewed with service provider or engineer.
- MERV 13 Filter depths are available in 1", 2" and 4" to accommodate existing filter racks in equipment.



Flat Filter



Pleated Filter



Filter Maintenance

- All air handling systems supplying air to occupied spaces will have air filters varying in both size and effectiveness. General exhaust systems likely do not have filters.
- It is recommended to review existing mechanical drawings and owner's manuals to determine original air filter requirements as well as existing filters in place.
- Based on above information, review MERV filter options available to improve filter efficiency when feasible.
- Filter changing needs will depend on hours of operation, filter type and amount of particles airborne present. Particles requiring filtration can come from outside air depending on intake locations, but majority of particles are from indoor sources. It is the indoor sources that provides the greater risk of particles carrying the virus.
- Air filters should be inspected monthly and replaced quarterly. Depending on level of filter buildup, replacement schedule may be adjusted forwards or backwards.
- If pre filters and final filters are provided, replacement on a quarterly basis for the prefilters and final filters replaced every other quarter may be feasible depending on conditions.

Filter Change Procedure

Recommended procedures for filter replacement to protect maintenance staff and building occupants:

- Air Handlers/Fans should be turned off during filter inspections and changes.
- Maintenance staff should wear PPE consisting of face mask, face shield/goggles and gloves when handling filters being replaced. Use of Tyvek suit would provide an additional level of PPE protection during filter changes.
- Removed filters may contain virus and other particles that should be contained to prevent reentry into spaces. Removed filters should be bagged immediately when removed. Bag should be tied closed and disposed of properly in trash. Filters do not require special disposal areas.

Filter Change Procedure

- New MERV 13 or greater filters should be installed if possible. If not, MERV 11 should be installed. In no areas should filters of less than MERV 8 be installed.
- On air handlers with more than one filter are provided, taping the front face of filters between filters will improve filter effectiveness. Sealing should occur on the inlet side of the filters to ensure seal will remain in place.
- New filters must fit properly in filter racks or filter frames. Any air that bypasses the filter will remix with filtered air and result in a reduction of filtration effectiveness.
- If filters do not fill filter frame opening completely, install blank spaces at edges to prevent airflow from bypassing filters.
- Record of filter changes should be recorded on chart at filter location as well as captured on maintenance records. Write filter change date of filter housings for quick review.

MERV 8 Prefilter

MERV 14 Filter



MERV 14 Filter with MERV 8 Prefilter



MERV 8 Unit Ventilator Filter

Filter Sizing Considerations

- Filters and filter racks in equipment typically are rated at 500 fpm velocity maximum.
- Filter racks should be filled with filters and not provided with blank off areas if a full filter or half filter will fit.
- Pressure drop through MERV 13 filters will be greater than those with a lower MERV rating. A 2" deep MERV 8 Filter may have a pressure drop of 0.31" while the 2" MERV 13 Filter would have a pressure drop of 0.41".
- The results of this additional pressure drop will reduce airflows unless adjustments to motor/fan are made to increase motor/fan speed by service provider.

2" Nominal Depth	Part Numbers	Nominal Size (inches)	Initial Resistance (inches, w.g.)	Airflow Capacity (cfm)	Total Media Area (sq ft)
15 Pleats per Lin. Ft.	405413001	20x16	0.41	1110	9.6
	405413002	20x20		1380	12.0
	405413003	25x20		1730	15.1
	405413004	25x16		1380	12.0
	405413005	24x24		2000	17.3
	405413006	24x12		1000	8.4
	405413007	24x20		1660	14.5
	405413008	24x18		1500	13.0
	405413009	25x18		1560	13.6
	405413010	20x14		970	8.3
	405413011	25x14		1210	10.5
	405413012	24x16		1330	11.5
	405413013	25x25		2170	19.0

Sample MERV 13 data (Camfil AP Thirteen)

PERFORMANCE DATA 2" Deep Filter (actual filter depth 1.75")							
Part Number	Nominal Depth (inches)	Nominal Size (inches)	Actual Size (inches)			Initial Resistance (inches w.g.)	Airflow Capacity (cfm)
			Depth	Height	Width		
402314001	2	12x12	1.75	11.62	11.62	0.31	500
049880019		16x16		15.5	15.5		880
049880022		16x25		15.5	24.5		1380
049880024		18x18		17.5	17.5		1120
049880008		20x10		19.5	9.5		690
049880007		20x12		19.5	11.88		830
049880009		20x14		19.5	13.5		970
049880011		20x15		19.5	14.5		1040
049880001		20x16		19.5	15.5		1110
049880013		20x18		19.5	17.5		1250
049880002		20x20		19.5	19.5		1380
049880023		20x24		19.5	23.5		1660
049880021		20x25		19.5	24.5		1730
402271007		20x30		19.5	29.5		2080
049880006		24x12		23.38	11.38		1000
049880016		24x16		23.5	15.5		1330
049880015		24x18		23.5	17.5		1500
049880012		24x20		23.5	19.5		1660

Sample MERV 8 data (Camfil FARR 30/30)

Portable Air Cleaning Devices

- For locations where mechanical systems do not include ventilation or where equipment in place can not be provided with MERV13 filters, Portable Air Cleaners should be considered to improve air filtration within occupied spaces.
- Systems such as Unit Ventilators, Air-to-Air Heat Pumps, small Air Handling Units are likely to have limited filtering efficiency. See images of an Ionization installed in a Unit Ventilator with MERV 8 Filters installed.
- Portable Air Cleaners can utilize a variety of technologies available. Some of these technologies may not be appropriate as they may create other concerns/hazards such as ozone generation. Prior to using these technologies, owner should review manufacturer's data.
- MIAQC recommends use of HEPA filtered portable air cleaning devices as this technology has long been utilized, simple technology and does not generate other hazards that may be present in other technologies available.



HEPA Filtered Air Cleaning Device



Ionization Air Cleaning Device
In Unit Ventilator

Filtration: Knowledge Check

1. Air Filters remove _____ from the airstream.
2. MERV rating of _____ or higher are recommended for effective air filtration.
3. HEPA filters are 99.97% effective at filtering particles sizes of _____ microns and larger.
4. Filters should be placed in _____ immediately upon removal.
5. New MERV 13 or greater filters _____ installed if possible.

Filtration: Knowledge Check - Answers

1. Air Filters remove **airborne particles** from the airstream.
2. MERV rating of **13** or higher are recommended for effective air filtration.
3. HEPA filters are 99.97% effective at filtering particles sizes of **0.3** microns and larger.
4. Filters should be placed in **bags** immediately upon removal.
5. New MERV 13 or greater filters **should be** installed if possible.

To learn more...

- ▶ Visit the COVID-19 Resources Page on the website of the Maine Indoor Air Quality Council. Click here: [COVID-19 Resources Page - Maine Indoor Air Quality Council](#)

- ▶ Contact:

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Congratulations!

You made it to the end of this session for
Maine Indoor Air Quality Council: Filtration.

Your next step is to
start learning about
Operations &
Maintenance.