Part Two: A Must-Do for Every School: MERV 13 Filtration Upgrades to Central Air Handling Stations

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By Raj Setty, PE, CxA, ASHRAE Epidemic Task Force (ETF)

In the second part of my series, "Clearing the Air for Our Kids: School Ventilation Guidance." I am focusing on another important step school districts and buildings should take as children return to in-person learning: MERV 13 Filtration upgrades to central air handling stations.

The basis for this recommendation is fairly simple. By improving the filtration in air handlers, it's possible to decrease the chance of aerosolized viral particles being spread through the air distribution system. In simple terms, the goal is to decrease the spread of the particles that carry infectious particles like COVID-19 through the air.

An area of research is focused on the nature of small particles (<10 micron). It's known that once particles drop below the 5 micron diameter, they tend to stop dropping and instead stay persistent in the air and diffuse throughout the space. Particles in the 5-10 micron range can be transported much longer distances, depending on conditions. The smaller particles (<10 micron) can be inhaled and contribute to the risk of additional infection.

First, some background. While the COVID-19 virus itself is in the 0.125 to 0.3 micron range, the particulate that carry it are likely larger or in the same relative size. While there's much research going on in this field for COVID-19, we can rely on past research for the Influenza virus. Particles of this size stay suspended in the air and are big enough to carry enough infectious germs that spread infection. The particle mesh of a MERV 13 filter or higher such as HEPA (high efficiency particulate air) will only allow particles below .3 through. This gives us the indirect correlation of capturing the virus at the filters since we are arresting the particles that carry the viruses.

The viral cells themselves aren't stable when exposed to air. (Their lipid layer breaks down and the virus is deactivated.) However, when transported inside droplets, the cells present a risk of infection. The

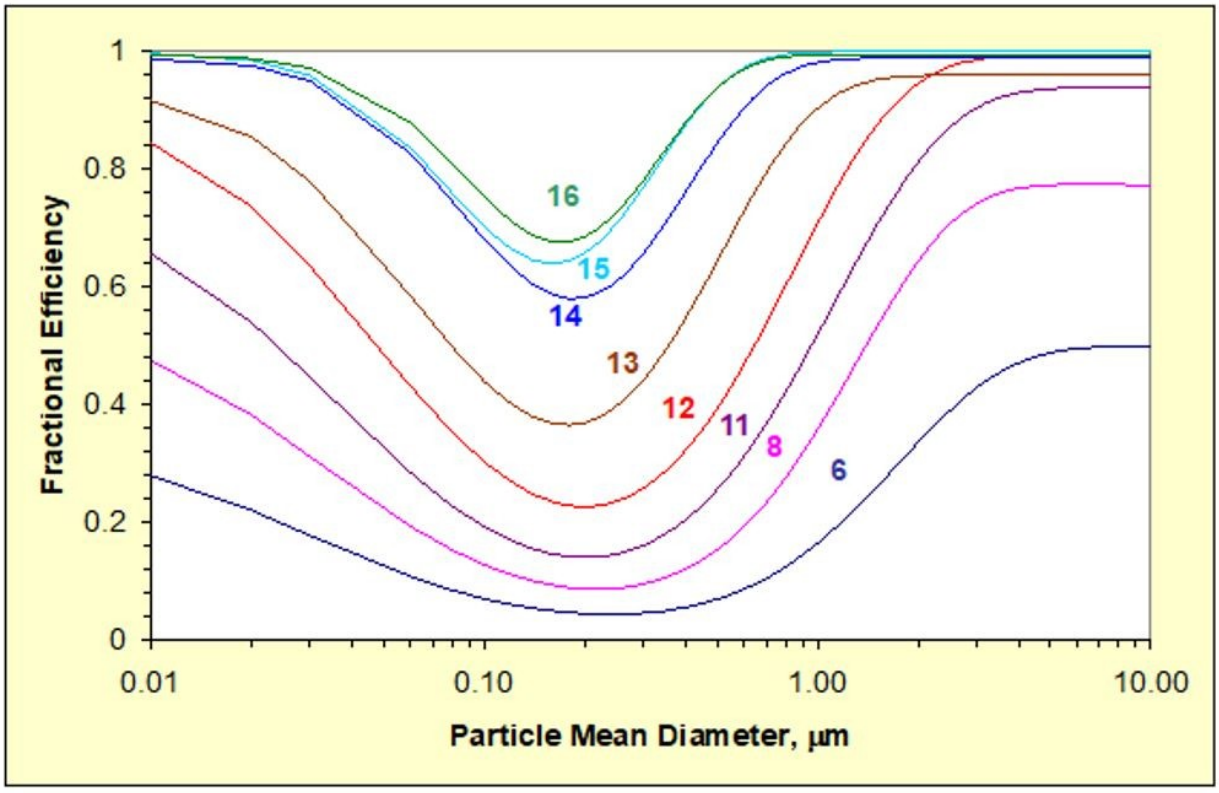
'larger droplet' transmission path of viruses and bacteria is widely accepted and considered the base of modern germ theory. In fact, these larger droplets (>10 micron) are the basis of the 6-foot social distancing parameter employed in most public places around the country.

These infectious particles (quanta) are commonly generated through respiration with increased rates while speaking, singing, shouting, or greater cardiovascular activity like running. This risk is recognized by most research and is why ventilation is recommended. From empirical data we know that the risk of **transmission outside is much lower than the risk inside** and this is likely due to the role of these infectious quanta/aerosolized particles.

The solution to this problem is filtrating the classroom air to remove the viral particles -- but the balance of system considerations, cost, motor capacity, energy offsets and air distribution need to be considered. While higher filtration is more effective, it may not be practical in the central air handling units due to systems limitations and design.

Apply common sense. Install the MERV 13 filters and if there is diminished temperature control or occupant comfort, then go back to the next filter size such MERV 12. HVAC systems are sized for peak conditions and will have capacity at part load conditions. Occupants should be told that due to the higher grade of filters, during the peak heating and cooling days they may experience space temperatures, over 74 F summer and under 68 F Winter. If it continues to be a problem, go back to the rated filter size of the HVAC unit.

Additionally, existing equipment has several limitations such as fan static capacity. Higher levels of filtration are better, but from research, it has been determined that MERV 13 to MERV 14 is where diminishing returns begin in the effectiveness of these particles being removed. There is a filtration efficiency that is gained with multiple passes across the filters every air. We want to achieve a CADR (clean air delivery rate) of 4-6. Filter the air and dilute with fresh air every 10-15 minutes.



For those who don't know,**MERV stands for Minimum Efficiency Reporting Value**. It's a system used to evaluate the efficiency of an air filter and is used to report a filter's ability to capture larger particles between 0.3 and 10 microns (µm). This value is helpful in comparing the performance of different filters. In simple terms, the higher the MERV rating (such as MERV 8 or MERV 13), the higher the air filtration. Note that MERV ratings are not additive and a MERV 6 plus a MERV 8 does not give you a MERV 14 rating.

Std. 52.2 Minimum Efficiency Reporting Value (MERV)	Application Guidelines		
	Typical Controlled Contaminant	Typical Applications and Limitations	Typical Air Filter/Cleaner Type
16	**0.30 to 1.0 µm Particle Size**	Hospital inpatient care	**Bag Filters**
	All bacteria	General surgery	Nonsupported (flexible) microfine fiberglass or synthetic
15	Most tobacco smoke	Smoking lounges	media. 300 to 900 mm (12 to 36 in.) deep, 6 to 12 pockets.
	Droplet nuclei (sneeze)	Superior commercial	**Box Filters**
14	Cooking oil	buildings	Rigid style cartridge filters 150 to 300 mm
	Most smoke		(6 to 12 in.) deep may use lofted (air laid) or paper (wet laid)
13	Insecticide dust		media.
	Copier toner		
	Most face powder		
	Most paint pigments		
12	**1.0 to 3.0 µm Particle Size**	Superior residential	**Bag Filters**
	Legionella	Better commercial	Nonsupported (flexible) microfine fiberglass or synthetic
11	Humidifier dust	buildings	media. 300 to 900 mm (12 to 36 in.) deep, 6 to 12 pockets.
	Lead dust	Hospital laboratories	**Box Filters**
10	Milled flour		Rigid style cartridge filters 150 to 300 mm
	Coal dust		(6 to 12 in.) deep may use lofted (air laid) or paper (wet laid)
9	Auto emissions		media.
	Nebulizer drops		
	Welding fumes		
8	**3.0 to 10.0 µm Particle Size**	Commercial buildings	**Pleated Filters**
	Mold	Better residential	Disposable, extended surface, 25 to 125 mm
7	Spores	Industrial workplaces	(1 to 5 in.) thick with cotton-polyester blend media,
	Hair spray	Paint booth inlet air	cardboard frame.
6	Fabric protector		**Cartridge Filters**
	Dusting aids		Graded density viscous coated cube or pocket filters,
5	Cement dust		synthetic media.
	Pudding mix		**Throwaway**
	Snuff		Disposable synthetic media panel filters.
	Powdered milk		
4	**>10.0 µm Particle Size**	Minimum filtration	**Throwaway**
	Pollen	Residential	Disposable fiberglass or synthetic panel filters
3	Spanish moss	Window air conditioners	**Washable**
	Dust mites		Aluminum mesh, latex coated animal hair, or foam rubber
2	Sanding dust		panel filters
	Spray paint dust		**Electrostatic**
1	Textile fibers		Self charging (passive) woven polycarbonate
	Carpet fibers		panel filter

Note: A MERV for other than HEPA/ULPA filters also includes a test airflow rate, but it is not shown here because it has no significance for the purposes of this table.

It's widely believed that MERV 13 is likely the highest filtration level that most existing systems can accommodate and is why it's recommended as a minimum across the industry. An increase from MERV 8 or MERV 11 represents a substantial increase in the efficacy of filtration of small infectious particles.

If MERV 13 filters can't be installed in your school, consider the following:

- Increase the filtration in the unit to the maximum available - check the fan static at maximum cfm. Fans have a system curve of pressure vs. cfm. Find your spot on the curve.
- Install a recirculation fan filtration unit and duct into the return of units
- Provide a HEPA air cleaner filtration unit in each classroom which re-circulates air within the space - simplest and highly effective. This can be portable or fixed in the ceilings. Great place to install air cleaners are in bathrooms where you can not socially distance.
- Consider additional treatment technology such as UV-C to stop the replication of airborne infectious aerosols
- Refer to **ASHRAE Filtration and Disinfection** recommendations
- Consider alternate filter locations in return duct or grille but consider static pressure drop implications and relationship with outside air dampers

One of the most important things a school can do to make the learning environment safer for children is upgrading the building's central air handling station to MERV 13. For more specific instructions or to learn how to do a filtration analysis, **contact me directly on LinkedIn**.