



PATHWAY TO CREATING HEALTHY SCHOOLS

Eneref Institute examines how
MERV-13 filters in HVAC systems for
K-12 schools improve IAQ.



ELIMINATING PATHOGENS USING AIR CONDITION FILTRATION

MERV-13 FILTERS RECOMMENDED BY U.S. ORGANIZATIONS

To protect students from respiratory virus infection, MERV-13 air filtration is highly recommended by organizations responsible for school safety including the U.S. Department of Education, U.S. Center for Disease Control, U.S. Environmental Protection Agency, ASHRAE (the principal guiding association of air conditioning engineers), and the National Air Filtration Association. Equally important, MERV-13 filters improve indoor air quality (IAQ), minimizing adverse health effects for students by reducing pollutants. Eneref Institute encourages governments to fund MERV-13 filtration installation throughout the U.S. public school system.

Across the United States, over 50 million students attend K-12 public schools. In 2020 during the COVID-19 pandemic, 1.4 million fewer students attended school than in the previous year, according to the U.S. National Center for Education Statistics. With nearly 100,000 public schools nationwide—two thirds of which are elementary schools—the need for healthier, more robust filtration should be a national priority.

INDOOR AIR QUALITY

EPA's Science Advisory Board consistently ranks indoor air pollution among the top five environmental risks to public health, as indoor contaminants can be as much as one hundred times higher than outdoor levels. Beyond increasing exposure to respiratory viruses, poor indoor air in schools has been shown to aggravate asthma, allergies, and other respiratory illnesses in students.

AIRBORNE TRANSMISSION OF RESPIRATORY VIRUS

One million Americans died during the COVID-19 pandemic from the SARS-CoV-2 virus. Although children were less likely to become symptomatic, they were still likely to be infected at school and bring the virus home to older family members. The HVAC equipment in schools almost certainly played a role in transmission; according to ASHRAE's "Filtration & Disinfection Guidance" document (issued May 7, 2021), "airborne transmission of SARS-CoV-2 is significant and should be controlled." Outdoors, viral particles are dispersed by winds. Indoors, proper filtration is needed to reduce concentration and, thus, the overall viral dose to which occupants are exposed.

MERV-13 filtration in air conditioning systems can help protect students from contracting the SARS-CoV-2 virus. While the individual virion molecules are only 0.1 micrometer in size, the virions are embedded within, and spread through, respiratory droplets that are an order of magnitude larger—from 1 to 3 micrometers in size. MERV-13 filtration is 85% effective at capturing particles in the 1 to 3 micrometer size range—more than five times the efficacy of the more common MERV-8 filters.

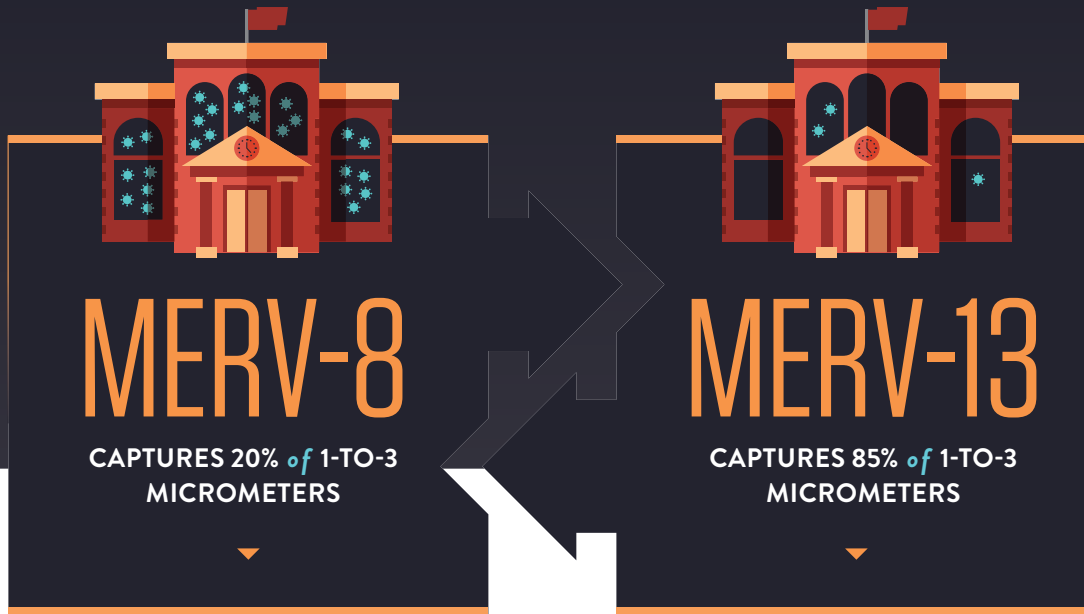
DISEASES IN SCHOOLS ARE ROUTINE

According to the United Nations Environmental Program, one new infectious disease emerges in humans every four months. Only a few viruses have ever become endemic, among them ebola, bird flu, swine flu, MERS, Rift Valley fever, SARS, West Nile virus, Zika virus, and coronavirus COVID-19. Influenza ("the flu") is also a respiratory viral infection and causes more hospitalizations among young children than any other vaccine-preventable disease. School-aged children have a high rate of flu illness and are at high risk for complications.

Asthma, which affects 25 million Americans, is triggered by indoor

FILTRATION *can* REDUCE VIRUSES

MERV-13 FILTRATION can help protect students from contracting the SARS-CoV-2 virus because MERV-13 is significantly more efficient at capturing the virus than MERV-8.



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EFFICIENCY VALUE	PARTICLES CAPTURED	PARTICLES CAPTURED
EFFICIENCY	0.3 to 1.0 MICROMETERS	1.0 to 3.0 MICROMETERS
MERV-8	CAPTURES 0%	CAPTURES 20%
MERV-13	CAPTURES 50%	CAPTURES 85%

* Values derived from ASHRAE Standard 52.2-2017

exposure to allergenic irritants such as dust mites, pests, and molds. Nearly one in thirteen school-age children suffer from asthma. There is no cure, but asthma can be managed with proper filtration.

EFFICIENCY OF MERV-13 AT CAPTURING PARTICLES

Filters are tested in accordance

with ANSI/ASHRAE standards and given a MERV rating (Minimum Efficiency Reporting Value). Air conditioner filters are designed to remove particles from airstreams and typically consist of porous fibrous materials. The amount of particulate matter captured by the filter determines its MERV rating, which is graded from 1 to 16 and identifies the filter's

efficiency. A MERV filter rating of 13 or greater captures airborne respiratory viruses.

According to the CDC, MERV-13 filters are "significantly more efficient at capturing particles of concern than a typical MERV-8 filter, which is only around 20% efficient in the 1-to-3 micrometers size range and is not rated for capture

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50 MILLION STUDENTS ATTEND K-12

In 2020 during the COVID-19 pandemic, 1.4 million fewer students attended school than in the previous year.

efficiency of the smaller 0.3 to 1.0 micrometers particles.” For this reason, the U.S. Department of Education, as well as ASHRAE, also recommends MERV-13 filtration for schools.

AIR FILTRATION CAN REDUCE EXPOSURE TO AIRBORNE PATHOGENS

ASHRAE’s “Guidance for the Reopening of Schools and Universities” recommends filtration and ventilation to improve air distribution and reduce airborne exposure to the SARS-CoV-2 virus. Larger respiratory droplets tend to settle within seconds on room surfaces, but the smaller droplets that hide the virus can stay suspended in the air for hours or even days. Particle filtration in HVAC systems is used to

remove these smaller particles from the air. The effectiveness of filtration depends on the size of the filtered particles, the airflow through the filter, and the filter’s MERV rating.

ASHRAE recommends pre- and post-occupancy purge cycles to flush school buildings with fresh outdoor air. A good supply of outside air to dilute indoor contaminants is a first line of defense against aerosol transmission of respiratory viruses and can be as simple as opening windows and using window fans. However, the CDC suggests that while ventilation can reduce the risk of viral exposure, it will not eliminate risk completely. Proper air filtration, without significantly reducing airflow, is especially helpful when enhanced outdoor air delivery

options are limited. In fact, appropriate filtration can lower the need for outdoor air, thereby lowering the costs of heating and cooling.

WINDOW AIR CONDITIONING AS A SOLUTION FOR SCHOOLS

Adding a centralized ducted MERV-13 system is a major infrastructure renovation. Nor can a centralized system create “safe bubbles” by prioritizing individual rooms; instead recycled air may be distributed from classroom to classroom. Energy-efficient mini split systems, which are a popular alternative to ducted central air — and ideal for homes — are difficult to retrofit with MERV-13 filters because the systems are typically designed with smaller

filter cavities and lower power. Mini splits commonly use basic MERV-1 or MERV-3 filters that trap lint but not particulate.

A straightforward, cost-effective solution for schools to modernize spaces with MERV-13 filtration is with window or through-the-wall room-sized air conditioners. As of this study, the only MERV-13 window unit available for schools is the Friedrich Kühl Smart Room Air Conditioner. The costs are significantly less than installing central air conditioning. The Friedrich unit can also act as a MERV-13 filtration system for any existing central system by continually re-filtering and circulating conditioned air regardless of temperature demand.

GOVERNMENT FUNDING TO IMPROVE AIR FILTRATION IN SCHOOLS

Through funds allocated by the \$1.9 trillion American Rescue Plan Act, signed into law on March 11, 2021, public school districts can purchase MERV-13 filter equipment to reduce students' risk of viral transmission and exposure to environmental health hazards. Included in the plan is \$122 billion specifically targeting elementary and secondary schools alongside two other funds for higher education: Federal Higher Education Emergency Relief funds and Governors Emergency

Education Relief funds. All three funds support both short-term and long-term improvements to enhance student health through better indoor air quality (IAQ).

Eneref Institute urges HVAC governing bodies to emphasize the benefits of window units in K-12 schools. Better filtration will not only prepare school districts for the next infectious

disease but will create immediate IAQ benefits for over 50 million students. Good IAQ contributes to a favorable learning environment for students, better performance of teachers and staff, and an overall sense of comfort, health, and well-being. These elements combine to assist a school in its core mission: educating children.



THE *SciBox*:

FILTRATION AND ENERGY

Filter efficiency builds upon the demand for decarbonization

THE NEED FOR MERV-13 in schools furthers the argument for renewable energy. All filters increase resistance to airflow in an HVAC system. The higher the filter efficiency, the greater the air pressure required to force air through the filter—and thus the greater the energy. This increased resistance, called “pressure drop,” creates a drop in static pressure of the air from the upstream side of a filter to the downstream side. Only 19.8% of U.S. electricity comes from renewables. Increasing renewable energy for electricity can mitigate the increased energy use of more efficient filters.



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