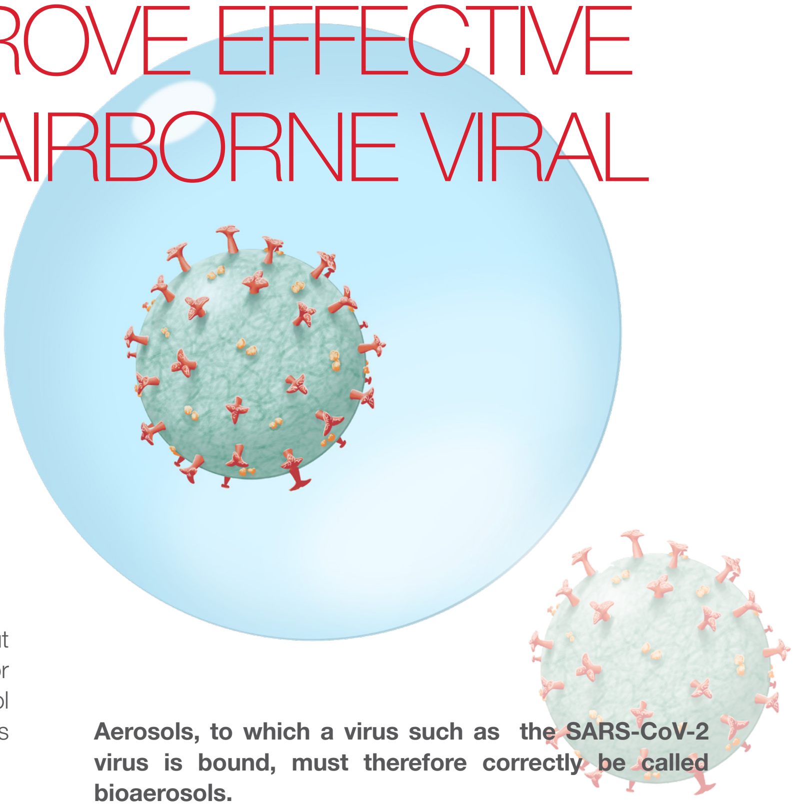
AAF FILTERS PROVE EFFECTIVE AT REDUCING AIRBORNE VIRAL CARRIERS



EFFICIENT CONTROL OF AEROSOLS

According to the latest scientific report from the World Health Organization on the transmission of SARS-CoV-2, there is overwhelming evidence that aerosols play an important, if not decisive, role in the spread of the SARS-CoV-2 virus.

In general, quite apart from the ubiquitous discussion about the SARS-CoV-2 virus, air filters are the method of choice for the efficient removal of viruses due to their ability to control aerosol levels in the air. This has been researched for years and has been proven by numerous studies.

The Conclusion: The control or containment of aerosols by means of efficient filtration is synonymous with the containment of the viral load in the air, which consequently leads to a reduced risk of COVID19 infections.

This paper is intended to contribute to a better understanding of aerosols and their properties, as well as providing explanations that show, that the right filter-choice is crucial for reducing the risk of infection due to virus-laden air.

Characteristics of Aerosols

Generally an aerosol is defined as a suspension system of solid or liquid particles in a gas. An aerosol includes both the particles and the suspending gas, which is usually air. Aerosols are typically classified according to their physical form and how they were generated. Fume, mist, smoke, smog, diesel soot or fog are typical examples.

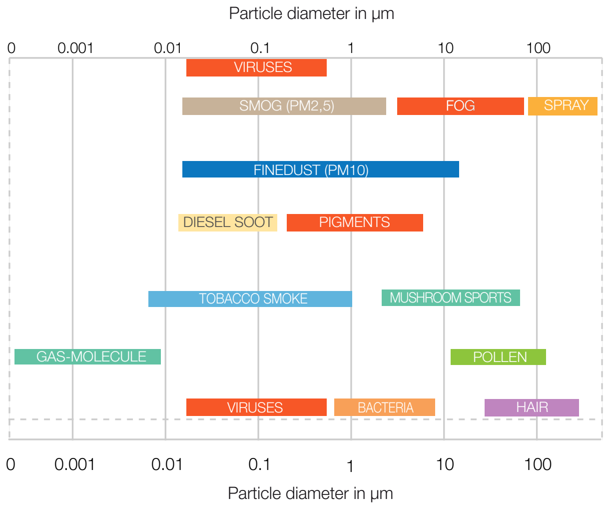
The diameter of aerosol particles is in the order of magnitude between 0,01 µm and 10 µm. Particle size is often determined by the process that generated the particle. For example combustion particles usually start out in the 0,01-0,05 µm size range, but are likely to combine with each other (agglomerate) to form larger particles. Individual aerosol particles are therefore not visible to the naked eye. A quantity of aerosol particles in air is only visible, depending on the particle size, from concentrations of 10.000 to 100.000 particles per cubic centimeter. All accumulations of aerosols in the air to which fungi, bacteria, pollen or viruses adhere are called bioaerosols.

Aerosols, to which a virus such as the SARS-CoV-2 virus is bound, must therefore correctly be called bioaerosols.

The connection between Aerosols and Viruses

How exactly the corona virus is spread - whether primarily via a droplet infection or rather via aerosols in the air we breathe is currently intensively researched. When a corona patient coughs, speaks, or sneezes, a jet of droplets and aerosols of different sizes is created, which then penetrates the room air. All of these different sized droplets and aerosols potentially contain viruses, because viruses tend to stick to larger particles.

Graphic 1: Size comparison of solid and gaseous substances in the ambient air



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As the graphic 1 shows, viruses typically have a size of 0,02 µm - 0,4 µm. SARS-CoV-2 in particular is in the size range 0,06 - 0,14 µm.

With a droplet infection, the virus particles in a droplet of saliva reach the mucous membranes of another person directly. When airborne, the viruses enter the respiratory tract, bound in tiny liquid particles – the aerosols . The size of the carrier aerosols is decisive for the behavior of viruses in the air. As well is the indoor climate, the air exchange rate and the way in which ventilation is carried out.

The spread of virus-laden air, which arises when speaking, coughing and sneezing, takes place in two steps. First a contaminated air stream is generated by coughing / speaking / sneezing, which penetrates the room air and increasingly mixes with it. The direction of the air stream depends on various boundary conditions such as speed, turbulence, the temperature difference between the air stream and the ambient air, and the difference in air humidity. It is known from various studies that particles of 0,01 µm to 1500 µm occur when speaking / coughing / sneezing. The smaller particles largely follow the room air flow, while larger particles gradually fall to the ground.

The very large particles falling to the ground are only emitted while sneezing. Small aerosols, that remain in the air in overwhelming numbers, are almost exclusively generated during normal speaking and coughing.

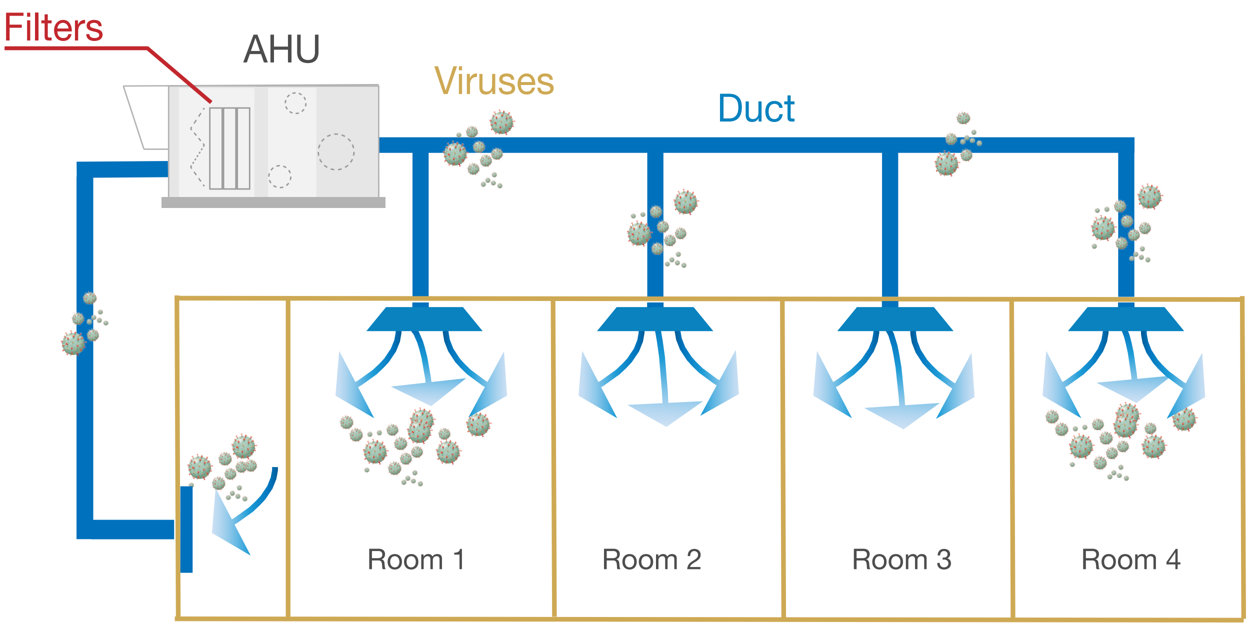
Sedimentation Time: The smaller the particle (aerosol), the longer it stays in the air.

In various studies the so-called sedimentation time (deposition time) of particles of different size classes was measured. The results show that tiny particles remain in the air for several minutes, sometimes hours. If there are several people in a room and it is not sufficiently ventilated, the effect increases.

In general HVAC Systems, that are recirculating the air, can play a crucial role in the spread within a building, if virus-laden aerosols are not removed from the air stream. **With a given air change rate of approx. 7 times per hour*, living viruses (assuming 3-hour lifetime) can be carried by aerosols and circulate 21 times and spread throughout the building within the ducts.** A schematic visualization of this scenario is shown in graphic 2.

**based on a 5.500 m² building with AHU operating at 12.000 m³/h (using a bank of four 600x600 filters with an avg. airspeed of roughly 2,2 m/s.*

Graphic 2:



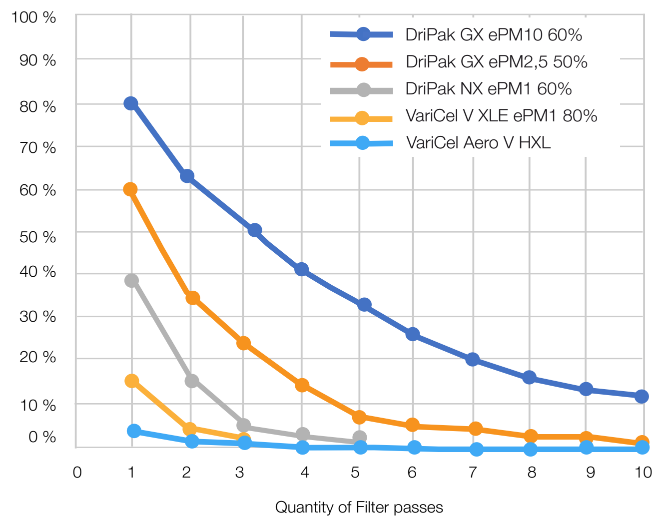
Effective reduction of virus carriers (Aerosols) in the air by air filtration.

All research results already shown suggest that the control or containment of aerosols by means of efficient filtration leads to a reduced risk of COVID19 infections. Consequently the target must be: Maximum filtration efficiency with a minimum number of air changes at reasonable costs.

Assuming that the majority of viruses is travelling on rather small sized aerosols in the size range of 0,3 – 1,0 **µm a suitable combination of air filters is able to capture up to 98% of this particle fraction size within a single air change.**

Graphic 3: % of 0,3 – 1,0 µm potential virus-laden particles remaining in the air stream

Captured virus carriers by filter efficiency

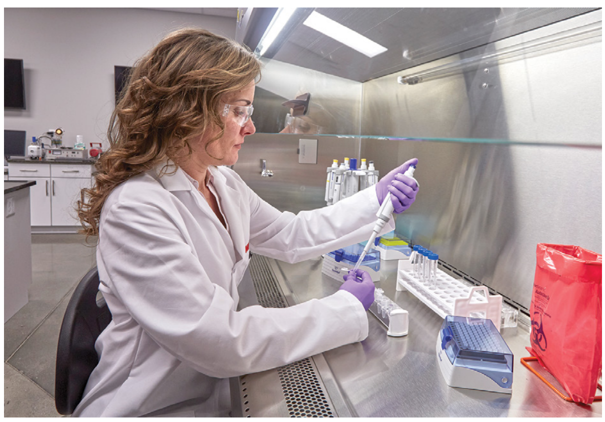


Filter choice based on scientific studies

AAF's Clean Air Center (CAC) located in the United States recently replicated a study originally done by the University of Minnesota. The study demonstrated that air filtration efficiently reduced airborne particles within the 0,5-1,0 micron size range that viruses tend to travel on.

Because SARS-CoV-2, the coronavirus that causes COVID-19, is highly infectious to humans, the biological research team in CAC tested penetration rates used the Porcine Epidemic Diarrhea (PED) virus for their studies because the PED virus is not known to infect humans. Although it is a different virus, the PED virus is, like SARS-CoV-2, a member of the coronavirus family, is of similar size and behaves similar in aerosols.

Results clearly demonstrated that, the percentage of airborne virus-carrying particles (Aerosols) reduced by air filtration correlates with the particle efficiency of the filter.



Opening in 2016, the AAF Clean AIR Center (CAC) boasts 3,600 sqm of space that houses our media and materials lab, an ABSL-2 biosafety research lab and several certified test ducts. The unique combination of biosafety capabilities and test ducts positions AAF as the worldwide leader in air filtration innovation, allowing us to test our air filters for removal of airborne pathogens, such as bacteria and viruses. These capabilities of the CAC make AAF the only filtration company able to replicate the University of Minnesota research that demonstrates that particle efficiency corresponds to viral removal.

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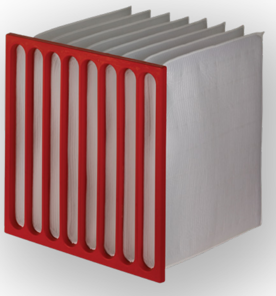
Recommendation to effectively reduce airborne viral carriers

Based on the results achieved in the CAC and the knowledge gained from decades of research in the filtration industry on aerosols, **AAF is able to offer a filtration solution that is both highly efficient to reduce airborne viral carriers and cost-effective for AHU unit operators.**

Featured products

Prefilter (1st Stage of Filtration)
DriPak® NX+ ePM1 65%

- Highest media amount of small particle efficiency layer in a pocket filter
- Low initial resistance
- 100% synthetic media



Mainfilter (2nd Stage of Filtration)
VariCel® Aero V HXL ePM1 95%

- Increased protection against the transmission of airborne diseases
- High filtration efficiency - up to EPA filtration class E10
- Minimum 95% efficient on 0,3µm
- Repellent media arranged in vertical pleats to maximize drainage of moisture and ensure maximum efficiency
- Faceguards on the downstream side provide increased stability and robustness
- The extra large filter area of the VariCel Aero VHXL (440mm depth) compared to the VXL provides not only an increase in filter efficiency, but also a further increase in dust holding capacity and, due to the lower pressure drop, has an even lower total cost of ownership.

Key performance indicators of AAF's recommended solution for a two stage filtration system.

Combined Efficiency
on virus-laden aerosols:

99,7%

Number of airchanges needed to achieve 99,7% efficiency

#1

Δpi
Initial combined pressure drop:

170 Pa

Combined DHC
(Dust Holding Capacity)

2.850 g

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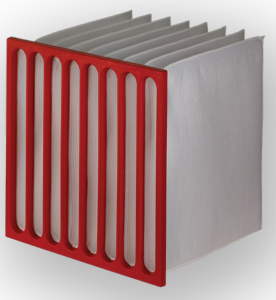
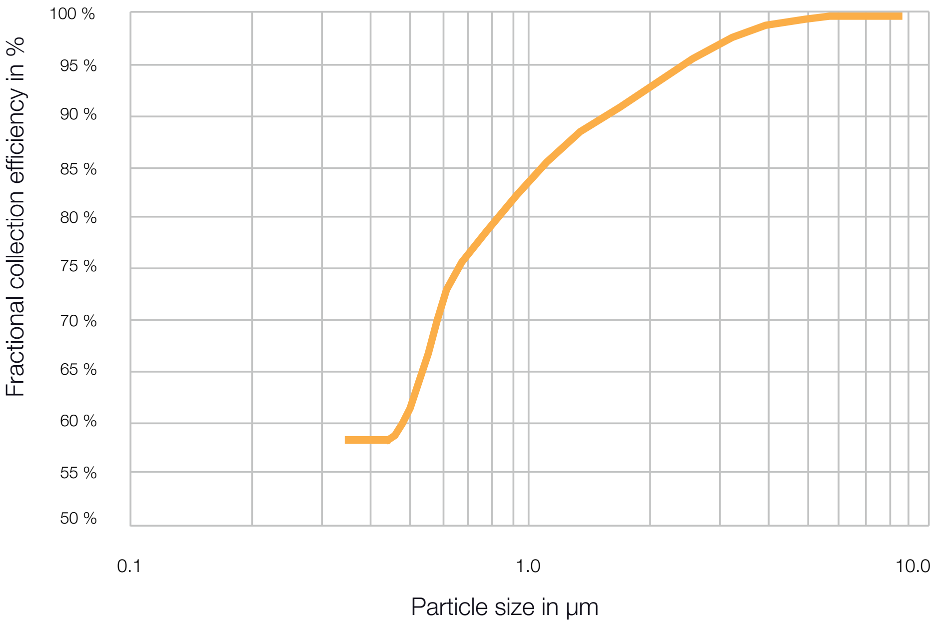
Filter name	Dimensions (mm) 592 x 592 x Depth	Filter area (m²)	Number of pockets	Initial dp (Pa) Δpi	Acc. to Eurovent 4/21:2018		Dust Holding Capacity (DHC)	ISO 16890 Classification	Average values		
					kWh	Energy Rating			ePM1 (%)	ePM2,5 (%)	ePM10 (%)
DriPak NX+ ePM1 65%	635	7,2	10	55	720	A+	1700	ePM1 65%	66	75	92
VariCel Aero V HXL ePM1 95%	440	25,7	-	115	1390	A	1150	ePM1 95%	99	99	99

Prefilter (1st Stage of Filtration)
DriPak® NX+ ePM1 65%





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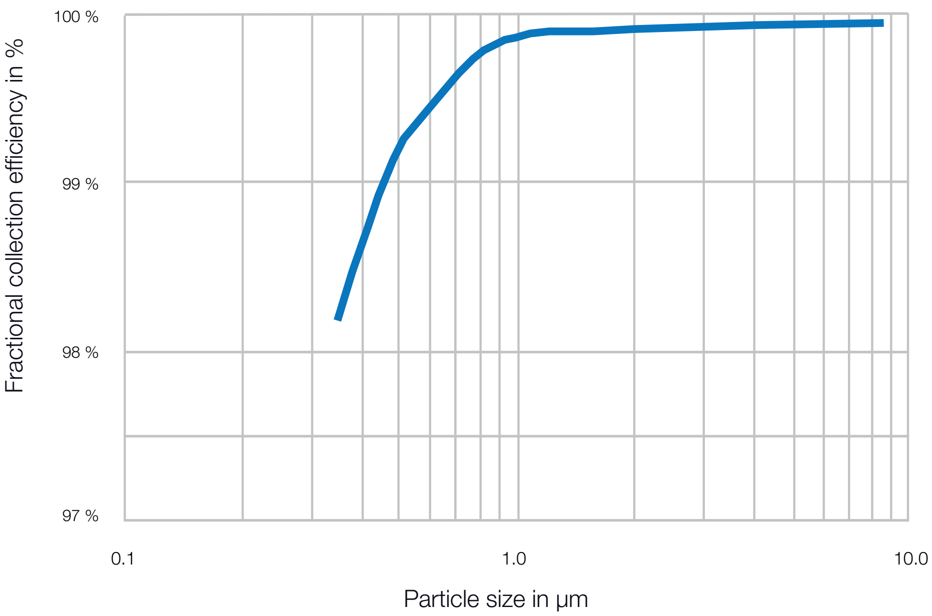
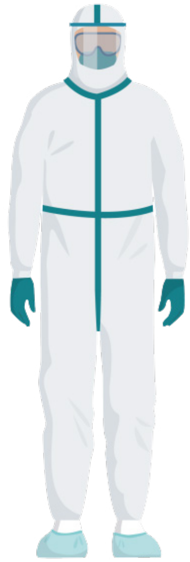


Filter replacement and maintenance works during a pandemic

At this point it is very important to emphasize that the reduction of virus-laden particles in the air is not the same as their destruction. By means of suitable filtration, these harmful particles are only "caught" or prevented from spreading further and are not immediately killed.

When doing a filter change there is a risk of getting in contact with still active contaminants. **However, the Covid19 health crisis has not changed our general stance on best practice for changing out dust-loaded filters which have and will always carry the risk that they are contaminated with harmful pathogens.**

When replacing used filters, suitable protective clothing should therefore generally be worn and maximum care should be taken.



Contact your local AAF representative to learn how you can upgrade your air filtration to protect against airborne viral carriers.

GET THE FACTS ON TRANSMISSION VIA AEROSOLS

WHO, July 2020, Transmission of SARS-CoV-2: implications for infection prevention precautions
https://www.who.int/news-room/commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions

CDC, July 2020, COVID-19 Outbreak Associated with Air Conditioning in Restaurant, Guangzhou, China, 2020
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Mahesh Jayaweera, Hasini Perera, Buddhika Gunawardana, Jagath Manatunge, June 2020, Transmission of COVID-19 virus by droplets and aerosols: A critical review on the unresolved dichotomy
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https://www.nejm.org/doi/full/10.1056/NEJMc2004973?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed

SARS-CoV-2 Blog, Hermann Rietschel Institut | TU Berlin
https://blogs.tu-berlin.de/hri_sars-cov-2/

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