Feedback from the AIVC Webinar "COVID-19 Ventilation related guidance by ASHRAE and REHVA" – Your questions answered!

The Air Infiltration and Ventilation Centre with support from ASHRAE (https://www.ashrae.org/) and REHVA (https://www.rehva.eu/) organized the webinar "COVID-19 Ventilation related guidance by ASHRAE and REHVA" held on November 20th, 2020. 406 people from 42 countries attended the webinar.

Jarek Kurnitski – chair of REHVA COVID-19 task force– introduced the latest guidelines by REHVA and William P. Bahnfleth – chair of ASHRAE's Epidemic task force– presented ASHRAE's guidelines. Valérie Leprince – member AIVC COVID-19 working group & ASHRAE's Epidemic task force– had a closer look into the similarities and differences in both guidelines.

Due to the high numbers of attendance, there were several questions addressed to the speakers who did not manage to answer to all within the event's timeframe. This article includes edited transcripts of the answers given by the speakers during the event and provides answers to the non-answered questions.

Questions addressed and answered by Jarek Kurnitski– chair of REHVA COVID-19 task force during the webinar.

- ***If central recirculation cannot be used, what about the transfer of air from one room to another (e.g., through corridors, when the doors are open)?***

Jarek Kurnitski: *"REHVA has no specific recommendation. However, when the doors are open then air can circulate in a way. This effect could be similar to re-circulation. It would thus be reasonable to keep the doors closed when everybody is sitting in their office room (cellular office layout)."*

- ***In the previous guideline released (V03), REHVA was recommending a maximum 5% recirculation rate for rotary heat recovery sections or within AHUs in general. This limit is not mentioned anymore in V04. Is there a reason? Is there any limit?***

Jarek Kurnitski: *"It is included in v04. This is basically the leakage rate; the 5% is based on the current standards (EN 16798-3:2017) which is a reasonable value. For existing systems, the leakage should be less than 5% and should be compensated with increased outdoor air ventilation."*

- ***Given that the evidence is showing that mechanical ventilation is the best way to mitigate the infection rate in buildings, do you think that we are going to begin to move away from natural ventilation?***

Jarek Kurnitski: "Mechanical ventilation can provide a very stable air flow rate. Basically, the question is about the amount of outdoor air ventilation, no matter with which ventilation system this is achieved. In most cases the easiest way is to use mechanical supply and exhaust ventilation, especially because of thermal comfort issues in the winter. Otherwise, we have many hybrid and natural ventilation systems in use, but it is a challenge to be sure that the air change is good. In the longer run it also a challenge to operate buildings with natural ventilation; it is a lot of heating cost (that is against the very strict EP requirements) in which case MHRV is needed.

- ***How long does the virus survive in HEPA filtration?***

Jarek Kurnitski: *"3 hours in the air and a number of days on the surface (depending on the surface); sometimes even a week."*

- ***If there is a mechanically ventilated room that is being used by 1 person at a time, how long do we need to consider it safe for a second person to use it?***

Jarek Kurnitski: *"You need 3-time constants (inversed value of ACH) to remove 95% of pollutants in the air. So, the room needs to be ventilated with 3 air volumes. If the ACH is 1 then you will need 3 hours; if the ventilation rate is higher, you 'll need much less e.g., in well ventilated meeting rooms 30 min is quite sufficient."*

- ***Do you see any value in UVC or bipolar ionisation?***

Jarek Kurnitski: *"Yes. UVC is a way to inactivate the virus. This can be applied to the so-called Upper room UV devices or in the return air - duct installation of UV lamps. UVC devices are more widely used in the US while in Europe their use is largely limited to hospitals."*

Questions addressed and answered by William P. Bahnfleth – chair of ASHRAE's Epidemic task force during the webinar.

- ***What is the efficiency of portable air-cleaners to remove SARS-CoV-2 from classrooms?***

William P. Bahnfleth: *"Typically, if they are rated devices, portable air-cleaners are selected for their clean air delivery rate (essentially the product of flow rate and efficiency). The Association of Home Appliance Manufacturers has a test procedure for removal of particulate matter by portable air cleaners. The required clean air delivery rate to a classroom depends on what the ventilation rate and filter performance of existing systems is. It has been suggested that 5 – 6 air changes per hour of virus free air is a good target. A calculator produced by Harvard University and the University of Colorado calculator for schools allows the user to enter information on the ventilation and filtration that already exists determine the portable air cleaner capacity is needed."*

- ***We are seeing UV systems being installed but mainly single tube UV systems for coils or for ducts. Does ASHRAE have guidelines on minimum install of UV to include (FPM) for exposure to protect end users from poorly done installs?***

William P. Bahnfleth: *"In the US, UV has had more acceptance and interest for a long time. ASHRAE has a technical committee on UV. It is not a question of how many lamps are needed. There is a dose response model for exposure to germicidal light. Working with that exponential disinfection relation and knowing the rate constant of the microorganism - its susceptibility to UV – the require dose can be determined. The dose is a function of the UV irradiance or fluence. Once that has been determined, a configuration of lamps can be developed that will deliver it. This should be worked out with the manufacturer and based on the characteristics of the sources."*

- ***How is the ASHRAE Standard 62.1? e.g., how many litters of fresh air should be provided per person per second normally?***

William P. Bahnfleth: *"The goal of ASHRAE Standard 62.1 is No harmful concentration of contaminants as established by cognizant authorities and 80% of those exposed to not express dissatisfaction. Basically, it goes back to experiments like those of Fanger and others on the relationship between*

ventilation rate and satisfaction level. That leads to a requirement of about 7 litters per second per person for 20% dissatisfaction. Ventilation rates required for effective infection control may be much higher."

- ***The HVAC industry historically does not seal filters and many systems cannot be sealed due to track design. What is ASHRAE's stand on sealing the higher efficiency MERV 13 filters when 1) folks do not seal & 2) the system cannot be sealed?***

William P. Bahnfleth*: "This is something that we are aware of and concerned about. In ASHRAE's detailed guidance we discuss taking steps to avoid bypass of filters, for example by taping over the gaps between them."*

- ***If filtration is not 100%, and fresh clean SARS CoV-2 free air is 100% effective, then is a plate type energy recovery technology (less than 0.1 % or zero cross contamination) not an option? Energy recovery would negate energy penalty.***

William P. Bahnfleth: *"We are all in favour of using energy recovery that doesn't result in unacceptable levels of re-entry. It is impossible in a lot of cases to limit re entrainment to zero even from exhausts on the outside of the building into outdoor air intakes; the goal is to have it be low enough that is not a concern. So, we certainly support energy recovery as a way of reducing the impact of ventilation. Unfortunately, it's still significant even with energy recovery".*

Questions addressed and answered by William P. Bahnfleth – chair of ASHRAE's Epidemic task force & Jarek Kurnitski– chair of REHVA COVID-19 task force during the webinar.

- ***Both REHVA and ASHRAE do not pay a lot of attention to the (horizontal) air flows and directions. This seems to be an important factor in the (super) spreading. What is the opinion of the panel about this and should this item get more attention in guidelines?***

Jarek Kurnitski: *"Yes, in our new guidance we have put the limit for the velocity; its 0.3m/sec what we see as a threshold for this type of mostly horizontal airflow or any direction it can be; 0.3m/sec is recommended in our guidance to control the air distribution design."*

William P. Bahnfleth: *"The statement in the guidance is to avoid strong horizontal air currents that can cause transmission from person to person so it's the same concept. We have not quantified it with a specific velocity limit but use of personal fans and pedestal fans that are sometimes used for ventilated comfort cooling in indoor spaces is discouraged because we have evidence that its important. An important general point about air distribution is that to a large extent, during the pandemic, we must accept whatever a building has. I think that some of these considerations about air distribution may become very important in thinking about what standards will look like in the future".*

- ***In my view, in order to know if we are effective on any application, we need to monitor CO_2, PM and humidity. I see a lot of ideas and applications being applied but I am not seeing results published with real time monitors. What is the recommendation from both sides?***

William P. Bahnfleth: *"The interpretation of CO_2 measurements requires understanding that the average member of the public may not possess. A low CO_2 concentration in a space may simply mean that it is lightly occupied, but not necessarily well ventilated from the perspective of infection risk reduction. I don't think ASHRAE or REHVA believes that manipulation of humidity or temperature is highly important*

in mitigating COVID-19 based on all the evidence. So, I don't think that is critical. One could monitor PM but having an infected person in an indoor space is not going to change the background PM profiles. So, I don't think you can determine that there is an infected person there simply by looking at PM levels and CO_2".

Jarek Kurnitski: *"I agree with Bill. CO_2 is just a useful proxy for ventilation already now used in many buildings to be measured. When you control your airflow rates based on the CO_2 it is important to overrule these settings so that these systems will operate at full capacity (e.g. in demand controlled systems)."*

William P. Bahnfleth: *"I think this is one of the things that we go back and forth in our thought process; demand control ventilation for odour where every person in the space is a source makes a lot of sense. In that case you are controlling the ventilation in proportion to the source strength, but if you have 1 infected person in a space it doesn't matter whether you have 5 or 10 uninfected persons in the space; each of them has the same risk of airborne exposure based on the Wells-Riley model even though the CO_2 concentrations would be quite different. That is why we are not certain that it is possible to set a CO_2 set point for infection control. If you look at healthcare ventilation standards, you will see that they use air changes as the basis, not ventilation rate per person and I think that may be the reason why".*

Jarek Kurnitski: *"Yeah that's a good point but let's say especially in buildings which do not have ventilation systems, CO_2 is still a good indicator when you need to open a window or to arrange some other area to have ventilation. Perhaps in the EU we have more such buildings which do not have ventilation systems and very much rely on the window opening."*

William P. Bahnfleth: *"It's a good way to determine the air exchange rate under conditions that you understand, I am just not so sure about it if you don't have the other factors to put the measurement in context; I wouldn't recommend pushing the quantitative conclusions regarding a particular level too far."*

- ***CO_2 sensors obviously come at a cost and will need to be recalibrated to be accurate. Are there many options that are cost effective?***

Jarek Kurnitski: *"Yeah I think there are. For a 100-euro sensor you can expect +/- 50 ppm accuracy and indeed they will need calibration, probably every second year or something like that. These sensors have developed quite nicely."*

William P. Bahnfleth: *"What we are hoping is that we can eventually not have to use CO_2 sensors to, in effect, count people in a space and I think that technology that permits direct occupant counts is really making good progress."*

- ***How should natural ventilation through windows be used in classrooms, residential dwellings, and office buildings?***

Jarek Kurnitski: *"It is not very easy to provide any general recommendation. REHVA recommends keeping windows open at least for 15minutes; this 15min intensive window airing is needed if you are going to the room somebody else has left."*

Further questions addressed during the event and answered by all speakers after the end of the webinar.

- ***Recuperation in ventilation group (GP+GE) with wheel. We always talk about the possibility of air leakage between extraction and pulsion (delta p); but what about COVID-19 fixed on the wheel in extraction side which could afterwards escape in the pulsion side?***

Jarek Kurnitski: *"COVID-19 fixed on the wheel" means the virus inside desiccated droplets that are solid particles. There is evidence that wheels do not transfer particles, but just smells that are gas phase pollutants".*

- ***Do you see a value on Bipolar Ionization?***

William P. Bahnfleth: *"ASHRAE does not currently have a Society position on bipolar ionization. However, the ASHRAE Epidemic Task Force did reach out to the US Centres for Disease Control and Prevention (CDC) for its position on the technology. The following is the response from CDC in its entirety:*

Thank you for your question. Although this was pointed out in the earlier CDC responses, it is important for me to re-emphasize that CDC does not provide recommendations for, or against, any manufacturer or manufacturer's product. While bi-polar ionization has been around for decades, the technology has matured and many of the earlier potential safety concerns are reportedly now resolved. If you are considering the acquisition of bi-polar ionization equipment, you will want to be sure that the equipment meets UL 2998 standard certification (Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners) which is intended to validate that no harmful levels of ozone are produced. Relative to many other air cleaning or disinfection technologies, needlepoint bi-polar ionization has a less-documented track record in regard to cleaning/disinfecting large and fast-moving volumes of air within heating, ventilation, and air conditioning (HVAC) systems. This is not to imply that the technology doesn't work as advertised, only that in the absence of an established body of evidence reflecting proven efficacy under as-used conditions, the technology is still considered by many to be an "emerging technology". As with all emerging technologies, consumers are encouraged to exercise caution and to do their homework. Consumers should research the technology, attempting to match any specific claims against the consumer's intended use. Consumers should request efficacy performance data that quantitatively demonstrates a clear protective benefit under conditions consistent with those for which the consumer is intending to apply the technology. Preferably, the documented performance data under as-used conditions should be available from multiple sources, some of which should be independent, third party sources".

- ***When using air cleaners in rooms what is the max CO_2 level allowed?***

Jarek Kurnitski: *"If air cleaners are able to provide an equivalent air change per hour of 3 to 5 then higher CO_2 values can be accepted. Perceived air quality will limit CO_2 to 1200 ppm and the highest acceptable CO_2 value is 1500 ppm".*

William P. Bahnfleth: *"ASHRAE has not made recommendations for indoor CO_2 levels for reasons discussed in response to a previous question".*

- ***The recommended measures have impact on the design methodologies used by architects for new offices etc. Are their professional organisations sufficiently involved to spread this information to their members?***

William P. Bahnfleth & Valérie Leprince: *"Right now, most recommended measures are applicable in existing buildings. But indeed, this pandemic could change ventilation system design (filtration systems, maximal flowrate, etc.). European design standards have not (yet) been adapted to handle pandemic situations.*

Measures recommended by ASHRAE are generally applicable to existing buildings and are being implemented during the pandemic. It is not clear at this point how design standards and methodologies will change in the future. Before that happens, there will need to be a comprehensive assessment of COVID-19 response experience".

- ***When the air is recirculated, is it common to have the CO_2 removed, besides filtering?***

Valérie Leprince: *"No, CO_2 is not removed by common filtering systems".*

- ***How minimum is the minimum outdoor air?***

Jarek Kurnitski, William P. Bahnfleth & Valérie Leprince: *"Every country has its own regulation on how much outdoor air shall be provided; there is no general answer for that. For guidance, one can look at EN 16798-1. With typical occupant densities in non-residential buildings, minimum outdoor air rates are close to 10 L/s per person. Per-person rates resulting from application of ASHRAE Standard 62.1, the predominant standard in the US, vary widely with space type and are generally somewhat lower".*

- ***Can it be that the high air changing rate (like 12) can drastically increase the air inlet speed up to the point that can make droplets move easier (transport) from one person to another in the same room?***

Jarek Kurnitski, William P. Bahnfleth & Valérie Leprince: *"This is not an issue when supply air jets enter the occupied zone if inlets are designed for that flow rate. Current guidance focuses on increased outdoor air flow rates, not supply air flow rates. Both REHVA and ASHRAE recommends limiting the air speed and avoid strong horizontal air current for this specific reason (REHVA recommends maximum 0.3m/s)".*

- ***What do you think about Electrostatic filters applied on recirculation air****?*

Jarek Kurnitski, William P. Bahnfleth & Valérie Leprince: *"With Electrostatic filters the removal occurs by charging particles and collecting particles on plate or on mechanical air filter.*

Those systems are generally efficient but may also generate Ozone and NOx, the efficiency of those systems may also decrease with the fouling of plates, therefore they need regular cleaning.

Some standards exist to check Ozone Emission "ANSI/UL 867", IEC 60335-2-65 but do not classify the efficiency of those systems, so the manufacturer data is needed.

Fibber filter technology is capable of removing fine particles that may contain virus from recirculated air. This is a well-developed and widely used technology, so there does not seem to be a strong motivation for using other types of filters".

- ***Can continuous air quality monitoring help choose the right strategy for the space?***

Valérie Leprince: *"Most of the times No. Monitoring air quality may help to detect room stuffiness and inform the occupant for a need for more ventilation. However, in the context of COVID-19, it depends on which pollutants are monitored and whether the concentration of those pollutants is correlated with the risk of COVID transmission".*

- ***For MERV HVAC filters, is the guidance to still follow the system Manufacturer's replacement schedule?***

Valérie Leprince: *"Yes. The replacement of filters shall occur as scheduled but with adequate protection for the technician, see: "HVAC System Maintenance and Filter Replacement during the COVID-19 Pandemic"".*

- ***Can the virus pass through enthalpic heat exchangers?***

Jarek Kurnitski*: "No, the virus will not pass the membrane of enthalpy heat exchangers".*

- ***What is the amount of air flow rate through windows if there is no mechanical ventilation? Is it significant?***

William P. Bahnfleth & Valérie Leprince: *"The flowrate through windows is highly variable and depends on multiple parameters, windows area, windows location, wind speed, wind direction, temperature difference, hight of the building, etc. EN 16798-7 provides a simplified formula to calculate flowrate through windows, but it is important to keep in mind that this flowrate won't be constant and can vary from almost nothing to a very significant value".*

- ***What is the importance of ventilation effectiveness on the required amount of air changes?***

William P. Bahnfleth & Valérie Leprince: *"The ventilation effectiveness is of course very important. If known, the ventilation effectiveness should be multiplied by the flowrate and divided by the volume to obtain the air change rate per hour that matters".*

- ***What if the air is exhausted via plenum in the corridor?***

Valérie Leprince: *"In this case this is recirculated air, either the air shall be filtrated, or this recirculation should be switched off. If it is not possible the corridor should be massively ventilated with outdoor air (maybe by installing temporary fans on external doors or windows)".*

- ***Extraction from the office to the underground parking. So COVID-19 pulsed in the parking...What to do?***

Jarek Kurnitski & Valérie Leprince: *"If possible, the air should be filtrated before being rejected in the underground parking. The risk will still stay low because of high dilution and short occupancy time in such spaces".*

- ***ECDC still recommends the use of fans as it creates more air flows. Will they be changing it as well?***

William P. Bahnfleth: *"Ceiling fans that can operate in updraft mode can help to mix spaces and potentially reduce exposure. Pedestal fans that create strong air flows are hazards. A recently published*

case study found that a diner in a restaurant infected other diners 5 -7 m away due to strong air flows of up to 1.2 m/s velocity caused by the HVAC system".

- ***Do you think natural ventilation and windows opening are a solution for domestic buildings?***

William P. Bahnfleth & Valérie Leprince: *"If there is no mechanical ventilation system installed then yes, it is the only solution for domestic buildings. Fans placed in windows can help to ensure air flow".*

- ***How could the viruses be killed at the HEPA filters? Is it important to make maintenance and change the filters safely?***

William P. Bahnfleth & Valérie Leprince: *"The virus is not killed at the HEPA filters it is just captured. Yes, the maintenance change should be done safely (see ASHRAE recommendations on this topic: "HVAC System Maintenance and Filter Replacement during the COVID-19 Pandemic" in https://www.ashrae.org/technical-resources/filtration-disinfection). It should be noted that SARS-CoV-2 virus does not reproduce outside the host and loses its infectivity over a period of several hours to several days, so residual contamination of filters is likely to be low, nevertheless, it is prudent to exercise caution".*

- ***How do you see the role of CO_2 meters in classrooms to monitor ventilation (a) via windows b) via mechanical ventilation)?***

William P. Bahnfleth & Valérie Leprince: *"ASHRAE and REHVA have a different opinion on this subject ASHRAE do not think CO_2 meters are useful to stress the need for ventilation in the context of COVID while RHEVA recommends their use. One may refer to the last AIVC newsletter where this subject is discussed. https://www.aivc.org/content/aivc-newsletter-special-issue-covid-19-november-2020".*

- ***What about humidity rates?***

Jarek Kurnitski, William P. Bahnfleth & Valérie Leprince: *"ASHRAE does not discourage humidification, which has multiple benefits, but does not recommend it for COVID-19 risk reductions due to the lack of evidence that it may indeed help to reduce disease transmission (https://www.ashrae.org/technical-resources/residences-faq). The effect of inactivation as affected by humidity is small relative to the impact of ventilation and filtration. REHVA says that the current evidence does not support the view that moderate humidity (RH 40-60%) will be beneficial in reducing the viability of SARS-CoV-2 and so humidification is NOT a method to reduce the viability of SARS-CoV-2".*