ASHRAE

Q1. SHOULD WE DIRECT LABORATORY WORKERS TO OPEN FUME HOODS AS A WAY TO INCREASE AIR FLOW THROUGH THE ROOM?

A. No. Fume hoods are chemical safety devices and the proper operation should include keeping the sash closed as much as possible. Consider bringing in Environmental Health & Safety (EH&S) to evaluate the capture efficiency of the hood in a full open condition and a Consulting Engineer to evaluate the impact on the ventilation effectiveness and internal pressurization.

Q2. WHAT IS THE MOST COST EFFECTIVE MANNER TO IMPROVE THE VENTILATION WITHIN AN EXISTING LABORATORY?

A. Laboratory ventilation systems are quite complex and unique so there is not one specific solution that will work for most labs. Consider bringing in EH&S personnel and a Consulting Engineer to evaluate the impact on the ventilation effectiveness and internal pressurization.

Q3. SHOULD WE BE USING CASCADES SYSTEMS MOVING FORWARD CONSIDERING THAT OFFICE AIR COULD BE CONTAMINATED?

A. The general guidance at this time is that cascading air transfer systems have the potential to transfer the aerosolized COVID-19 virus from one space into the other. It is unknown if the quantity is sufficient to cause an infectious dose. If it is possible to either eliminate the cascading flow or add at least a MERV13 filter, or greater, within the transfer duct, then these steps should be considered. However, care should be taken to make sure that any alterations to the HVAC supply system does not reduce the total airflow into and out of the laboratory.

Q4. HOW DO WE CLOSE OFF CERTAIN AREAS WHILE LEAVING SOME WORKING FROM AN HVAC PERSPECTIVE?

A. It is likely that the Building Automation System allows definition of operating modes room by room. Air flow rates and other parameters can be selected for the different modes. Investigate to see if the mode features of the system can support the desired operating state of the rooms. Then consider operation of the primary systems at levels of load that result from the partially closed facility.

Depending upon the size of the areas to be closed off, it may warrant a rebalancing of airflows within the occupied areas to make sure that proper pressurization is maintained.

Q5. HUMIDITY - COME WINTERTIME ISSUE, HOW TO MAINTAIN 40-60% RH? LEAKY ENVELOPES. SOMETIMES NO HUMIDIFIERS.

A. Research has shown that the human respiratory immune system works better when the relative humidity is between 40 and 60%. If the existing HVAC system does not have a humidifier, the HVAC system needs to be evaluated to determine whether a humidification can be added and the impact adding humidification will have on the HVAC system and the building envelope. If humidification cannot be added to the HVAC system, utilizing portable in-space humidifiers should be considered. Further guidance on humidification is available the ASHRAE Healthcare ETF Guidance Document. However, increasing the RH above design values is not generally recommended.

Q6. IN A LAB THAT IS 100% OUTSIDE AIR, DOES FILTRATION MATTER? PATHOGENS ARE IN THE LAB, NOT OUTSIDE.

A. Additional filtration for virus capture is not necessary for systems using 100% outside air. If the system includes heat recovery, refer to the Practical Guidance for Epidemic Operation of Energy Recovery Ventilation Systems.

Q7. HOW CAN VENTILATION BE RECONCILED WITH ITS EFFECTIVENESS IN ELIMINATING CONTAMINANT EMISSIONS WITHOUT AFFECTING THE PERFORMANCE OF FUME HOODS, ESPECIALLY THOSE WITH LOW FACE VELOCITIES?

A. It is likely that the existing ventilation rate in the lab is higher than rates suggested to limit infection. Further increase in the ventilation rate may not be warranted. Furthermore, as postulated, increases in the ventilation rate may adversely impact the effectiveness of containment devices by increasing vertical flow rates and turbulence across openings. If the current system is considered highly effective (no dead zones, no drafts, good directional flow) do not change it without careful evaluation by Consulting Engineer and Environmental Health & Safety personnel.

Q8. AS OWNERS, WHAT IAQ PARAMETERS SHOULD WE BE MONITORING? WHAT ARE THE CORRECT TOOLS AND METHODS TO MONITOR?

A. There are a number of variables that may impact IAQ and the potential transmission of aerosolized viruses in the built environment. However, key indicators of IAQ include:

- Particle counts can help identify transmission pathways and the potential for exposure to aerosolized viruses.
- TVOCs measurement can help mitigate odors due to increased cleaning and have been shown to impact productivity.

- Relative humidity is a key determinant of comfort and potentially can impact surface survivability of SARS-CoV-2 among other airborne pathogens.
- Temperature is a key indicator of the ventilation systems ability to deliver adequate airflow.
- CO_2 can also be a key indicator of inadequate ventilation.

These parameters are important in all space types; however, they have increased importance in laboratories based on the nature of the work undertaken in laboratories and the increased importance of adequate airflow.

Q9. WOULD HOOD PLACEMENT DIRECTIVES CHANGE? CSA 315?

A. Hood placement directives have been put in place to ensure containment and reduce the chances of hoods being challenged and hence increase the possibility of a breach. Therefore, the placement of hoods is not expected to change.

Q10. CAN CFD EVALUATIONS OF FULL FACILITIES AND ALL THEIR SPACES BE MADE BOTH RELIABLE AS A DESIGN TOOL AND COMMERCIALLY FEASIBLE, COST AND SCHEDULE (DESIGN OR RE-DESIGN) EFFECTIVE? IF YES, HOW?

A. CFD assessments of the ventilation effectiveness of space are becoming more reliable and cost effective. Much of this is due to increase in computational power and data storage. CFD analyses, if performed properly with adequate expertise, can be an effective design tool.

Q11. WHAT TOOLS ARE AVAILABLE TO IDENTIFY AIR TRANSMISSION RISKS WITHIN THE EXISTING LABORATORY ENVIRONMENT?

A. Ventilation effectiveness of laboratory HVAC systems can be evaluated by the following tools. These are listed in the order of complexity and comprehensiveness of the results.

1. ***Bulk flow Analysis***
   This technique assumes “well-mixed” conditions in a lab space. Dilution equations either in a steady-state or in transient format can be employed to estimate the extent of dilution by computing an average well-mixed concentration of contaminants. A simple spreadsheet can be developed for this analysis or by running the NIST CONTAM model. This is a zero-dimensional analysis, and hence, cannot predict spatial and temporal variations of contaminant concentration and resulting exposure of occupants. This technique can be used for existing facilities as well as for new conceptual designs. This can be used for rough estimation of dilution.
2. ***Smoke Visualization***
   Airflow Visualization Tests are conducted by generating a visible plume of smoke or other aerosol to observe airflow patterns in the vicinity of the source. However, such visualization is

subject to the tracer release location, tracer properties, release rate and techniques employed for release of the tracer/smoke. Though such technique can provide visualization of airflow movement in space, it cannot provide any qualitative information on the potential distribution of contaminants. Also, how the space is lit, and the perspective taken by the observer, can highly influence the results. This technique is useful only for the existing facilities.

3. ***Tracer Gas Analysis***
   Air tracer techniques can be employed for the existing facilities to challenge ventilation systems and evaluate their ability to dilute and remove aerosolized pathogens. Ventilation Effectiveness Tests that employ air tracer tests can be used to measure accumulation and decay of concentration at certain discrete points in a space under the prevailing operating conditions. Air Tracer Tests involve generation of gases and particulates to simulate contaminant emissions and sensors to detect the migration, accumulation and dilution of contaminants within the space. However, such information is limited to the number, locations and type of sensors utilized during the test. Data collected at a few points in space may only present a limited picture of an entire 3D distribution in a space. Once again, this technique can only be applied for existing facilities.
4. ***Computational Fluid Dynamics (CFD) Analysis***
   CFD analysis involves numerical solution of three-dimensional equations of air motion, heat transfer, mass transfer and similar transport process. CFD analysis can predict and help visualize the most comprehensive three-dimensional airflow patterns, flow path of airborne contaminants and resulting distribution of contaminant in a 3D space. If performed properly with adequate expertise, CFD analysis can be an effective design optimization tool both for the existing and new facilities. During the early design process, CFD analysis help identify issues related to contaminant hazard and test various mitigation strategies before construction. However, CFD analysis requires expert knowledge of the science of numerical simulation, fluid mechanics and transport processes with adequate computational hardware and robust software. Furthermore, it is often evaluating a static condition, the movement of people, the opening of doors and the addition of high plug loads and large equipment can significantly alter the airflow conditions within the lab. So, it is often used as a design tool to define the optimum placement of supply diffusers and exhaust vents but may not represent actual conditions at any given time in the lab (this is common for all of these techniques).

Q12. WILL ASHRAE 62.1 UPDATE OUTDOOR AIR REQUIREMENTS FOR THE LAB AREAS?

A. No, new requirements are available for the ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality Standard at this time.

Q13. WE OPERATE AN OLD CONSTANT VOLUME LAB AND HAVE CONCERNS AROUND PRESSURIZATION. HOW IMPORTANT IS PRESSURIZATION AS IT RELATES TO THE TRANSMISION OF COVID BETWEEN OCCUPANTS IN ADJACENT SPACES?

A. When we don't know the location of the infected person, space pressurization is not a tool to prevent transmitting the virus. Nevertheless, building managers are advised to verify space pressure relationships and correct deficiencies. If infections occur, you will not be glad to learn that incorrect space pressurization contributed.

Q14. CONSIDERING WE ARE 100% OUTSIDE AIR, IS A 2M SEPERATION STILL REQUIRED FOR SOCIAL DISTANCING. LABS USE MUCH MORE AIRFLOW AND WE HAVE READ THAT THE AMOUNT OF OUTSIDE AIR AND VENTILATION EFFECTIVENESS IS CRITICAL. LABS SHOULD HAVE BOTH OF THESE ITEMS. HOW DOES THAT HELP US?

A. The recommended separation distance of 6 ft (2m) is based on the potential projection of large virus containing droplets being expelled through the mouth and nose. Increased ventilation will have little or no impact on the projection of these droplets (if anything, higher air flow rates may actually increase the lateral travel of these droplets, suggesting an increase in the recommended separation distance).

Therefore, even if lab ventilation systems might be more efficient than other type of spaces at dispersing aerosolized viruses, all recommendations from the Authority having jurisdiction such as CDC or Health Canada should be considered as minimum requirements even in lab.

Q15. FOR LABS WITH NO GENERAL EXHAUST - EXHAUST IS ONLY THROUGH HOODS, HOW CAN WE INCREASE AIRFLOW?

A. Depending upon the type of fume hood or biosafety cabinet installed, it may be possible to increase both supply and exhaust volume flow rates. For example, low flow hoods which are designed for a face velocity of 50 fpm (0.25 m/s) may continue to work properly if the face velocity is increased to 100 fpm (0.5 m/s). However, as discussed in Q1, this increased airflow should not be attained by simply increasing the sash heights, as this might reduce the containment effectiveness of the fume hood. As such, arbitrarily increasing the airflow within the laboratory is not recommended. If you are concerned that your lab lacks proper air flow, consider bringing in EH&S personnel and a Consulting Engineer to evaluate the opportunities to increase volume flow rates.

Q16. LABS ARE 100% OUTSIDE AIR. DO WE NEED TO CONSIDER PURGING THE ROOM BETWEEN LAB SHIFTS? HOW LONG? LAB CONTROL CHANGES?

A. Yes, a ventilation purge is recommended between occupied periods (which would also include shift changes). The time period of the purge cycle depends on the ventilation rate. ASHRAE guidance is to have at least three (3) air changes between occupied periods.