

Working with nitric acid: Dependent on the concentration (higher concentrations are more dangerous), recommendations are to use a face shield and splash goggles and use only in well-ventilated areas, i.e., fume hoods. NOTE: when working in a hood with nitric acid, make sure all incompatible materials are removed. Most fume hoods are not rated for nitric acid work, and extensive use of this chemical can corrode components of the hood ventilation system. Respiratory protection recommended is dependent on exposure.

Storage: Keep away from incompatible materials: Alkali metals, reducing agents, cyanides, aldehydes, powdered metals, ammonia, and acetic anhydride, organic acids, and all organic materials including organic solvents. Because of the high number of incompatible materials, ideally nitric acid should be stored in its own cabinet, in its original container away from direct sunlight. Keep the container within secondary containment (Nalgene/polypropylene tray or tub). If possible, store in a cabinet made of plastic laminate rather than wood or metal. Do not store above eye level.

Disposal: Nitric acid is incompatible with many materials and nitric acid waste should be segregated, including from other acids.

—Christina Bisulca, *Detroit Institute of Arts*, and Molly McGath, *Associate Research Scientist, The Mariners' Museum and Park, Newport News, VA*

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Protecting People Versus Artifacts: Resolving the COVID Conflict

Major changes to surface cleaning and HVAC operation are being made in an attempt to control the spread of COVID-19. When it comes to museums, however, these modifications can be damaging to collections. This article questions the need for COVID control measures which impact air quality and thus create conditions contributing to artifact deterioration. Alternative strategies are presented which minimize occupant health risk while protecting collections.

COVID studies show that most infections are transmitted directly by a nearby individual, which neither HVAC systems nor sanitizing can prevent. While costly upgrades to air-conditioning and cleaning are being advocated to address the pandemic, available information suggests that relatively minor HVAC adjustments and cleaning enhancements may be sufficient to minimize COVID-19 spread, especially when personal infection control measures (masking, social distancing, handwashing, case identification/isolation) are in place and are now being reported as the most effective measures for reducing the spread of this disease.

Understanding how COVID-19 is actually spreading in buildings is critical to establishing a prioritized and evidence-based COVID response program. Review of the related science indicates:

- › Nearby exposure (within several feet of an infected individual) is the primary transmission route.

- › Airborne transmission (caused by exposure beyond several feet) has been associated with COVID spread in situations where ventilation is very poor, but this appears to be relatively infrequent, overall.
- › Based on review of the scientific literature, no studies were found showing that recirculating HVAC systems with return air discharge virus into other areas or that HVAC re-circulation has been associated with COVID transmission. Sites have recently been documented where surface samples collecting inside HVAC systems of filters and exhaust duct tested positive for total virus but were negative for infectious virus. (Ben-Shmuel et al. 2020, Light 2021a)
- › Similarly, fomite transmission (contact with contaminated surfaces) appears to play only a minor role in the overall spread of COVID-19. Although the virus responsible for COVID-19 (SARS-CoV-2) is widely dispersed on surfaces from an infected occupant, field tests for infectious virus have generally been negative. The REALM study of surface contamination of collections has found that most SARS-CoV-2 inactivates quickly and is no longer detected on many types of materials within several days to a week. (OCLC and IMLS 2020, Light 2021b) Epidemiology has not documented fomite transmission of COVID-19, and assumptions that COVID spreads by surface are based on similarity to other respiratory infections, such as flu.

SURFACE CONTAMINATION

Enhanced sanitizing programs are now being implemented to address potential fomite transmission. However, these treatments can impact susceptible artifacts. For example, use of strong, volatile (i.e., chlorine-based) disinfectants increases air corrosivity, exposure to UV light causes deterioration, and fogging deposits chemicals on surfaces.

Conservators are considering data from the REALM study to determine if materials from a potentially contaminated area can simply be quarantined for a period of time and then handled without treatment. (OCLC and IMLS 2021) Based on findings to date, the health risk from handling these objects after a period of quarantine might be considered acceptable, with the precautionary recommendation to continue to wear gloves or wash hands frequently, and wear face coverings per local and institutional requirements. With respect to treatment of other surfaces (i.e., structural, furniture, furnishings), limited use of sanitizers with relatively low volatility and corrosivity (i.e., some products used around hospital patients) may be consistent with materials conservation. Exposure to UV light used to control SARS-CoV-2 on surfaces or in the air is always inconsistent with protection of artifacts.

Even though the risk of COVID-19 infection through fomite transmission appears to be low, regular sanitizing of surfaces subject to frequent touching and periodic sanitizing of other surfaces is a good precaution. However, this must be done carefully and selectively to protect collections. Again, frequent handwashing and identification/isolation of infected occupants may be the most effective measures for minimizing fomite transmission.

AIR CONTAMINATION

Recommendations for controlling airborne SARS-CoV-2 encourage maximizing ventilation and filtration and suggest various air treatments. Careful consideration of the outcomes of these measures with all stakeholders is important for both people and collections, along with exploration of other possible options for providing a safe environment.

INCREASING VENTILATION

Epidemiology suggests that addressing areas with very poor ventilation can lower SARS-CoV-2 virus transmission. Increasing fresh air to a poorly ventilated space can dilute the airborne virus concentration, thus reducing potential exposure. However, substantial increases in ventilation are costly and can also have adverse environmental effects. Increasing outside air requires more energy use and raises utility costs. It will also make the building uncomfortable as the system's capacity to condition outside air is exceeded. Under some weather conditions, introducing excessive outside air can raise



REALM

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<https://www.oclc.org/realm/home.html>

or lower indoor humidity which can contribute to dimensional changes in materials or increase exposure to outside air pollutants. Disruption of air flow patterns by HVAC modifications for COVID can also contribute to increased particulate deposition on artifacts in some areas. Opening windows to allow in outside air can also provide some dilution of the virus but has even more potential for the adverse effects noted above.

While increasing ventilation can decrease viral concentration, reducing occupancy can also be effective at reducing airborne virus concentrations and may have less cost and impact on existing HVAC deficiencies, in some situations. Controlling and adjusting occupancy levels can provide a more targeted approach by focusing ventilation increases in areas where occupancy levels are difficult to reduce or involve more public use, ensuring at least minimal ventilation requirements in minimally occupied areas and eliminating ventilation improvements in areas that can remain unoccupied during the pandemic. Another option to ventilation increases may be a rethink of the workspaces, moving essential work activities currently being performed in poorly ventilated areas to areas with better ventilation — or performing the work outdoors instead of increasing ventilation in a deficient space.

INCREASING FILTRATION

If infectious virus does not inactivate or plates out on ductwork, filtration can reduce airborne concentrations. Because higher MERV-rated filters remove more of the smaller particles, recommendations often include upgrading filters to MERV 13 or higher, where airflow restriction will not adversely affect building conditions. However, higher efficiency filters have not been shown to reduce COVID-19 transmission and tend to cost more. Study of this important issue has been limited to measurement of virus deposited on duct surfaces before and after filters. While a MERV-10 pre-filter reduced the amount of deposited SARS-CoV-2 by approximately 70%, downstream the MERV-15 final filter did not further reduce virus. (Horve et al. 2020, Light 2021c)

Rather than upgrading to higher efficiency filters, a lower-cost way to improve removal of SARS-CoV-2 is to identify and seal the bypass area around currently used filters. HVAC filters often do not fit tightly in their frames, allowing air to pass through without particle removal. Eliminating bypass also improves general indoor air quality.

AIR TREATMENTS

Before choosing any type of air treatment to help reduce SARS-CoV-2 virus transmission, carefully research its effectiveness, application, and impacts. Many treatments may need to be used only in unoccupied areas and may be toxic or destructive to contacted materials. ASHRAE provides [guidance](#) on multiple types of filtration and disinfectants. (ASHRAE 2021) If you are choosing a particular treatment specifically for the SARS-CoV-2 virus, ensure that it has actually been tested and proven to help reduce transmission for this particular virus.

With respect to potential treatment impacts on materials, discharge of ozone (i.e., ozone generators, electrostatic precipitators, some air purifiers) directly damage surfaces, reactions with background VOCs by ozone and negative ions (i.e., bi-polar ionization) can increase air corrosivity, and humidification can cause a variety of other unwanted changes. Moreover, treatments that modify air flow patterns can increase surface soiling in some areas.

Many air treatment methods like humidification also have limits. As humidity increases from the low to the moderate range (i.e., >40%), virus survival and susceptibility to respiratory infection decrease. However, other factors can override these effects, and COVID-19 epidemiology does not show benefit by adding humidification when the RH is below 40%, the minimum level recommended by ASHRAE for COVID.

Well-placed HEPA units may be particularly beneficial to treat air in targeted areas subject to greater virus exposure, such as bathrooms and elevators. Careful design, placement, operation, and maintenance of portable HEPA units is necessary for their effective use. Portable HEPA-filter units remove virus in their immediate vicinity but can also increase occupant exposure where they direct air between occupants, draw their

return air through the breathing zone, or blow on surfaces re-suspending virus. Noise generated by these units can also be problematic.

SUMMARY OF RECOMMENDATIONS

1. Make the following personal infection control measures top priority to reduce COVID-19 transmission:

- Ensure performance of daily health screenings and encourage those who are sick to remain at home
- Test all occupants periodically, if possible, followed by detailed contact tracing and mandatory quarantine
- Social distance to the extent feasible, including difficult-to-manage activities
- Always wear face coverings whenever possible
- Wash hands frequently

2. When considering changes to surface cleaning and HVAC operation for COVID-19, address higher risk areas first:

- Poor ventilation (i.e., no outside air introduced)
- Air flow patterns concentrating virus (i.e., fans blowing virus between occupants)
- Dense occupancy (i.e., elevators)
- Additional sources of virus (i.e., bathrooms)
- Sensitive occupants (i.e., elderly)

3. Where HVAC modifications are proposed, consider the following alternatives to prevent damage to collections:

- Make occupancy adjustments to compensate for HVAC deficiencies
- Move work activities to areas with better ventilation when possible
- Instead of major increases in the overall ventilation rates:
 - Repair HVAC equipment and adjust controls where needed to restore intended ventilation
 - Start-up HVAC before occupancy
 - Disable demand-controlled ventilation
 - Adjust variable air volume to increase ventilation
 - Expand economizer schedule
 - Seal bypass around HVAC filters

4. Consider the following alternatives to prevent damage to collections where surface sanitizing is proposed:

- Instead of sanitizing collection objects, quarantine for an acceptable period of time based on REALM data.
- Sanitize surfaces other than collection objects carefully, with sufficient quality control to avoid contacting artifacts. Carefully choose products that will not emit gaseous components that may affect collection items, and preferably those with low-volatility and low toxicity.
- If you must handle contaminated collections or contact contaminated surfaces, wear gloves or wash hands frequently and utilize local exhaust ventilation, lab hoods or respiratory protection as needed.

—Ed Light, CIH President, Building Dynamics, LLC, Ashton, MD

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Air Treatment or Disinfection

Many questions have arisen about the efficacy and advisability of air treatments that aim to clean air, either within the HVAC ductwork, when expelled from a space, exhausted from a space, or while it moves within a room. While these technologies have been studied, their effectiveness is very much dependent upon air movement, the technology employed, where it is deployed, and whether research has proven that it can reduce transmission. As described on the ASHRAE website, types of disinfection include (but are not limited to):

- › Electronic Air Filters
- › Gas-Phase Air Cleaners
- › Ultraviolet Energy or UV-C energy, including:
 - LEDs
 - In-duct air disinfection
 - Upper-air disinfection
 - In-duct surface decontamination
 - Portable Room decontamination
- › Photocatalytic Oxidation (PCO) and Dry Hydrogen Peroxide (DHP); activated by a UV light source
- › Bipolar Ionization/Corona Discharge/Needlepoint Ionization and other ion or reactive oxygen air cleaners
- › Ozone
- › In-room or portable air cleaners
- › Chemical Disinfectants
- › Vaporized Hydrogen Peroxide (VHP)
- › Pulsed Xenon (pulsed UV)
- › 405 nm Visible light, sometimes referred to as "near UV" although not in the UV spectrum
- › Far UV

This list was compiled from the ASHRAE website at: www.ashrae.org/technical-resources/filtration-disinfection. The website includes more information about each technology, including a simple description of how it functions and potential hazards.

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