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TECHNICAL FACILITY INTELLIGENCE

# Reducing Risk from COVID-19 Transmission in Buildings

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# Reducing Risk from COVID-19 Transmission in Buildings

Over the last several month's buildings across the U.S., and the world, have experienced the effects of the novel coronavirus (COVID-19) with property closures and limited occupancy, causing owners to strategize around how to create safe spaces for their valued staff and clients. Being able to protect the health and well-being of all who occupy the building is now imperative. Time is of the essence to implement systems or make modifications to these properties to allow the return of staff and clients to feel comfortable and occupy their workspaces, knowing the risks of airborne exposure to a virus are significantly reduced. SiTESPAN understands this concern and can help property owners evaluate what the best cost-effective, sustainable solution is not only for today but ensuring safe spaces for the future.

This paper briefly describes SiTESPAN's review of the potential modifications to air conditioning systems that have the highest efficacy to reduce transmission risk without significantly increased operating and maintenance costs. It is essential to understand that the methods discussed here will NOT ELIMINATE the risk, but significantly reduces the potential for transmission safely and cost-effectively. If a cost-effective solution is incorporated, the reduced risk results will be sustainable; both now and when future viruses emerge.

## Executive Summary

SiTESPAN has completed a review of the typical air conditioning equipment for buildings and alternate methodologies to upgrade or change these existing systems to reduce the potential transmission of the COVID-19 virus to all occupants. The CDC guidelines regarding building workspaces[1] recommend enhanced filtration, increased outside air dilution, and longer operating hours. Each of these CDC guidelines will add considerable capital, operating, and maintenance costs, with a questionable reduction in transmission rates and without consideration of alternative methodologies that will attack the viruses with less potential costs to building ownership.

Alternate methodologies considered include in-room and in-duct germicidal ultraviolet illumination (GUV), bi-polar ionization (BPI), and photocatalytic oxidation (PCO). Based on our review, we recommend consideration of the photocatalytic oxidation (PCO) method for the following primary reasons:

- PCO will not require modification to the existing filtration, outside air ventilation, and operating hours.
- PCO continuously disinfects all surfaces in the space, not just those exposed to UV illumination.

[1] https://www.cdc.gov/coronavirus/2019-ncov/community/organizations/businesses-employers.html

- PCO does not require additional housekeeping that may be currently considered.
- PCO can be installed in-room or in-duct at a reasonable cost.
- PCO requires minimal maintenance, energy use, and operational costs.
- PCO has proven effective in reducing virus transmission risk (testing specific to COVID-19 is still being conducted).

CDC guideline recommends increased ventilation and filtration, which are questionable solutions in many properties. Other alternative methods for reduced transmission risks have been identified and are addressed below.

## Why Increased Ventilation is Questionable

In general, outdoor air ventilation rates can only be increased centrally under outdoor conditions that allow indoor temperature and humidity to remain under control. In spaces, outdoor air (if provided at all) is a fixed quantity directly ducted to the room or fan coil unit (FCU) and cannot be changed. So, this method of improvement is very limited in the capability of increasing the potential dilution of indoor contaminants.

Central air handling units sequence of operation (SoO) can be modified to optimize the amount of ventilation air by increasing outdoor airflow rates. However, increased outdoor airflow can only occur until supply air conditions exceed temperature/humidity (or dew point temperature) that will affect conditioned spaces. Typically, the periods where outdoor conditions can increase are limited, and the effective results would be minimal. These programming changes assume air handling equipment that is currently automatically controlled also has the needed economizer dampers installed. If that is not the case, then increasing outdoor air quantities will require capital cost expenditures to upgrade or remediate the existing system and controls.

## Why Increased Particulate Filtration is Questionable

The purpose of improving filtration is to capture the virus and contaminants from recirculated air systems for both central and individual room systems. Currently, minimum efficiency reporting values (MERV) ratings of MERV 13 for central air handling systems and MERV 8 for individual spaces are recommended. (Refer to ASHRAE Standard 52.2 for more information regarding MERV ratings.[2]) The CDC recommendation to include high-efficiency particulate air (HEPA) filtration is based on the relative size of virus particles to be captured and the ability of the filtration media to capture and retain the particulate. Capturing virus-laden particles in HEPA filters may also complicate the filter changeout and disposal procedures currently in place.

HEPA filters have an initial pressure drop requirement of 1.5 inches and a final pressure drop requirement of 2.5 – 3.0 inches water column. Therefore, the installation of HEPA filters to the existing central air handling units is not feasible without changes to fans, fan drives, and motor

[2] https://ashrae.iwrapper.com/ViewOnline/Standard_52.2-2017

sizes. Additionally, the space required for installation is at a premium in most mechanical equipment rooms and may negate the ability to added HEPA filtration due to physical constraints.

There is considerable discussion in the literature regarding particle size related to the COVID-19 virus and other viruses. However, the ability to modify existing air handling equipment to add HEPA filters will never be easily accomplished and most likely be unnecessary if additional treatment methodologies are used to reduce virus transmission to building occupants.

## Why Supplemental Methods Can Reduce Virus Transmission Risk

Since modifications to outdoor air quantities and increased filtration are typically not feasible options to remove viruses in recirculated air streams, additional methods were reviewed including:

- Germicidal Ultraviolet (GUV) irradiation, both in-room and in-duct
- Bi-polar ionization (BPI)[3], both in-room and in-duct
- Combination in-room or in-duct devices using HEPA, GUV and BPI
- Photocatalytic oxidation (PCO)[4], both in-room and in-duct

All these methodologies will reduce transmission risk and be employed in existing HVAC systems. Most in-room methods result in reduced occupant experience and are not the preferred method since their use, while effective, will be at the expense of and subject to occupant satisfaction. All in-room options, except upper room GUV, are very easy to employ and can be done immediately. Also not discussed herein, is the use of handheld UV surface disinfection devices that can be used by housekeeping or building operations staff.

Reducing the risk of virus transmission needs to be considered in a manner that is sustainable over the long term without significant reduction in occupant experience, staff safety in the workplace, and profitability. Each of the methods listed above has advantages and disadvantages that can be addressed as they would apply to each property.

Use of GUV for in-duct disinfection can be applied to both central systems and individual room systems but do require a relatively low flow velocity ≤ 500 FPM. With 0.25 seconds of irradiation time, it will require significantly more UV power to make an effective dose rate. It is assumed that some central systems can be modified to have extended duct lengths that would increase the irradiation time and reduce power requirements. Surface contamination can only be addressed by direct irradiation. Complications to the use of in-room GUV is the relatively low

[3] https://www.plasma-air.com/how-it-works

[4] https://www.casprgroup.com/about/

amount of air mixing, low ceilings, and low air change rates that are ideal for this type of application.

BPI uses positive and negative ions generated in-room or in-duct and supplied to the space for treatment via either standalone devices or air supply systems. They are a form of oxidation as well as an agglomeration of particles that are either captured in the filtration media or direct reduction of virus and bacteria cells, VOCs, or other aerosols. These devices can easily be added to central systems and individual room units without significant duct modifications and only minimal electrical needs. They have been tested to determine that ozone generation is not a concern when properly installed and operated. They do require the air handling systems to operate continuously to maintain the active disinfection.

PCO is a photocatalytic oxidation method that uses UV light to illuminate a proprietary photocatalytic coating, producing hydroxyl radicals (OH-), oxygen ions ($O_2$-), and the disinfection agent hydrogen peroxide ($H_2O_2$). CASPR stands for **c**ontinuous **a**ir and **s**urface **p**athogen **r**eduction and is a no-touch methodology for enhanced disinfection. The CASPR product was initially developed about 18 years ago for applications overseas where continuous disinfection in the healthcare environment was needed to reduce hospital-acquired infections[5] (HAI), which occurs approximately 2,000,000 times annually in the U.S. and results in nearly 100,000 deaths. CASPR was introduced to the U.S. in 2016 to provide a no-touch technology that does not rely only on housekeeping for disinfection and to be safely used in occupied spaces. The PCO system can be installed in-duct or standalone in-room units.

*Figure 1: In-room CASPR PCO Unit*

*Figure 2: In-Duct CASPR PCO Unit*

[5] https://www.ncbi.nlm.nih.gov/books/NBK441857/

## Recommendations

Table 1 below is a subjective comparison based upon application criteria common to building spaces. Ranking values are shown between 1 and 5, with the best options having the highest total scores.

*Table 1 - Supplemental Filtration/Cleaning Technologies Comparison Table*

| Comparison Criteria | Germicidal UV | Bi-Polar Ionization | Combined Methods | Photocatalytic |
|---|---|---|---|---|
| Low capital cost | 1 | 5 | 3 | 5 |
| Added O&M cost | 1 | 4 | 3 | 4 |
| Safety consideration for occupants | 1 | 5 | 4 | 5 |
| Adaptable to multiple property and room types | 1 | 5 | 5 | 5 |
| Long term efficacy | 3 | 5 | 4 | 5 |
| **Totals** | **7** | **24** | **19** | **24** |

Table 1 indicates approximate equal ratings for both Bi-polar and PCO technologies. However, based upon our review of the available alternative methods, we recommend PCO technology as manufactured by CASPR Group offering the highest potential reduction in virus transmission risk to both occupants and building staff, for the following reasons:

- Proven technology that has demonstrated effective virus reduction in healthcare, food service, and other types of facilities.
- In-duct units can be installed in both central and individual room air conditioning units without significant modifications to ductwork or existing filtration and are scalable for the room size.
- Disinfection occurs on all surfaces regardless of position and does not rely on direct illumination, increased mixing, airflow patterns, or additional outdoor air for dilution.
- Timed intervals for pre- and post-occupancy disinfection can be controlled by the system controls to allow normal set-back of air flows or temperatures for energy use reduction.
- Housekeeping requirements can return to normal since disinfection is continuous on all surfaces and does not rely on over-cleaning high-touch surfaces.
- Adverse room temperature and humidity that can be experienced in some properties will not affect operation.
- In-room units are scalable for the size of the space being treated.
- Side benefits include improved odor control, VOC reduction from room finishes, disinfection of food service area and ice machines, and elimination of mold spores on all surfaces.

- Can be purchased directly and maintained by the property or leased and maintained by the manufacturer via multi-year lease/maintenance agreements.
- Requires minimal maintenance and 2-year replacement of the catalyst.
- Produced in an EPA registered facility and each product is reported and tracked by CASPR Group to maintain efficacy and replacement requirements.

To establish a plan forward, in mitigating the risks of viral exposure to building occupants, SiTESPAN recommends the following steps:

- Plan a review process involving facility decision-makers and SiTESPAN, with the purpose of outlining a step-by-step review, decision, and implementation plan.
- Design “in-room” testing, including baseline, pre-and post-testing phase. Utilize in-room Petri dish and swab sample methods. SiTESPAN would help locate and select a third-party auditing firm for the test procedures, and review of the final test data.
- Complete an on-site assessment of the central and/or individual room air conditioning systems to determine the most cost-effective method for the reduction of risk potential. The assessment team would include engineering and construction personnel to develop the best mix of design, means-and-methods, and lifetime cost. This assessment and recommendations would be presented to management in a final report.
- Incorporate simple monitoring methods to air handling units and individual room fan coil units to allow visual verification of system operation. The provision of training, and/or providing maintenance support, should be included.
- Work with Property Management and Operations Staff to design and implement a phased schedule, which would facilitate the shortest timeline for implementation of the new systems.
- Provide the turn-key installation of the new systems; while providing a single point of responsibility, cost and schedule controls, and constant progress reporting.

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*DISCLAIMER: SiTESPAN, LLC is not connected to nor sponsored by CASPR Group for the recommendation of their products. This is an independent review and represents the evaluation opinion of Norm Nelson, PE, as an employee of SiTESPAN, LLC.*

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