

ASHRAE TC 5.2 White Paper

Return Ductwork Requirement for Airborne Pathogens Through the Airstream

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No magic bullet exists to defeat COVID-19. A long list of steps, protocols and mitigation techniques have been used to help keep people safe and healthy for more than a year. These include everything from handwashing and face coverings to ventilation, filtration and disinfection of a building's air. Technical societies such as ASHRAE, companies and governments have collaborated to find holistic solutions to minimize COVID-19 infection and spread, including solutions in the built environment.

More than ever before, indoor air quality has become a hot topic, even among non-HVAC professionals. But, for those who ensure systems are working up to their design intent, keeping up with new standards, protocols and recommendations is ongoing. In a new white paper approved by ASHRAE Technical Committee 5.2, Duct Design, ducted return versus plenum returns are discussed to address safety, efficiency and code compliance. This white paper, "Return Ductwork Requirement for Airborne Pathogens Through the Airstream," is available at the Technical Committee's website.¹ Members of this subcommittee who authored the white paper consist of leadership from the Technical Committee and a balanced representation from building owners, industry organizations and manufacturers.

A building engineer's ability to reduce pathogen transmission in existing buildings is limited by the original mechanical system design, the original installation

achieving design intent, and proper maintenance by a skilled, trained and certified technician. Two approaches he or she has to reduce pathogen transmission are pressure barriers and airflow distribution.

Per the International Mechanical Code (IMC) and the Uniform Mechanical Code (UMC), commercial buildings can use the cavity above a finished ceiling as a return air plenum to the air handler to be combined with supply air—in cases of occupied commercial and industrial facilities—and reconditioned as supply air. But, there are considerations to be made when doing this.

Open ceiling plenum returns limit a building engineer's capabilities to reduce pathogen transmission by removing fundamental aspects of pressure barrier and airflow distribution strategies. Safety concerns exist as

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well regarding daily maintenance tasks, infiltration, source control and introduction of additional airborne particulates that may compromise indoor air quality and reduce the ability to disinfect. A common term used to describe these return air systems is “wild,” since they are so difficult to control.

With a ducted return—instead of a ceiling or attic plenum—a testing, adjusting and balancing (TAB) technician has the capability to maintain the duct as well as adjust room pressures, modify airflow patterns and stay safe from exposure to biologically active pathogens within the airstream and on the surfaces around them. Besides providing a level of thermal control, return ducts also help avoid reducing building occupants’ immune responses by providing conditioned air at a controlled indoor temperature and relative humidity optimal for occupant health.

ASHRAE reported in an April 2020 position document that viruses such as the one that causes COVID-19 can spread through the air in two ways: larger droplets can travel 6 ft to 7 ft (1.8 m to 2.1 m) before dropping to the ground, but smaller droplets can mix with room air, remaining airborne for extended periods of time.²

While a ducted return can be cleaned and disinfected using established methods, a ceiling plenum cannot, leaving facilities personnel working inside it at risk of exposure.

“Airborne transmission of SARS-CoV-2 is significant and should be controlled,” ASHRAE released in a statement. “Changes to building operations, including the operation of heating, ventilation and air conditioning systems, can reduce airborne exposures.”³

Because of this, ceiling plenums are a health concern for anyone working inside them. They also limit the ability to create pressurized rooms during a pandemic, introduce potential infiltration, reduce source control and lack the ability to be cleaned or disinfected.

During a pandemic, when medical office buildings, wellness centers and school nurse stations are being transformed into alternate care sites for COVID-19 patients, a TAB technician has to be able to adjust a room between positive, neutral or negative pressures. Return ductwork allows room pressure differentials to be accurately adjusted to maintain a consistent setpoint. Ceiling plenums simply cannot be controlled in this manner.

Ceiling plenums also represent a hazard besides that posed by COVID-19. In buildings constructed before 1980, asbestos, polychlorinated biphenyls and dust and

particulates containing heavy metals may be among the hazardous materials introduced to workers inside ceiling plenums. Ceiling plenums also can have microorganisms develop over time through leaks and condensation from uninsulated pipe or duct. Any maintenance activities—even by a worker in proper protective gear—can agitate particles and fungal spores that can enter the airstream.

Given the health and safety benefits of return ductwork, ASHRAE Technical Committee 5.2 supports the white paper’s recommendation that ducted return systems be used in all new buildings, core renovations and additions as prioritized by occupancy classification and use.

Due to the urgency to provide health-care environments that do not increase the spread of COVID-19, medical facilities are recommended as the first priority to install ducted returns for any new construction, core renovations and building additions. Education facilities are recommended as a second priority, due to the volume of occupants that would use those facilities. Assembly areas, business, factories, commercial and residential facilities are third priorities.

Some benefits exist to a ceiling plenum return, such as energy efficiency and a reduction in labor and materials costs. The decrease in HVAC system costs is due to the lack of return ductwork, including labor, time and materials. Compared to a ducted return, plenum returns can result in reduced fan energy consumption due to lower plenum return resistance, as well as with the use of passive relief or relief fans instead of return fans.⁴

The need to balance these benefits with health and safety concerns has never been more important than it is today. Adoption of these recommendations will address this need, making buildings more resilient to biological and indoor environmental hazards.

References

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3. ASHRAE. 2021. “ASHRAE Epidemic Task Force Releases Updated Airborne Transmission Guidance.” ASHRAE. <https://tinyurl.com/ecjd99bs>
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