HVAC SOLUTIONS

For Reducing Airborne Pathogens - New Construction

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Ventilation and filtration provided by heating, ventilating, and air-conditioning (HVAC) systems can reduce the airborne concentration of SARS-CoV-2 (the virus that causes COVID-19) and thus the risk of transmission through the air.[1]

From improved filtration to alternative supply air methodologies, changes to your HVAC system can reduce the probability of exposure to airborne pathogens within workplaces, schools, and other high occupancy areas.

Particle size & suspension time comparison

COVID-19 VIRUS
<1 µm in diameter
Can remain suspended for hours

BACTERIA & AEROSOLS
<5 µm in diameter
Can remain suspended for hours

POLLEN & DROPLETS
5-100 µm in diameter
Can remain suspended for minutes

HUMAN HAIR
20-180 µm in diameter
Suspended for seconds

*1 µm = micrometer = 0.000039 inches

REDUCING AIRBORNE PATHOGENS

Most North Americans spend approximately 90% of their time indoors, whether they are at school, at work, or out shopping, so indoor air quality (IAQ) can have a significant effect on the health of the population.

The quality of the air delivered by an HVAC system is commonly measured by its ventilation effectiveness, which is the ability of the system to remove internally generated airborne pollutants from a space. Generally, the HVAC system removes pollutants through the introduction of fresh, clean air and removal of polluted air. Ventilation Effectiveness, the quantity, is a function of Room Air Distribution airflow patterns and is measured as: Concentration of contaminants in Return / Concentration of contaminants in Occupied Zone.

This can be done through:

1. Removing contaminants with filtration to reduce the overall concentration of contaminants.
2. Diluting the number of contaminants in the space by increasing air change rates, specifically with filtered or fresh outdoor air.
3. Increasing ventilation effectiveness, through well designed air movement, such as displacement ventilation and underfloor air systems.

Price can supply solutions that use the above methods to best suit your application, fit in your budget, meet project time lines, and provide improved indoor air quality for occupants.

[1]https://www.ashrae.org/technical-resources/resources

STRATIFIED AIR SYSTEMS THAT PROMOTE OCCUPANT WELLNESS

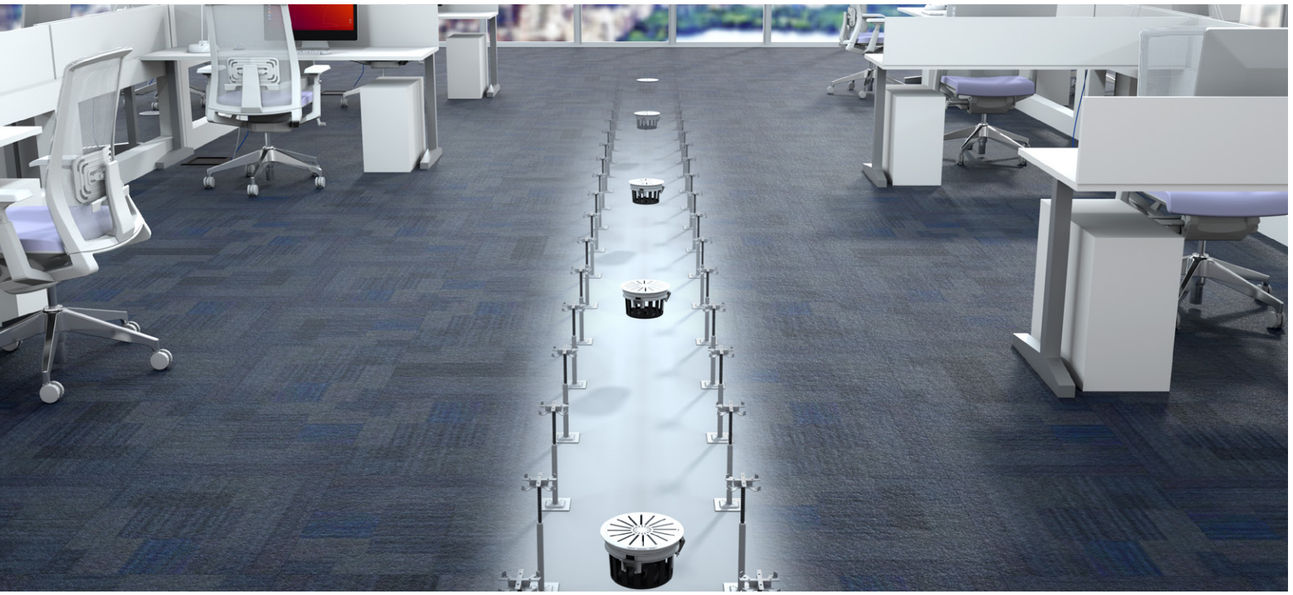
For larger scale remodels, renovations, or new construction consider Underfloor Air Distribution or Displacement Ventilation.

IMPROVED OCCUPANT WELLNESS

Stratified Air Systems deliver air directly into the breathing zone pushing contaminants up and out of the space. The results are improved indoor air quality, and less contaminants and airborne pathogens in the occupied zone.[2,7,8] **Research studies have found that stratified air system ventilation effectiveness can be twice as high as mixing systems.** [Price Engineer's HVAC Handbook, Ch4 Table 4.1]

INCREASED FLEXIBILITY

Underfloor service and air delivery can cut reconfiguration costs and time significantly through easily accessed power and data cabling and non-ducted air devices. This will reduce long term costs as businesses adjust to meet continually evolving office requirements for occupant density and furniture layouts.[2,9]



Underfloor Air Distribution (UFAD) is an alternative to traditional overhead air distribution that delivers air from a pressurized air plenum beneath a raised access floor, relying on the natural buoyancy of air to remove heat and contaminants.

[2] Bauman, Fred, P.E., Center for the Built Environment (CBE). (October 2007). TechNote Topic: Air Change Effective of UFAD and DV Systems Compared to Overhead Mixing Systems.

[7] Hines. (2018, December 11). Underfloor Specs. Retrieved from 609 Main at Texas: http://www.609mainattexas.com/#techspecs

[8] Alspach, Peter, P.E., & Moellenberndt, Anne Marie, P.E., Copyright ASHRAE. (2014). Impatient Optimism. Posted at: https://www.hpbmagazine.org/

[9] NSF/IUCRC Center for Building Performance and Diagnostics at Carnegie Mellon University (2004). Advanced Building Systems Integration Consortium: Guidelines for High Performance Buildings 2004.

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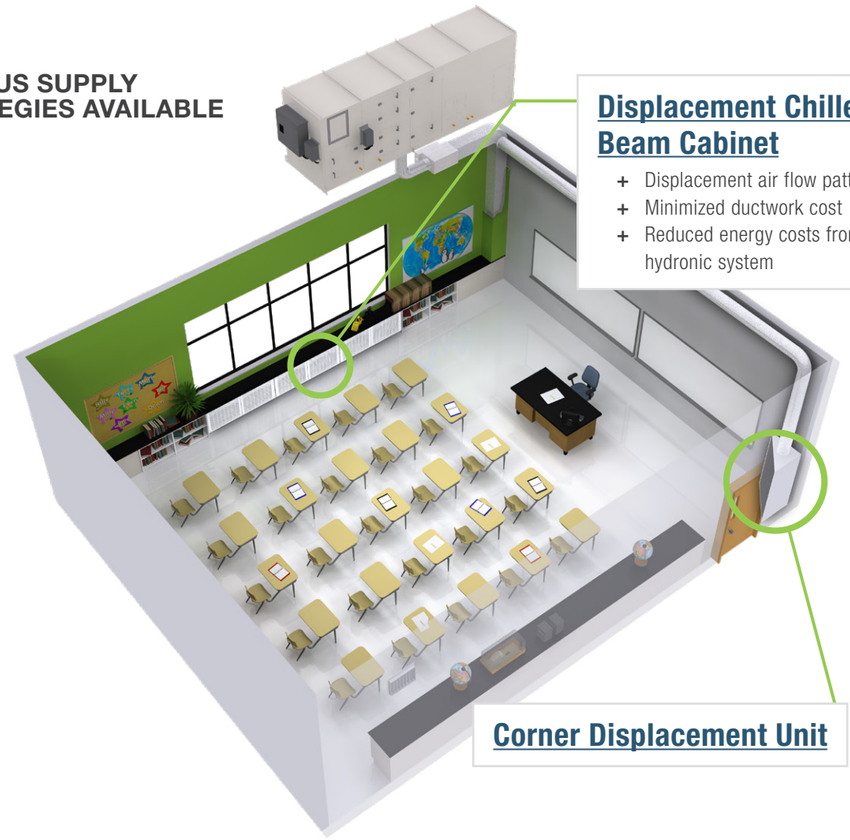
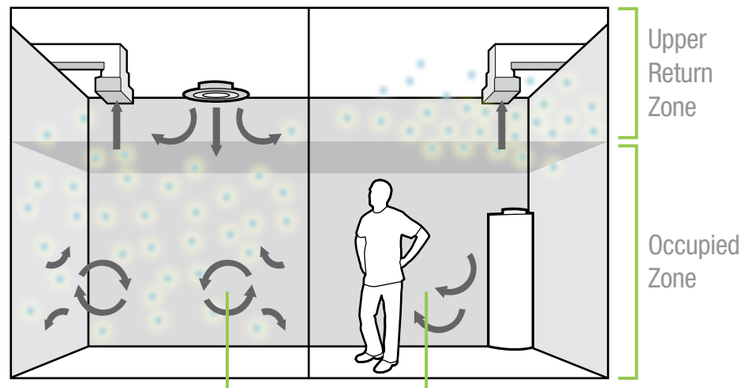
VARIOUS SUPPLY STRATEGIES AVAILABLE



Displacement Ventilation operates on the same principles as UFAD supplying air directly into the occupied zone and creating stratification. Typically diffusers are ducted from the ceiling to a low level supply diffuser. In some cases ceiling diffusers can be used to free up wall or floor space.



Mixing conditions the entire room with temperature and contaminants mixed uniformly throughout.

Displacement conditions only the occupied zone. The air is not mixed in this system, but instead air motion is driven by the heat sources pushing contaminants upwards out of the breathing zone.

DISPLACEMENT SUPPLY, FILTERED RETURN, AND ROOM FILTRATION

Displacement ventilation provides low velocity air at higher temperatures to create a comfortable environment. This type of approach to air delivery relies on natural convection to move the air throughout the space making it energy efficient. The air is supplied at low level and pushes contaminants and particles upwards out of the breathing zone resulting in improved air quality[2,3,4,5,6] instead of recycling contaminants back into the space. Enhanced filtration of the return air is provided by the MERV13 filters on the series fan powered terminal unit.

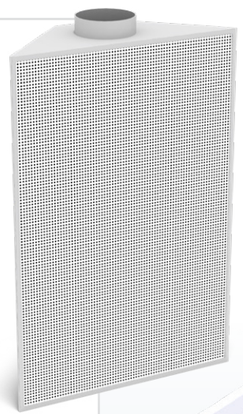
Option 3

Low Level Displacement with Fan Mixing Box

1 Way Corner Displacement Diffuser (DF1C)

Ductwork can be routed from the ceiling or walls and connected to the corner Displacement Corner Cabinet. This low level supply provides improved ventilation effectiveness, quiet air delivery, and comfortable airflow for occupants.

+ Improved ventilation effectiveness
+ Low level supply
+ Non-intrusive exposed duct
+ Duct cover options
  - Solid
  - Perforated
+ Various sizes available
+ Quiet air delivery
+ Comfortable, occupant driven air flow
+ Up to 850 cfm



Option 1

Ceiling Displacement

Displacement Flow Ceiling Diffuser (DFCD)

A ceiling model DFC displacement diffuser can be installed in a typical ceiling grid and paired with overhead ductwork and terminal units.

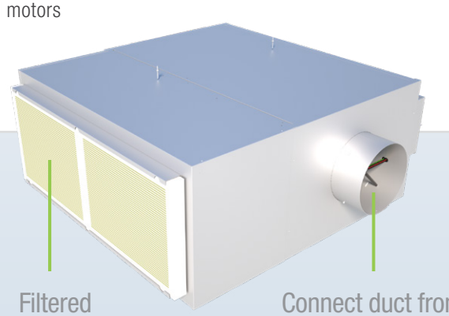
+ Fits into standard T-bar ceiling grid
+ 2' x 2' and 2' x 4' sizes available
+ Low pressure drop minimizes impact on system
+ Quiet air delivery
+ Comfortable, occupant driven airflow

Option 2

Ceiling Displacement with Fan Mixing Box

A fan mixing box with a MERV 13 filter is paired with ceiling mounted displacement diffusers (DFC) to provide enhanced filtration of the recirculated air. The FDC mixes return air to provide 62°F supply air temperature.

+ Fan mixing box replaces VAV terminal
+ MERV13 filter option
+ 400 - 1,500 cfm
+ ECM motors



[2] Bauman, Fred, P.E., Center for the Built Environment (CBE). (October 2007). TechNote Topic: Air Change Effective of UFAD and DV Systems Compared to Overhead Mixing Systems.

[3] United States Environmental Protection Agency. (2019, March 11). Creating Healthy Indoor Air Quality in Schools. Retrieved from United States Environmental Protection Agency: https://www.epa.gov/iaq-schools

[4] ASHRAE. (2013). ANSI/ASHRAE Standard 62.1-2013: Ventilation for Acceptable Indoor Air Quality.

[5] Arent, J., Eley, C., & Meister, B. (2006). Displacement Ventilation in Action: Performance Monitoring of Demonstration Classrooms. ACEE Summer Study on Energy Efficiency in Buildings.

[6] Smedje, G., & . (2000). New Ventilation Systems at Select Schools in Sweden - Effects on Asthma and Exposure.

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OVERHEAD SUPPLY WITH SUPPLEMENTARY FILTRATION

New construction overhead mixing systems can utilize targeted filtration to address specific zones that may have higher occupant activity or filtration requirements. Filtration at specific diffusers effectively reduces the concentration of airborne contaminants, thereby reducing the probability of exposure to airborne germs, viruses, and bacteria. Portable in-room filtration is the quickest way to improve air quality and our commercial grade units are easily positioned where they're needed most.

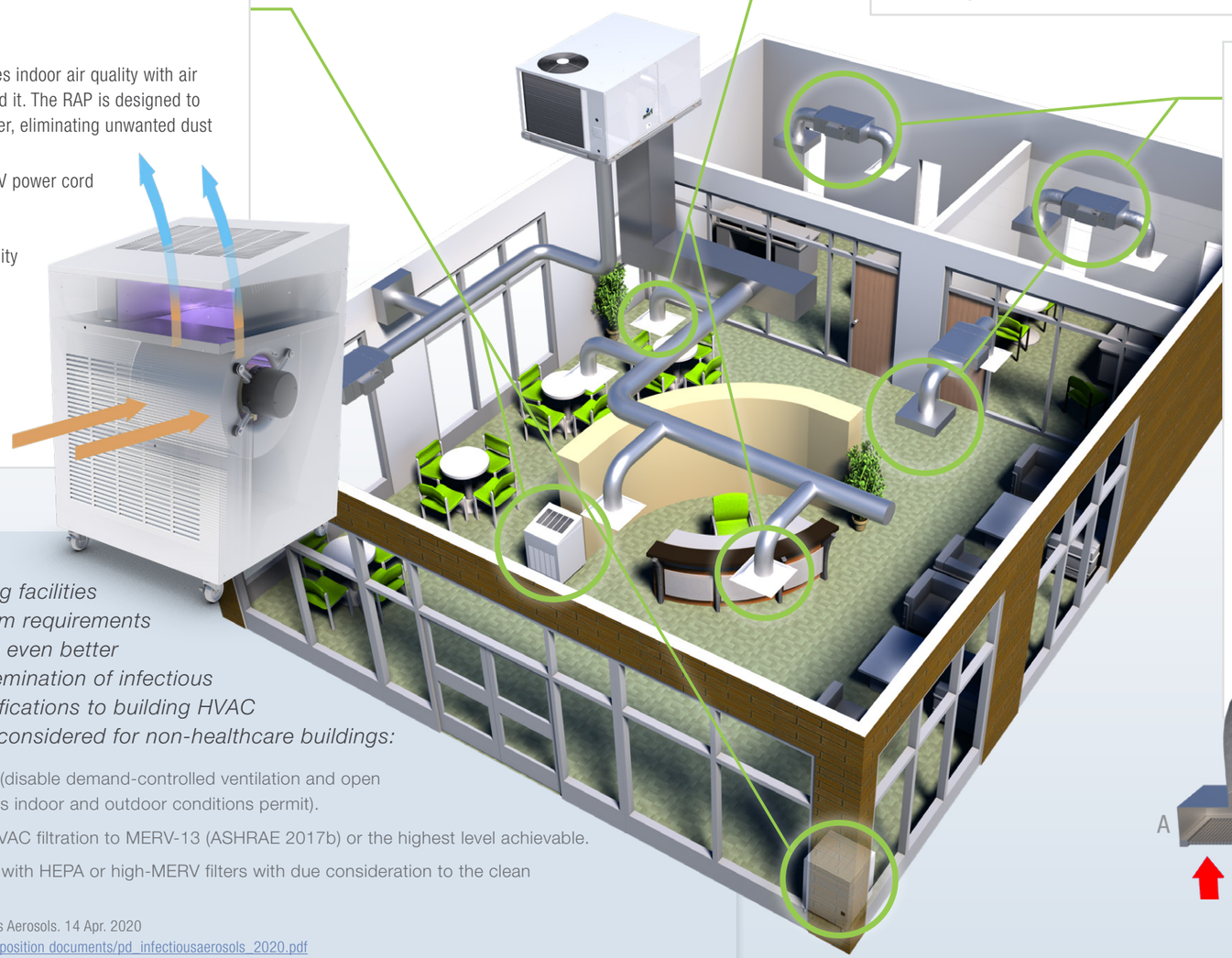
Option 1

Portable Air Purification

Room Air Purifier (RAP)

The Price Room Air Purifier (RAP) improves indoor air quality with air filtration wherever and whenever you need it. The RAP is designed to continuously cycle air through a HEPA filter, eliminating unwanted dust particles, germs and contaminants.

- + Plugs into standard outlet with 115V power cord
- + Energy efficient and quiet EC motor
- + Adjustable fan speed
- + Locking casters allow ease of mobility
- + Prefilter & HEPA filter
- + 150-600 cfm
- + Optional UV lights and bipolar ionization



Option 2

Recessed Diffusers with Integrated Ceiling-Access Filters

Filtered Diffuser Module (FDM)

Diffusers with ceiling-access filters have a 6" plenum box and are installed on top of the t-bar ceiling grid, replacing existing diffusers. These diffusers have integrated MERV 13 or 15 filters that require access to the ceiling plenum for periodic replacement. Filters are slid in or out of this diffuser though a hinged access door on the side of the unit. This diffuser style is available in any of the Price t-bar ceiling diffuser models.

Option 3

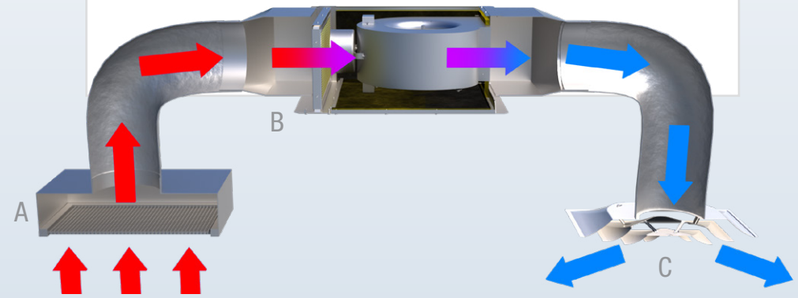
Overhead Air Purifier (OAP)

The goal of the Overhead Air Purifier (OAP) is to filter room air through consistent air changes. The fan powered unit draws air directly from the space, through a MERV rated filter, and discharges the clean air directly back into the space. The OAP is designed to be installed directly above any space and does not require modification to existing ductwork or other HVAC equipment.

The OAP can be installed in a T-Bar ceiling or an exposed ductwork layout. The unit pair perfectly with any Price grilles or diffusers. The The OAP is suitable for offices, classrooms, or any space requiring increased air filtration.

- + Quick installation
- + Simple air flow adjustments with EC motor
- + Easy filter changes
- + Quiet, low energy operation
- + 200-500 CFM
- + Larger sizes available
- + Compatible with MERV filters

Air flows from the space through the return grille (A) and then through a MERV13 filter (B). This provides increased filtration while also using the fan to overcome the additional pressure drop. The filtered air exits the OAP and is sent into the occupied space through the ceiling diffuser (C).



Designers of new and existing facilities could go beyond the minimum requirements of published standards to be even better prepared to control the dissemination of infectious aerosols. The following modifications to building HVAC system operation should be considered for non-healthcare buildings:

- ✹ Increase outdoor air ventilation (disable demand-controlled ventilation and open outdoor air dampers to 100% as indoor and outdoor conditions permit).
- ✹ Improve central air and other HVAC filtration to MERV-13 (ASHRAE 2017b) or the highest level achievable.
- ✹ Add portable room air cleaners with HEPA or high-MERV filters with due consideration to the clean air delivery rate (AHAM 2015).

- ASHRAE Position Document on Infectious Aerosols. 14 Apr. 2020
  http://www.ashrae.org/file library/about/position documents/pd_infectiousaerosols_2020.pdf

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PANDEMIC READY PATIENT ROOMS

Traditionally hospitals are built with very few airborne infectious isolation rooms (AIIR) as these spaces are seldom used and are more expensive to build and operate than standard patient rooms. The pandemic ready patient room solution from Price and Antec Controls allows the hospital to build one room that can be used for either standard patient care or as an AIIR, and can change between operational modes at the touch of a button, a feature that may be sought-after post Covid-19[1].

For more information on Pandemic Ready Patient Rooms, please view the ***full brochure***.

ROOM REQUIREMENTS

ASHRAE Standard 170-2017 Ventilation of Health Care Facilities dictates the following requirements for standard patient rooms and airborne infectious isolation rooms.

SETTINGS	STANDARD PATIENT ROOM (NORMAL OPERATION)	AIRBORNE INFECTIOUS ISOLATION ROOM
Airflow – Fresh	2 ACH[2]	2 ACH[2]
Airflow – Total	4 ACH[2]	12 ACH[2]
Pressure Differential	No requirement	Negative 0.01 in. w.g. pressure monitor required
Exhaust	Washroom exhaust	Washroom exhaust. Room exhaust located near patient head and direct ducted outdoors.
Return	Room return grille located near door	Return not allowed
Recirculation	Allowed	Only allowed if room air is recirculated locally through a HEPA filter.
Supply Diffuser	Not specified	Located near entry door. Air moves from clean to less-clean.

[1] Dudt, James, and Mark Stefanak. "Healthcare Building Codes and Design After COVID-19." Karpinski Engineering, June 2020, karpinskieng.com/insights/healthcare-building-codes-and-design-after-covid-19.

[2]Air changes per hour

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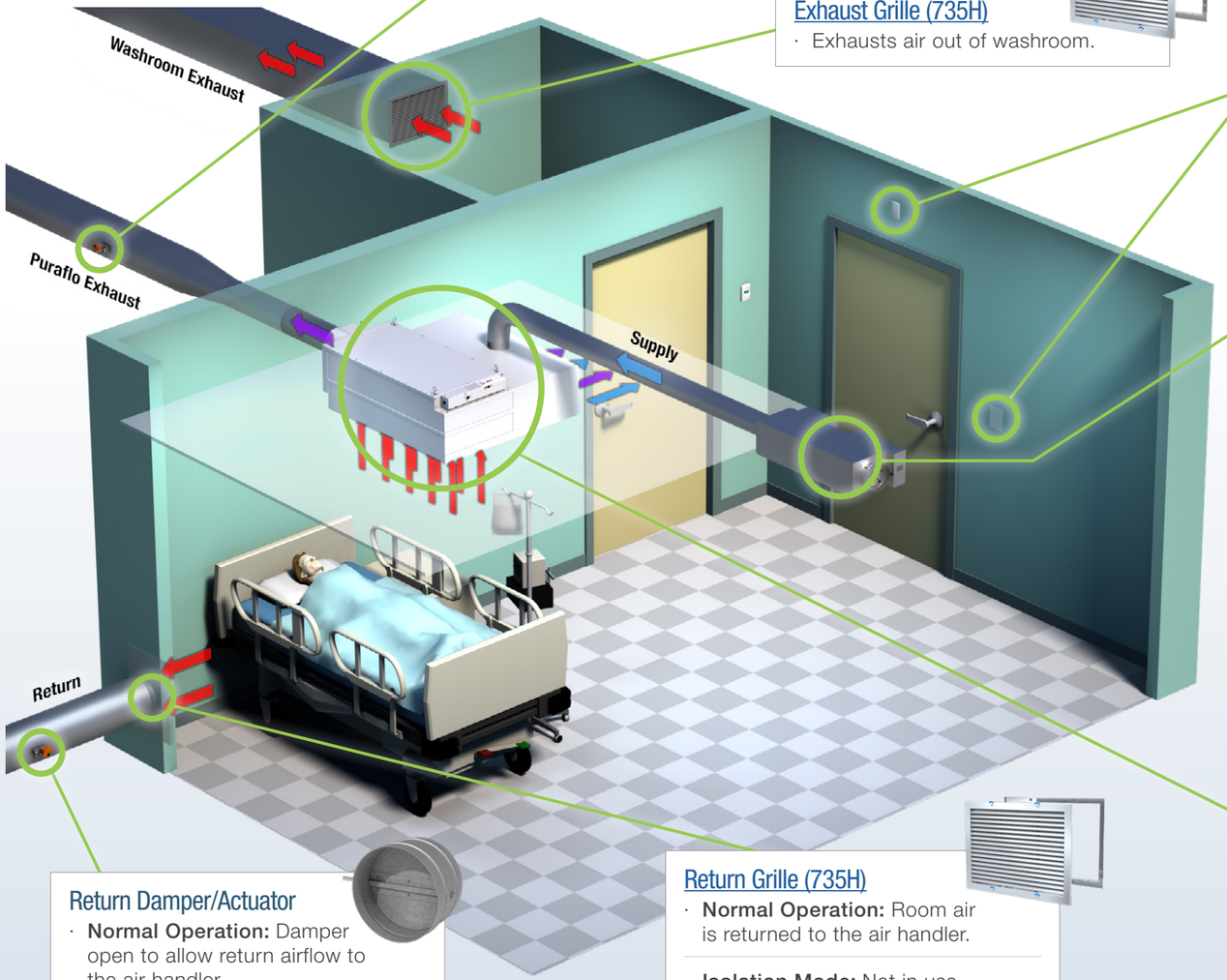


Exhaust Damper/Actuator

- **Normal Operation:** Damper closed.
- **Isolation Mode:** Damper modulates to control exhaust airflow and maintain negative room pressure based on PMT control signal.

Exhaust Grille (735H)

- Exhausts air out of washroom.

Room Pressure Monitor (PMT)

- **Normal Operation:** No room pressure requirement.
- **Isolation Mode:** Measures and displays room pressure. Activates FFU, closes return damper, and modulates exhaust damper to maintain negative room pressure.

Single Duct Terminal Unit with Reheat (SDV)

- Modulates supply airflow to the room.

Critical Area Recirculation/ Exhaust System (CARES)

The CARES is a single 48 in. x 48 in. airflow device that combines the capabilities of the dual-outlet exhaust flow FFU with a one-way, flush face radial flow diffuser (FRFD) and manages the airflow for the entire patient room.

- **Normal Operation:** Fresh air supplied to room.
- **Isolation Mode:** Contaminated room air is drawn in through the face of the FFU and passed through a HEPA filter before an actively-controlled portion of the airflow is exhausted to maintain room pressure. The remainder of the filtered air is recirculated to the space through the integrated
- FRFD. The integral FRFD is also used to distribute fresh air from the airhandler.

Return Damper/Actuator

- **Normal Operation:** Damper open to allow return airflow to the air handler.
- **Isolation Mode:** Damper closed to prevent return airflow to the air handler.

Return Grille (735H)

- **Normal Operation:** Room air is returned to the air handler.
- **Isolation Mode:** Not in use.

DENTAL OPERATORIES

Increased air change rates and extraction of aerosolized contaminants directly at the source can help protect dentists and hygienists from exposure to any aerosols generated during dental procedures. Dental Operatory solutions from Price make use of engineering controls including high-volume source extraction[1], HEPA filtration[2], and recirculated room air to improve indoor air quality while maximizing contamination control and system efficiency.

The amount of time required for removal of airborne contaminants from a space varies based on the air change rate. The addition of a HEPA air filtration unit can reduce aerosol concentrations in the room and increase the effectiveness of the turnover time[3]. As an example, increasing from 4 ACH, typical in many dental operatories, to 12 ACH with the addition of a HEPA filtration unit reduces the time to remove 99.9% of airborne contaminants from 104 minutes to 35 minutes, **a 66% reduction**.

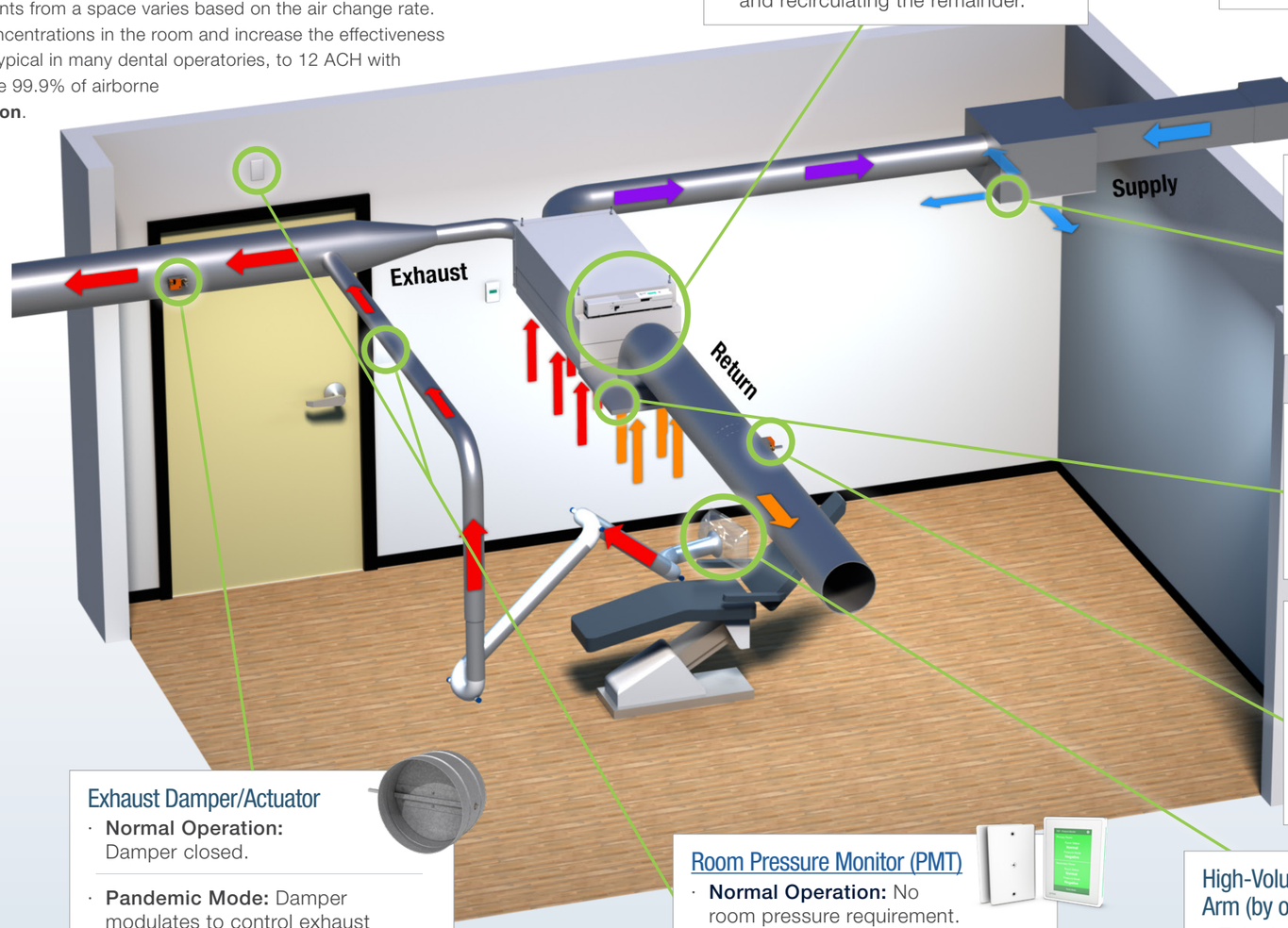
Dental operatories can be configured in many ways. The system shown here provides complete pressure control of the space to allow the dental operatory to function as a ***standard operatory*** or ***negative pressure isolation room***, and can change between operational modes at the touch of a button.

In ***Normal Operation*** the room will function similar to the base system with minimal air changes and no pressure requirements. In ***Pandemic Mode*** air changes will be increased and the space will be held at negative pressure relative to adjoining spaces.

For more information on Dental Operatories, please view the ***full brochure***.

ROOM REQUIREMENTS

	STANDARD ROOM	RETROFIT ROOM
Air changes per hour	4 ACH[4]	12 ACH
Required airflow	200 cfm[5]	600 cfm[5]
Time required for 99.9% removal or settling of aerosols	104 minutes	**35 minutes**



Combination Exhaust and Recirculating Fan Filter Unit (PURAFLO)

- **Normal Operation:** Not in use.
- **Pandemic Mode:** Puraflo turns on based on PMT control signal. Air is drawn out of the room through a HEPA filter, exhausting a portion and recirculating the remainder.

Single Duct Terminal Unit with Reheat (SDV)

- **Normal Operation:** Modulates supply airflow to the room.
- **Pandemic Mode:** Modulates supply airflow to the room.

Diffuser (SMD)

- **Normal Operation:** Fresh air supplied to the room.
- **Pandemic Mode:** Fresh and recirculated, HEPA filtered air from Puraflo supplied to the room.

Return Grille (80SR)

- **Normal Operation:** Room air is returned to the air handler.
- **Pandemic Mode:** Room air is returned to the air handler.

Return Damper/Actuator

- **Normal Operation:** Damper open to allow return airflow to the air handler.
- **Pandemic Mode:** Damper closed to prevent return airflow to the air handler.

Exhaust Damper/Actuator

- **Normal Operation:** Damper closed.
- **Pandemic Mode:** Damper modulates to control exhaust airflow and maintain negative room pressure based on PMT control signal.

Room Pressure Monitor (PMT)

- **Normal Operation:** No room pressure requirement.
- **Pandemic Mode:** Measures and displays room pressure. Activates Puraflo, closes return damper, and modulates exhaust damper to maintain negative room pressure.

High-Volume Extraction Arm (by others)

- This device can be placed directly at the patient's head, removing aerosols and contaminants from the room directly at the source.

[1] Katzenberger, Jake. "Healthcare Design in the Wake of COVID-19." Henderson Engineers, 4 June 2020, www.hendersonengineers.com/insight_article/healthcare-design-in-the-wake-of-covid-19/. 5.
All airflows based on a 15 x 20 ft. room with 10 ft. ceiling.

[2] "Health Care Facilities." ASHRAE Handbook - HVAC Systems and Equipment, American Soc. of Heating, Refrigerating and Air-Conditioning Engineers, 2020, p. 9.17.

[3] "Guidance for Dental Settings." Centers for Disease Control and Prevention, Centers for Disease Control and Prevention, www.cdc.gov/coronavirus/2019-ncov/hcp/dental-settings.html.

[4] Airflow requirement varies by room size and occupancy, refer to ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality Table 6-1 for guidance

[5] All airflows based on a 15x20 ft. room with 10 ft. ceiling.

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RESOURCES

For continously updated resources relevant to **COVID-19**, please visit our
COVID-19 Resources page

For **retrofit applications** projects, please visit our
HVAC Solutions for Reducing Airborne Pathogens - Retrofit Applications Brochure

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