mintie technologies, inc.

HEPA-filtered Negative Air Machines and their Role in Creating Airborne Infection Isolation Rooms with the ECU AnteRoom™

Frequently Asked Questions

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Can a HEPA-filtered negative air machine capture bacterial and viral particulates? If so, which ones?

How does a 99.97% @ 0.3 micron HEPA filter of the negative air machine capture viruses smaller than 0.3 microns?

Are all HEPA filters the same? Can I use any HEPA air machine on the market?

What is a negative air machine and why do I need one?

A negative air machine ("NAM") is nothing more than a large vacuum cleaner. Also known as air purification equipment, air scrubbers, a NAM looks like a small air-handling unit and consists of an electric motor-driven fan and a series of various filters contained in protective housing. It works by pulling air from the space requiring filtration through a series of filters and then discharges the filtered air either into the interior space or to the exterior of the building. NAMs are used when performing a variety of tasks in a variety of industries, each with its own guidelines establishing the standards for using a NAM. Negative air machines are available in a variety of sizes, and selecting the right size NAM is a matter of determining the amount of air needing to be cleaned (cubic feet per minute or "CFM"), and the proper filter efficacy. This is usually determined by the application of the NAM and the location of the air discharge, each a critical decision of for healthcare organizations. Many guidelines have been published in recent years by the Centers for Disease Control and Prevention ("CDC"), JCAHO and the Canadian Standards Association ("CSA") and now govern the use of NAMs in healthcare organizations. If the NAM is being used to meet certain criteria of the CDC for construction-related activities or temporary airborne infection isolation rooms, the CDC Environmental Infection Control Guidelines ("EIC Guidelines") recommend the exhaust from the room be at least 125 CFM greater than the air supply into the room. The CDC EIC also recommends HEPA (99.97%) filters if the air is going to be discharged into an occupied space or if the air is vented outside the building where the filtered air could be drawn back into the building by an air intake vent, open door, etc. HEPA filters are also required if the air is discharged in a location where the public is walking past the exhausted air.

How does a HEPA-filtered negative air machine work with the Mintie Technologies ECU AnteRoom™ to create short-term patient isolation rooms?

The two pieces of equipment (ECU AnteRoom™ and NAM) must be considered as one complete solution, as one without the other will not provide the protection necessary to convert a standard patient room into an airborne infection isolation room. The ECU AnteRoom™ becomes an airlock between the room being converted and the surrounding space. This unit is taped to the doorframe and floor leading into the room and becomes an entrance and exit chamber for caregivers and others needing access to the room, this arrangement is typically referred to as an anteroom. The HEPA filtered NAM becomes the dedicated exhaust for the converted room as the return air ducts must be sealed off prior to an infectious patient being placed in the short-term isolation room. If these ducts are not sealed off the airborne infectious particulate will be

recirculated back to the main air-handler and potentially distributed back into other occupied spaces. The HEPA filtered NAM must be sized to meet the demands of the rooms ventilation system, so it has at least 125 CFM more exhaust (total NAM CFM) than the air being supplied into the short-term isolation room.

As a solution for creating short-term patient isolation, how does a HEPA-filtered negative air machine paired with the ECU AnteRoom™ differ from an air scrubber located inside the patient room?

There are many differences between the technologies however the biggest one is the ECU AnteRoom™ does not require any permanent building modifications to the room being converted. Unlike the in-room air scrubber, which requires the exhaust from the unit to be vented to the outside or into an adjacent space so a negative pressure in the room is achieved, the ECU AnteRoom™ is simply taped to the doorframe of the room and the HEPA filtered NAM becomes the exhaust for the room. The exhaust port for the NAM is already outside of the room and therefore creates the required negative pressure in the converted room (See sizing of NAM in the previous question). An in-room air scrubber cannot just be placed in a room without having the converted rooms return air duct sealed and the exhaust from the air scrubber vented outside of the room. This "temporary" venting typically means permanently modifying the room wall or window by placing a conversion damper in the outside wall/window. There are other methods of venting in-room air scrubbers such as exhausting the high volume of HEPA filtered air into the return air system which may pressurize the return air duct and change the balance of the air-handling unit. Other differences are:

- The ECU AnteRoom™ takes the noise of the negative air unit outside of the patient environment thereby promoting a more therapeutic healthcare environment,
- By placing the negative air unit in the corridor, the ECU AnteRoom™ solution removes the need to have an 8 inch or greater exhaust duct across the patient headwall which could block needed patient related services such as medical gases, electrical power, emergency call systems, etc.
- Many older patient rooms have a minimal square footage and the addition of an air scrubber at the head of the bed can create a cramped environment. The ECU AnteRoom™ places this equipment outside of the room giving the caregiver free access to the patient.

Why is the air from the HEPA-filtered negative air machine exhausted into the hallway rather than to the outside of the building? Is this really safe?

The reason for exhausting the air into the hallway is very simple, with this solution no building modifications need to be made to create a short-term airborne infection isolation room. This solution also gives the organization the opportunity to quickly convert a room, under 20 minutes, without having to install conversion dampers in exterior walls or modify the ventilation system by pushing air into a return air system. It also gives the Infection Control Professional options on where to place the infectious patient as the short term isolation rooms do not have to be pre-selected for making advanced building modifications. The corridor systems in healthcare organizations have plenty of volume to absorb the additional exhaust air from the converted room(s) without over pressurizing the space. With the negative air machines being HEPA filtered the discharged air is much cleaner than any of the surrounding air and the HEPA filter has the efficiency to pull out all particulate 0.3 microns and greater in size. This is the level of filtration recommended by the CDC Environmental Infection Control Guidelines.

What is the role of the HEPA-filtered negative air machine in preventing the spread of infectious agents when a caregiver enters the ECU AnteRoom™?

The ECU AnteRoom™ acts like an airlock on the entrance to the short term isolation room. Caregivers and others entering the room must still follow standard personal protection equipment procedures and mask prior to entering the ECU AnteRoom™ and unmask after exiting the unit.

Protection of the surrounding environment is provided because the HEPA-filtered negative air machine makes both the temporary isolation space and the ECU AnteRoom™ a negative environment. With the door of the temporary isolation space left ajar the net supply air of the room is moving through the opening of the space into the ECU AnteRoom™ and into the HEPA filter of the attached HEPA-filtered negative air machine where the air is scrubbed. When a person enters the ECU-AnteRoom™ through the narrow side door the air flow direction will change from the door of the temporary isolation space to the narrow side door of the ECU AnteRoom™. The dynamics of airflow dictate that the path of least resistance will be the air flow direction from which the HEPA-filtered negative air machine is acquiring the majority of its air supply. There is more resistance within the air of the narrowly opened door of the temporary isolation space than at the narrow side door of the ECU AnteRoom™. The air flow at the door of the temporary isolation space stalls and the air flow from the narrow side door of the ECU AnteRoom™ streams inward toward the HEPA-filtered negative air machine.

Which HEPA-filtered negative air machine do I choose with the ECU AnteRoom™ to convert a space of "x" cubic feet to emergency temporary patient isolation?

Choosing the correct HEPA-filtered negative air machine is not determined by the area of a space but rather by the net air flow measured in cubic feet per minute (CFM) that enters that space. The engineering staff must verify the amount of supply air flow (CFM) and exhaust air flow (CFM) from the bathroom (if one is provided within the room). When converting a room, the return air is sealed off from the room side to prevent potential contamination of the HVAC system and recirculating potentially contaminated air into other occupied spaces. The amount of toilet exhaust air flow is then deducted from the amount of supply air flow to obtain the net supply air flow (CFM) being distributed to the space.

A negative air machine must then be selected that will provide a tested static pressure air flow rate through the HEPA filter greater than or equal to the determined net supply air flow plus a 125 CFM of negative air pressure over the supply air. This is a recommendation of CDC as it allows the room to remain under negative pressure even when some other elements within the room may leak enough to vary the room's negative pressure.

Example: If the net supply air flow is 400 CFM, then the required static pressure air flow rate produced by a negative air machine must be at the least 525 CFM, derived by adding 125 CFM to the net supply CFM air flow number of 400 CFM. The OmniAire 600V HEPA-filtered negative air machine is the most appropriate choice for this conversion.

When sizing a NAM for a room environment always consult your hospital engineering department for confirmation of appropriate size NAM capacity per the CDC guidelines.

How do the negative air machine requirements change when we create a larger containment space capable of caring for 12 to 15 patients?

The primary use of an ECU AnteRoom™ for this type of setting is as an airlock at the entrance and exit points to this space. With larger rooms, there will be more caregiver and other staff traffic into and out of the room. One of the major causes of AII room negative pressure failures are doors being opened and closed too often by staff. Once the ECU AnteRoom™ is set up at the entrances and the negative air volume over supply measured, facilities management will need to seal off return air ducts and balance the room for maintaining a negative pressure. The ECU AnteRoom™ will prohibit the spread of potentially contaminated air from around the entrance and exit points to the large room or space.

My facility will need six ECU AnteRoom™ units. Which HEPA-filtered negative air machine should I choose to operate with them?

We recommend the facilities management department be consulted and the ventilation parameters of the various rooms under consideration be analyzed. Short of performing this engineering analysis, we suggest that several different sizes of negative air machines be used. One size, even with variable airflow settings, is not always appropriate for all settings. This provides the healthcare organization with the ability of addressing multiple locations of varying sizes. For example, if the smallest space that you can conceive of converting is a standard two bed room, and the net supply air is 250 CFM or less, then the standard MiniForce II negative air machine can be used. If on the other hand, the net supply air is 350 CFM to 425 CFM, then the OmniAire 600V machine should be used. For the six ECU AnteRoom™ units, we would recommend that you buy one MiniForce II, four OmniAire 600V, and one OmniAire 1000V.

What are the static pressure CFM air flow rates produced by the HEPA-filtered negative air machines distributed by Mintie Technologies, Inc.?

Tested CFM Air Flow Rate With 99.99% @ 0.3 Micron Hepa Filter In Place At High Speed	Mintie Technologies HEPA-Filtered Negative Air Machine
375	MiniForce II
550	OmniAire 600V
950	OmniAire 1000V
1900	OmniForce 200V

Can a HEPA-filtered negative air machine capture bacterial and viral particulates? If so, which ones?

The 99.97% @ 0.3 micron HEPA filters will capture all bacterial and viral particulates 0.3 microns or larger in size. This includes the Tuberculosis virus which ranges from 0.5 to 1 micron in size. The 99.97% @ 0.3 micron HEPA filter will also capture viruses smaller than 0.3 micron such as the SARS virus. (See next question.)

How does a 99.97% @ 0.3 micron HEPA filter of the negative air machine capture viruses smaller than 0.3 microns?

Viral particulates smaller than 0.3 micron tend to attach themselves to particles larger than 0.3 micron like dust, water droplets or groups of similar particulates.

A virus such as the SARS virus when expelled from an infected patient is encased within water droplet nuclei. That water droplet is larger than 0.3 micron and will be captured by the HEPA filter. After the water droplet evaporates the SARS virus remains held within the folds and fibers of the HEPA filter through van der Waal's force. This is the same force which allows a spider to stick to a smooth pane of glass or the ceiling within a home. Little hairs on the feet of a spider called setae create an electrically charged attraction between it and a smooth surface allowing the legs of the spider to stick. Small viruses and bacteria have setae-like hairs which are negatively charged and will lodge the virus within the positively charged fibers of the HEPA filter.

Are all HEPA filters the same? Can I use any HEPA air machine on the market?

No. The CDC EIC recommends HEPA (99.97%) filters if filtered air is going to be discharged into an occupied space or if the air is vented outside the building where the filtered air could be drawn back into the building by an air intake vent, open door, etc. Mintie Technologies offers a HEPA filtration system that exceeds this requirement with an efficiency of 99.99% at 0.3 micron. The filter element in each unit is medical grade, constructed with an aluminum frame and has been factory tested and certified. Some other "HEPA type" machines on the market may not meet the 99.97% efficiency testing and certification requirement.