IsolationAir® System Testing for Usage In Surge Capacity Hospital Rooms

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AIR INNOVATIONS
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Performance
Air Changes Per Hour
60
Pressure Control
400" W
Particle Reduction (per cubic ft)
Equilibrium reached in 6 min.
32,000 to 62,000 particles/cub. ft.

Positive Pressure Test Results and Analysis:
Figure 7: Room After Installation for Negative Pressure

Negative Pressure Test Results and Analysis:
Figure 6: Room After Installation for Negative Pressure

In the negative pressure test, an equilibrium was reached at virtually zero percent of the initial particle count. The initial count for particles 0.3 µm and larger was 37,299 particles, and this number dropped to virtually 0 at equilibrium. An equilibrium pressure of 0.62” was reached within 6 minutes. There is a subtle spike in particle count when the tester entered the room at 30 minutes, but the count quickly drops back off to just about zero percent of the initial count when the tester leaves the room and closes the door. Figure 6 shows the particle counts over the 65-minute negative pressure test as both a percentage of the initial particle count and the total number of particles over time.

The following chart gives the key performance data collected for the positive test.

The chart below shows the key performance data collected for the negative pressure test. Note how quickly the environment reaches equilibrium as a result of the high number of air changes per hour.

Conclusion:
IsolationAir® system creates positive and negative pressure isolation environments that meet or exceed the CDC isolation space guidelines (1.7A:0) for pressure management, particle count reduction, and air changes per hour. This system can be very effective in both surge capacity temporary hospital rooms and permanent isolation spaces. The unit acts quickly in reducing particle counts, reaching an equilibrium in under 15 minutes in the test room for positive pressure and in under 5 minutes for negative pressure.

Study Objective
As a result of the Covid 19 pandemic, there was an increased awareness for the need of surge capacity temporary isolation spaces. Having an ample number of “air barrier” isolation environments is crucial during a pandemic or event that greatly increases demand for hospital beds. Depending on the type of sickness a patient has, it is important to be able to quickly create a clean, negative or positive pressure environment. The CDC guidelines for isolation spaces include a minimum of 12 air changes per hour, a minimum negative pressure deviation of 0.05” with the surrounding space, and a significant reduction in particles (0.3 µm and larger) via use of a HEPA filter. The objective of this study was to show how a portable isolation unit can dramatically reduce particle counts in size surge capacity hospital rooms and meet the CDC guidelines listed above.

Materials and Methods:
IsolationAir® (Air Innovations, Syncera, NY) system creates positive or negative pressure through circulating mechanisms. The system also maintains room temperature and uses HEPA filtration and ultra-violet light to remove air contaminants within the patient rooms. Once familiar with the setup and room, installation of the unit takes approximately 30 minutes.

An isolation unit was installed and tested on June 9th, 2021, in a “temporary, on-demand” room as part of the Berkshire Innovation Center in Pittsfield, Massachusetts. The room used for the testing was made from double-walled 1/2” thick corrugated cardboard. The room had an area of 76.66 square feet with close to 8’ ceilings giving the room a total volume of 618.25 cubic feet. Aluminum brackets along the outside edges secured the cardboard pieces together, and a plastic gluing seal was added to the outside of the room to provide insulation. The room was equipped with a wall air cooler, which was used to control the temperature within the room. The room had an air pressure of 0.05”. The particle counter was located at the front of the room facing the door. The bed, also constructed from corrugated cardboard, was positioned in the left back corner of the room. Across from the bed, in the right corner, stood the isolation unit.

Two 10’ ducts were built into the right back corner of the room about 6” off the ground so that the IsolationAir® unit had the necessary ducts to operate. The ducts were set up at 90-degree angles from each other to minimize interaction between the supply and exhaust airstreams. A detailed layout of the room is shown in Figure 1, and the duct installation is shown in Figures 3 and 4.

An AirData™ Multimeter AD8-860 was used to prove a sufficient pressure delta between the isolation space and surrounding areas created after several minutes of IsolationAir® unit operation. Initially, the room was not sealed well enough to create a sufficient gradient, so duct tape was used to seal off gaps between sections or the corrugated paper walls. For negative pressure operation, the goal was to create a minimum of 0.05” pressure gradient between the inside and outside of the room for positive pressure, the goal was to create at least a 0.01” gradient. The pressure sensor setup is shown in Figure 6.

The following chart gives the key performance data collected for the positive test.

The chart below shows the key performance data collected for the negative pressure test. Note how quickly the environment reaches equilibrium as a result of the high number of air changes per hour.

Figure 2: Room Before Installation

The Particle Plus® 3003 Handheld Particle Counter was set up on the bed to read particle counts over time. It was positioned away from the IsolationAir® system. The counter operated at 0.1 cm, and the sample flow rate was adjusted to best suit the room. The counter measures particle counts of 0.1, 0.5, and 1 µm in both differential and sum format. Differential format counts the number of particles between each size, while sum counts the total number of particles in a certain size or larger. An USB drive was used to export the data from the counter into Excel, where the particle count data over time could be viewed and analyzed.

Figure 3: Particle Counter

The chart below shows the key performance data collected for the negative pressure test. Note how quickly the environment reaches equilibrium as a result of the high number of air changes per hour.

Figure 4: Pressure Sensor Setup

Figure 5: Room After Installation for Negative Pressure