Opening Doors in Operating Rooms

New Room Pressure Monitor Avoids Problem of Lint Accumulation

In a large Boston area hospital, nurses complained that it was difficult to open doors to exit operating rooms (OR). The facility had 23 OR's, five of which had been built within the previous year; so this was clearly an issue which needed to be addressed. Unable to solve the problem internally, the hospital hired a veteran HVAC engineering and design consultant, Advantage Engineering, to look into the issue. The professionals at Advantage Engineering found that the differential pressure sensors monitoring OR pressurization were contaminated by lint, which resulted in a compromised reading and overpressurization of the space.

Yes, lint, the clinging bits of fiber and fluff that fall off fabrics on such products as hospital scrubs and patient linens, was affecting the accuracy of the differential pressure sensors which monitor room pressurization in the OR. As lint accumulates on the sensing elements of these instruments, they begin to under-report space differential pressure. Pressure is increased to the degree that it becomes difficult to push (or pull) open the doors to exit the ORs. The most obvious solution was to clean the existing instruments more frequently. However, the sensors on the existing lint-accumulating space differential pressure instruments are difficult to access and are extremely susceptible to damage during cleaning.

Setra Room Pressure Monitor

To address the issue, the hospital purchased a Setra Room Pressure Monitor (SRPM). Setra's differential pressure sensors use a capacitive-based technology, which unlike flow sensors, do not come in contact with the air being monitored eliminating the risk of lint contamination. In the year following the installation of the SRPM in one OR, there had been no incidents with the lint affecting the sensor and the pressurization problem in the room had been solved. As a result, the hospital chose to install the SRPM in all the ORs, infectious isolation rooms and other spaces where lint build up is a problem.

Airborne Lint Problem is an Issue in a Variety of Hospital Spaces

"There is a surprising amount of airborne lint in hospitals, even inside operating rooms that receive highly filtered supply air," remarks Paul Lindberg, a Principal from Advantage Engineering, the HVAC engineering and design firm who found the cause of the overpressurization issue. According to Lindbergh, the lint originates from "scrub" clothing, operating suite gowns, patient "johnnies," bed linens, and in other fabrics common to hospitals. Lindberg notes that ORs have one of the highest concentrations of airborne lint of any hospital spaces, due to the high number of people present in OR's during procedures. Substantial

amounts of airborne lint are not limited to the OR; they are readily present in infectious isolation rooms and other critical areas which require differential pressure monitoring. In critical environments, it is essential to use a differential pressure sensor that isn't susceptible to contamination due to airborne lint.

"In an operating room, air is highly filtered and there is positive pressure, since you do not want air to come into the operating room from the outside," said Lindberg. "The requirement for pressure is 0.01"W.C. This is a very small amount of pressure, one that can barely be felt by the palm of the hand. If there is that much pressure on the inside of the OR door, one can be certain that the airflow is going from the OR to the outside space, and not vice versa. If the controls malfunction, and pressure is pumped up much higher, for example, to 0.05", that is when one would begin to have difficulty with the door, feeling pressure against you as you try to push it open."


Paul Lindberg
Advantage Engineering

Part of the problem stems from the design of the existing instrument, which contains tubes with a 1.5" diameter where small sensors (with the diameter of a toothpick) could protrude into the tube, over which air passes. With such a narrow space, just a couple of fibers on the sensor can throw off the readings significantly.

After determining that the lint was building up on the instruments and causing incorrect readings, Lindbergh looked at whether frequent cleaning might correct the problem. "Cleaning was definitely a viable option, the medical center could send an instrument technician around to clean the units, say monthly," he says. "But there's a risk when you clean these sensors, even with the most delicate of tools, because the sensors are fragile and there is a good chance you're going to damage them." Also, the instruments quickly begin to lose accuracy again soon after the lint build up is removed. In as little as a month, their accuracy was reduced by about 20 to 30%, as lint particles begin to accumulate on the instrument sensors.

Lindberg wasn't convinced that cleaning was a good alternative, even if they were willing to invest in monthly cleaning. He then recommended that the hospital should find a different type of instrument that wouldn't be susceptible to accuracy loss due to airborne lint.

Search for Solution Leads to Setra Room Pressure Monitor

To find another option, Lindberg consulted the controls contractor that maintains the hospital's environmental control systems. The contractor suggested he contact Setra Systems, a leading manufacturer and designer of pressure measurement instrumentation. The controls contractor had experience using Setra instruments for industry cleanroom solutions.

"After contacting Setra, their factory representatives sent information on the Setra Room Pressure Monitor for space differential, and I was immediately interested in the fact that the sensors within the instrument are not exposed to environmental air, so airborne lint can't disrupt them," said Lindberg.

The room pressure monitors are designed for pharmaceutical, hospital, semiconductor, cleanrooms, research laboratories and critical low differential pressure applications that require stringent pressure monitoring and alarming. The unit's monitor the positive or negative pressure in protected environments and airborne infection isolation rooms in accordance with Centers for Disease Control (CDC) guidelines. The monitors use a capacitive-based sensor design, which measures highly accurate pressure readings to ±0.001"W.C. resolution with up to ±0.25% FS accuracy.

The medical center conducted a trial, installing a SRPM in one of its five new ORs. "The unit has been in place for a year, and has given excellent, reliable information, with no maintenance required," said Lind-

berg. He adds that he has checked the accuracy of the output of the new instrument five or six times over the past year with a very accurate portable differential pressure meter. The SRPM has matched the portable instrument within ±0.001"W.C. during each check. "At the same time, I checked the readings on the other instruments, and found them to be inaccurate, giving me a good view of how well the Setra unit performs in comparison to other instruments."

In addition to the fact that the instrument had worked precisely as planned, Lindberg found it easy to swap over from the existing instrument to the new one. He was also impressed with Setra's willingness to get involved in the project, even though the hospital was purchasing only one instrument. According to Paul Lindberg, "The unit has definitely met my expectations and I will definitely consider recommending Setra Systems for my next design job for OR suites or infectious isolation areas."