

IC Sentinel® Applications Guide for Healthcare Environmental Air Quality Monitoring

IC Sentinel® is a real-time environmental quality monitoring solution, comprised of facility-wide, low-cost, compact, multi-sensor modules. IC Sentinel® sensors can be placed just about anywhere in the facility to allow immediate realtime and 24/7 monitoring and long-term profiling. The sensors can also be conveniently moved around the facility as needed to respond to construction or problematic areas. There is no limit to the number of IC Sentinel® units that can be deployed within a facility to ensure adequate coverage.

INFECTION CONTROL

- Monitor airborne particulate count facility-wide
- Monitor differential room pressure of key areas
- Verify Performance Protective Environment rooms
- Verify Performance of Airborne Infection Isolation rooms
- Test for elevated humidity levels

FACILITIES MANAGEMENT

- Monitor construction and renovation areas for particulates
- Verify barrier and air filtration, effectiveness
- Monitor indoor air quality (IAQ), verify performance of HVAC
- Generate real-time alerts

OBJECTIVE

This article provides guidance in installation and application of the IC Sentinel product to achieve the following objectives

- Monitor an *Airborne Infection Isolation* room (All)
- Monitor an *Airborne Infection Isolation* room with an antechamber
- Monitor a *Protective Environment* (PE)
- Monitor a *Protective Environment* with Antechamber
- Monitor a construction area

The CDC has provided the following chart for Engineered specifications for positive and negative pressure rooms (CDC EIC MMWR June 6 2003)

	Protective Environment(PE) Positive Pressure	Airborne Infection Isolation (All) Negative pressure
Pressure Differentials	> + 2.5 Pa (Pascal) (0.01" Positive water gauge)	> - 2.5 Pa (Pascal) (0.01" Negative water gauge)
Air Changes per Hour (ACH)	> 12	> 12 (for renovation or new construction)
Filtration Efficiency	Supply: 99.97%@ 0.3um DOP1 Return: none required ²	Supply: 90% dust spot test Return: 99.97%@0.3um DOP1,3
Room Air Flow Direction	Out to the adjacent area	In to the room
Clean to Dirty air flow in room	Away from high risk /immunosuppressed patient	Towards the patient (Airborne disease patient)
Ideal Pressure Differential	> +8 Pa	> -2.5Pa

1 DOP is abbreviation for dioctylphthaltate particles of 0.3um

2 If the patient requires both PE and All, return air shall be HEPA filtered or otherwise exhausted to the outside

3 HEPA filtration of exhaust air from All rooms should not be required providing that the exhaust is properly located to prevent re-entry into the building

The 2010 Guidelines for Design and Construction of Healthcare Facilities specifies the following for Operating Rooms (ORs)

Air pressure relative to adjacent areas	Positive
Minimum Air exchanges of outside air per hour	4
Minimum total air exchanges per hour	20
Air re-circulated by means of room units?	NO
Relative Humidity	20-60 percent

Design Temperature	68-75 Degrees F
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In addition, the FGI and ASHRAE Design Guidelines recommend the following:

- Sealed room with about 0.1 cfm/ft²
- Greater than 125 cfm airflow differential Supply vs. Exhaust
- Clean to dirty airflow
- Monitoring of PEs, Alls, Construction and renovation areas, other critical areas
- > 12 air changes / hour (ACH) in new construction and 6 air changes / hour in renovation areas
- Anteroom airflow patterns suitably designed for the application

APPLICATIONS GUIDE

Use this guide to assist in determining where to place IC Sentinel monitor units.

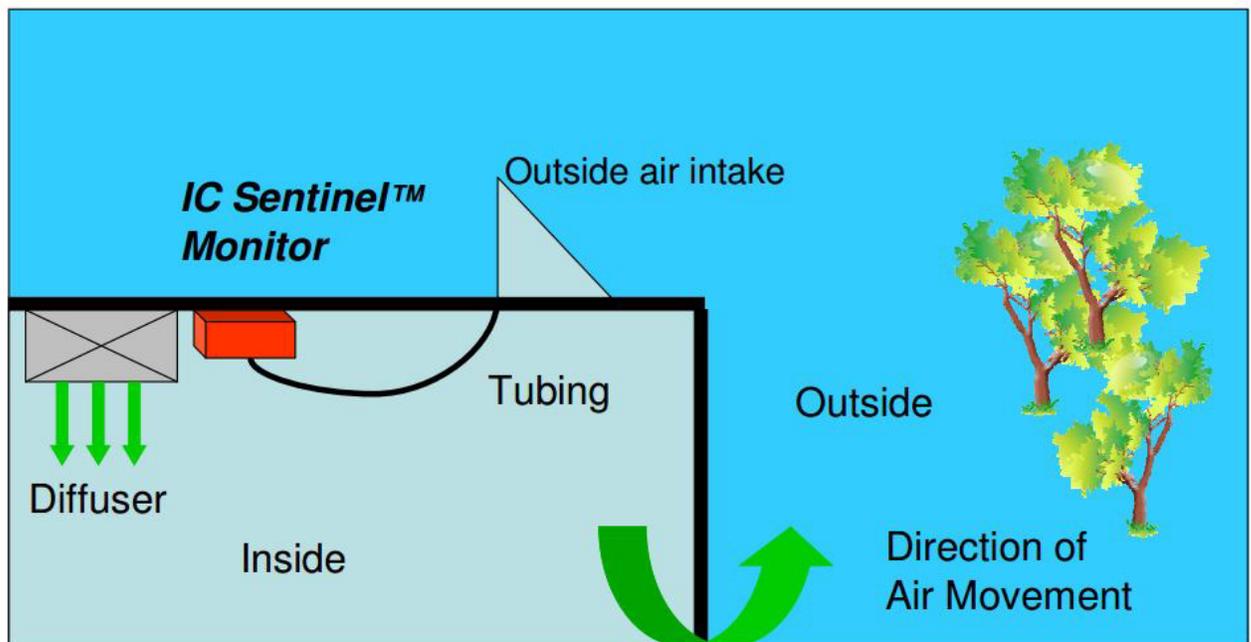
OUTDOOR BASELINE

IC Sentinel can be used to create a baseline for outdoor air quality conditions. Outdoor air quality can be adversely affected by dust storms, pollen, outdoor construction, pollution, forest fires and other factors. Before reacting to degraded indoor air quality, it is best to know if such degradation is caused by degraded outdoor air quality and particle count. For this application, the IC Sentinel monitor unit should be located indoors, ideally in the proximity of the outdoor location to be sampled. If it is desired to get differential air pressure, then the unit should be located in a nominal air pressure indoor location. Tubing is conducted from the IC Sentinel monitor's particle detector inlet (using the inlet adapter from the Zero Count Filter P/N 80846-1) to the outdoor location. The outdoor location should be located in the proximity of the air intake, to best sample air being brought into the building. Of course, an important factor is that the indoor air quality (particle count) is better than the outdoor air quality (particle count) but this is not always the case. Typically, it is desired that the indoor air pressure is positive relative to outdoor air pressure.

Monitoring outside particle count for baseline Air Quality

Intended Uses:

- *Create air quality baseline*
- *Verify indoor air is cleaner than outdoor air*
- *Monitor for poor outside air conditions*
- *Verify differential air pressure*



AIRBORNE INFECTION ISOLATION (AII) ROOMS

Alls are designed to protect healthcare workers, other patients, and the public in the hospital environment from potential infection by airborne agents carried by infected, or potentially infected, patients or groups. The All will have a negative pressure relative to adjacent spaces, and the (potentially infectious) air inside the All must be suitably exhausted. With the All, the IC Sentinel is mounted outside of the All room so that it can be visually checked without entering the All (in general, the IC Sentinel monitor unit is placed in the positive pressure location). Static Sensor Pressure Tips (P/Ns242901-0X) are used to sample the air pressure in the All, so that it can be compared to the air pressure in the adjacent corridor.

Thresholds can be set to alert personnel when the differential air pressure drops below desired levels.

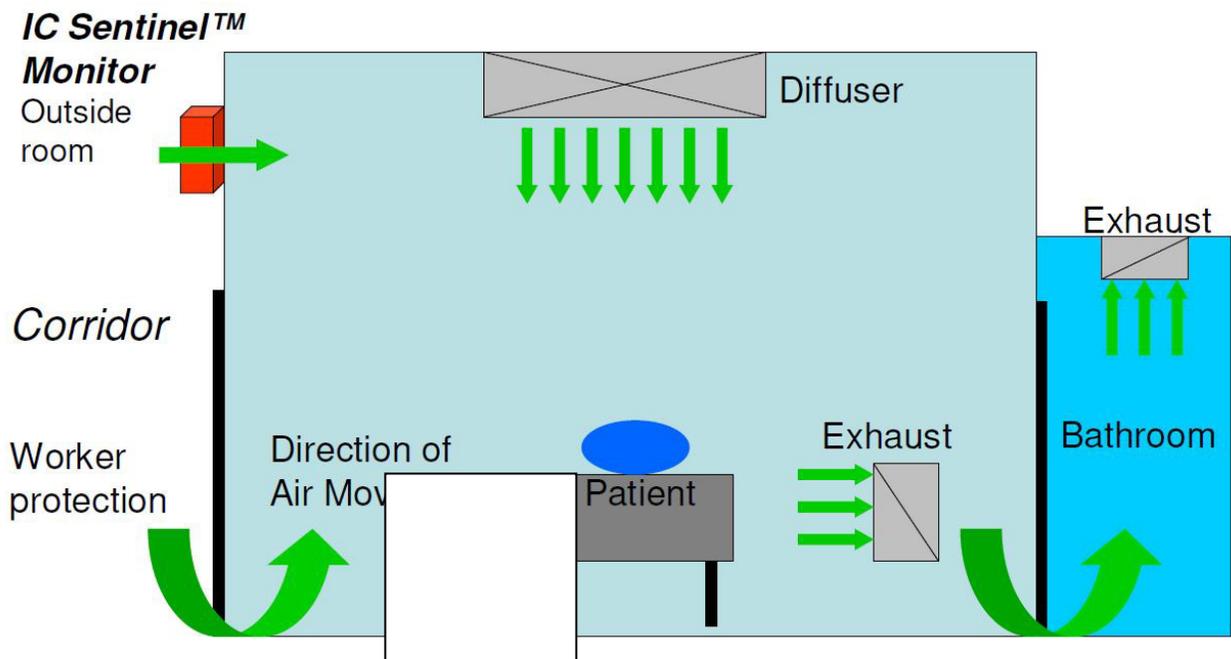
An All anteroom may be used in certain circumstances to provide additional All capacity in a hospital. In this case, the IC Sentinel Monitor unit can be placed in the anteroom, on the wall outside of the All room. Static Sensor Pressure Tips (P/Ns242901-0X) are used to sample the air pressure in the All room, so that it can be compared to the air pressure in the anteroom. The All room should remain at a negative pressure relative to the anteroom.

Thresholds can be set to alert personnel when the differential air pressure drops below desired levels.

Negative Pressure Room for Airborne Infection Isolation

Intended Uses:

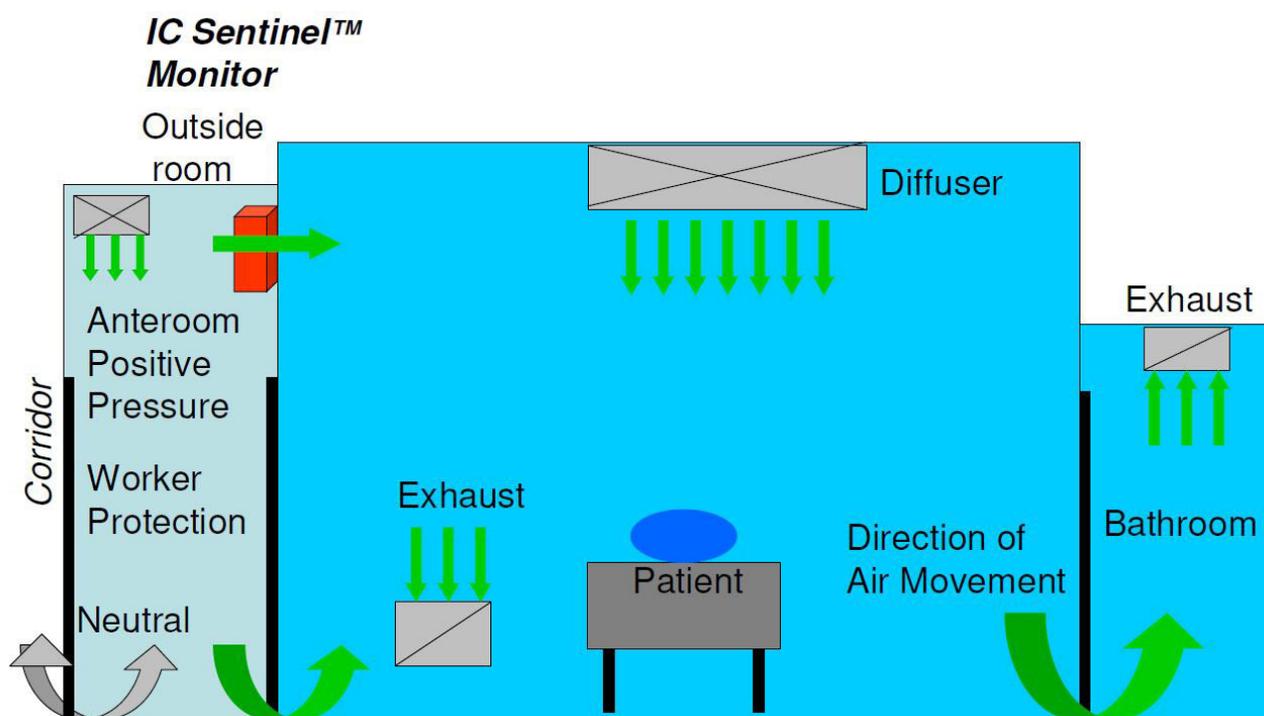
- ***Procedure/treatment***
- ***Emergency rooms***
- ***Bronchoscopy room***
- ***Autopsy rooms***



Negative Pressure Room for Airborne Infection Isolation with Positive Pressure Ante Room

Intended Uses:

- *Procedure/treatment*
- *Emergency rooms*
 - *Surge capacity*
- *Pandemic isolation*



PROTECTIVE ENVIRONMENTS (PE)

PEs are designed to protect patients who are most susceptible to airborne infectious agents. The PE will have a positive pressure relative to adjacent spaces, to keep airborne particles from leaking into the PE. With the PE, the IC Sentinel monitor unit is mounted inside the PE room so that it can be visually checked periodically by those within the PE. Static Sensor Pressure Tips (P/Ns242901-0X) are used to sample the air pressure in the adjacent space,

so that it can be compared to the air pressure in the PE. Thresholds can be set to alert personnel when the differential air pressure drops below desired levels. In general, the IC Sentinel monitor unit is placed in the positive pressure location.

A PE anteroom may be used in certain circumstances to provide additional PE capacity in a hospital. In this case, the IC Sentinel Monitor unit is placed in the PE room adjacent to the anteroom. Static Sensor Pressure Tips (P/Ns242901-0X) are used to sample the air pressure in the ante room, so that it can be compared to the air pressure in the PE room. The PE room should remain at a positive pressure relative to the anteroom. Thresholds can be set to alert personnel when the differential air pressure drops below desired levels.

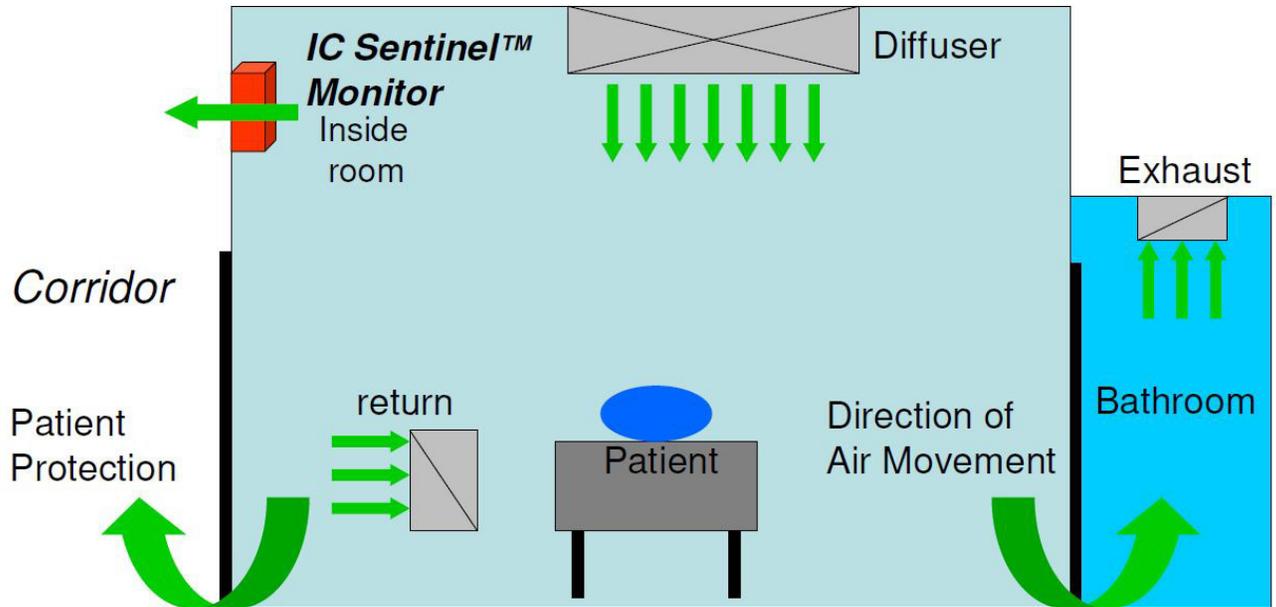
Importantly, the IC Sentinel will also measure particle counts in PE rooms (and other rooms where it is desired to monitor presence or generation of particles). Ideally the IC Sentinel monitor unit is located close to the diffuser or source of air, high on a wall or ceiling, so that the particle count is representative of the air coming into the room. This will enable the IC Sentinel system to detect degradations of incoming air quality, and help to minimize "false alarms" due to normal activities within the room which can create spikes in particle counts. In general, the IC Sentinel monitor unit is placed in the positive pressure location.

IC Sentinel will also monitor room humidity, which is a requirement in ORs. Sound and light levels can also be monitored which is important factors for overall patient satisfaction.

Positive Pressure Room for Protective Environments

Intended Uses:

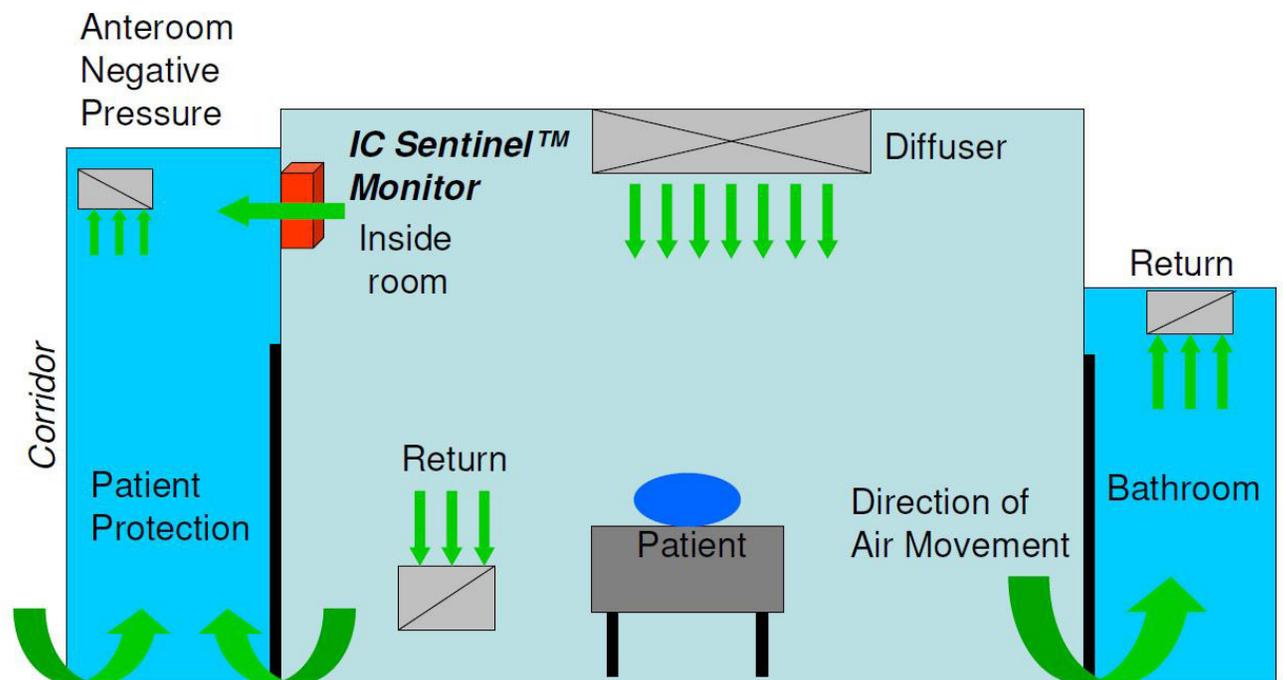
- Immune compromised patient
- Operating rooms



Positive Pressure Room for Airborne Infection Isolation and Protective Environments with Negative Pressure Ante Room

Intended Uses:

- Immune compromised patient
- Operating rooms



CONSTRUCTION AND RENOVATION

Construction and renovation activities create special requirements for monitoring differential pressure and particle counts. Work areas within the hospital must be maintained at a negative pressure so that particles generated within the work area do not spread through the facility. The air within the work area is circulated through a HEPA filter and is exhausted suitably. The IC Sentinel® Monitor unit should be located outside of the work area. Static Sensor Pressure Tips (P/Ns242901-0X) are used to sample the air pressure in the work

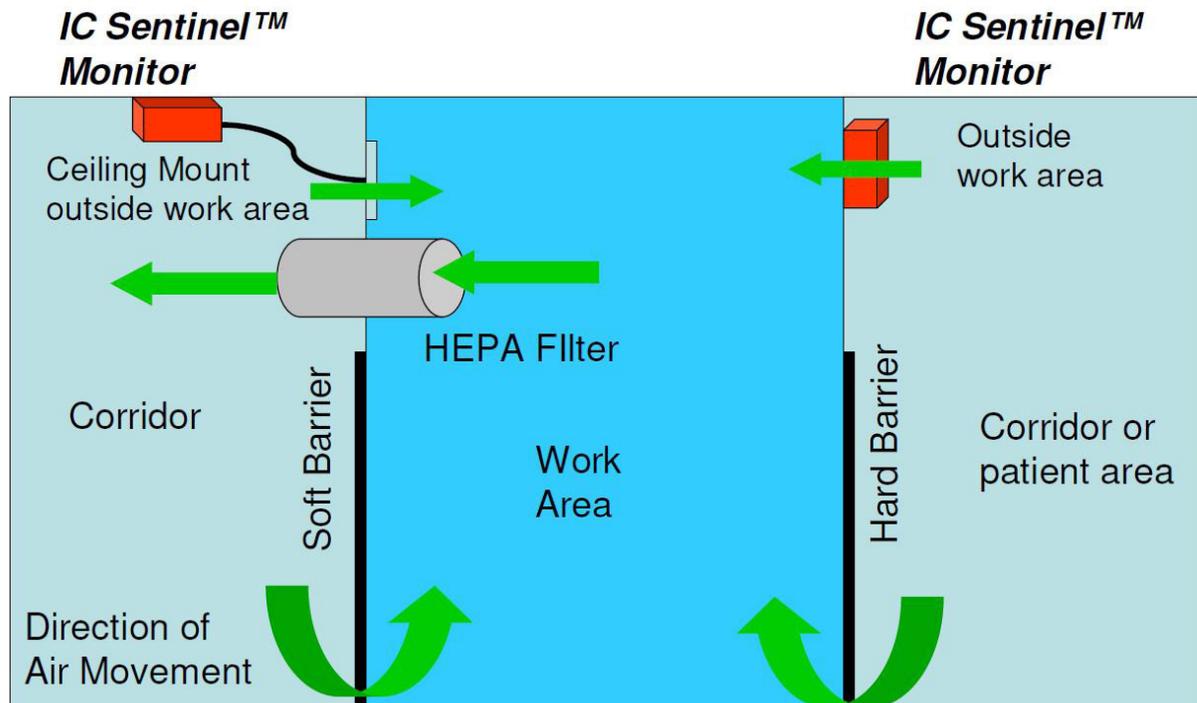
area, so that it can be compared to the air pressure in the adjacent corridor or patient area. Thresholds can be set to alert personnel when the differential air pressure drops below desired levels, which may indicate that the barrier has been incorrectly constructed, breached or damaged. For soft barriers, the IC Sentinel Monitor unit can be mounted on a ceiling adjacent to the barrier, and the sampling tube is conducted and attached to the barrier.

It is important to monitor particle count in areas adjacent to work areas to detect large increase in particle count caused by construction or renovation, which can signal a degradation in the barrier, malfunction of HEPA filter or fan, or ICRA procedure violations. Mount the IC Sentinel Monitor unit on the ceiling or on a high wall to avoid spurious false alarms due to normal activities, which can create spikes in particle count.

Monitoring Negative Air Pressure in construction area

Intended Uses:

- ***Barrier verification***
- ***Temporary monitoring***
- ***ICRA Compliance***
- ***Hazard Control***



REFERENCES

ASHRAE/FGI *Guidelines for Design and Construction of Healthcare Facilities*, 2010 Edition

ASHRAE 170-2008: *Ventilation of Health Care Facilities*

Centers for Medicare and Medicaid services (CMMS), Paragraph 482.41 *Physical Environment*

2012 Joint Commission Standards

CDC- Guidelines for Environmental Infection Control in Health Care Facilities

www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm

Solution

- [Infographic](#)
- [HAIs and Airborne Infectious Disease](#)
- [IC Sentinel® Applications Guide for Healthcare Environmental Air Quality Monitoring](#)



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