

Health Care Facilities Measuring Isolation Room Pressure—What Do The New CDC Guidelines Say?

Application Note LC-105

Introduction

What should health care facilities do to reduce the risk of TB transmission in their facilities? Specifically, how do they monitor the pressure differential between the TB isolation room and the corridor? To help answer those questions and others regarding TB, the Centers for Disease Control and Prevention (CDC) issued "Guidelines for Preventing the Transmission of Mycobacterium Tuberculosis in Health-Care Facilities, 1994" on October 28, 1994. The document updated and replaced all previously published guidelines on this subject.

What section applies?

Owners, engineers, contractors, architects, and health care workers should know how the new guidelines impact the TB isolation room design and operation. The guideline has many sections covering a variety of TB transmission issues. Supplement 3: Engineering Controls deals with those general ventilation concerns of utmost interest to the design and facility engineer. Excerpts from the CDC guidelines appear in italics.

Why use engineering controls?

Proper use of engineering controls can prevent the spread of the infectious droplet nuclei and reduce the concentration of contaminated air in the health care facility. Using pressure sensing devices to monitor TB isolation room pressure is one example discussed in the guidelines.

Why worry about airflow direction?

"The general ventilation system should be designed and balanced so that air flows from less contaminated (i.e., more clean) to more contaminated (less clean) areas. For example, air should flow from corridors (cleaner areas) into TB isolation rooms (less clean areas) to prevent spread of contaminants to other areas."

How is directional airflow achieved?

"The direction of airflow is controlled by creating a lower (negative) pressure in the area into which the flow of air is desired. ... Negative pressure is attained by exhausting air from an area at a higher rate than air is being supplied. ... To establish negative pressure in a room that has a normally functioning ventilation system, the room supply and exhaust airflows are first balanced to achieve an exhaust flow of



either 10% or 50 cubic feet per minute (cfm) greater than the supply (whichever is the greater). In most situations, this specification should achieve a negative pressure of at least 0.001 inch of water."

Is 10% offset adequate to guarantee negative pressure at all times?

No.

This criteria only establishes your initial offset. A hospital is a dynamic, not a static, environment and setting an initial offset does not guarantee that negative pressure is always present. In fact, the guidelines state, *"Negative pressure in a room can be altered by changing the ventilation system operation or by the opening and closing of the room's doors, corridor doors, or windows. When an operating configuration has been established, it is essential that all doors and windows remain properly closed in the isolation room and other areas (e.g., doors in corridors that affect air pressure) except when persons need to enter or leave the room or area."*

The only way to guarantee negative pressure is to *measure the pressure differential* between the isolation room and the corridor.

How is negative pressure monitored in a room?

"The negative pressure in a room can be monitored by visually observing the direction of airflow (e.g., using smoke tubes) or by measuring the differential pressure between the room and its surrounding area."

When you use smoke to check the room for negative pressure you are only monitoring the room at that precise moment. Using a smoke test does not guarantee that the room is under negative pressure two seconds, two minutes, or two hours later. Also, as described in the American National Standards Institute (ANSI) standard Z9.5 "at air velocities below 50 fpm, a small temperature difference between rooms will cause cold air to flow one way through the bottom of the opening and warm air the other way through the top." Thus, if air velocities into the isolation room are low (e.g., less than 50 fpm) the smoke test may indicate negative pressure at the bottom of the door but the air is actually moving out of the room at the top of the door.

Can a differential pressure-sensing device be used to monitor negative pressure?

Yes.

"Differential pressure-sensing devices also can be used to monitor negative pressure; they can provide either periodic (noncontinuous) pressure measurements or continuous pressure monitoring. The continuous monitoring component may simply be a visible and/or audible warning signal that air pressure is low. In addition, it may also provide a pressure readout signal, which can be recorded for later verification or used to automatically adjust the facility's ventilation control system."

TSI's room pressure monitors and controllers measure the pressure differential continuously, provide visual and audible alarms, and a continuous analog output for recording the pressure differential. The controllers can also adjust the room ventilation system.

Where should the measurement be taken?

"Pressure-measuring devices should sense the room pressure just inside the airflow path into the room (e.g., at the bottom of the door). Unusual airflow patterns within the room can cause pressure variations; for example, the air can be at negative pressure at the middle of a door and at positive pressure at the bottom of the same door."

However, locating a sensor at the bottom of the door may be impractical in most health care facilities. Also, as mentioned previously, low velocities into a room can also cause problems regarding measurements taken at the bottom of a door.

Can the sensor be in a different location?

Yes

"If the pressure-sensing ports of the device cannot be located directly across the airflow path, it will be necessary to validate that the negative pressure at the sensing point is and remains the same as the negative pressure across the flow path."

TSI's room pressure monitors and controllers can be calibrated to meet this requirement. TSI locates the sensor above the door and uses a through-the-wall sensor to measure the airflow into the room.

What alarms are needed?

"Pressure-sensing devices should incorporate an audible warning with a time delay to indicate that a door is open. When the door to the room is opened, the negative pressure will decrease. The time-delayed signal should allow sufficient time for persons to enter or leave the room without activating the audible warning."

TSI's room pressure monitors and controllers provide both visual and audible alarms, including remote visual alarms for nurses' stations. We also have time delays that are adjustable from 20 to 600 seconds.

Isn't there a problem with using pressure-sensing devices?

Maybe.

"A potential problem with using pressure-sensing devices is that the pressure differentials used to achieve the low negative pressure necessitate the use of very sensitive mechanical devices, electronic devices, or pressure gauges to ensure accurate measurements. Use of devices that cannot measure these low pressures (i.e., pressures as low as 0.001 inch of water) will require setting higher negative pressures that may be difficult and, in some instances, impractical to achieve."

TSI's room pressure monitors and controllers avoid this problem by using a thermal anemometer and a patented bi-directional sensor. We have used proven thermal anemometer technology to accurately measure and control pressure differentials of 0.001 inch of water or lower in laboratory rooms and hospital rooms since 1986. TSI has used thermal anemometer technology in other industrial and commercial applications since 1961.

How often is the room checked for negative pressure?

"If pressure-sensing devices are used, negative pressure should be verified at least once a month by using smoke tubes or taking pressure measurements."

This means verifying the unit. If smoke tubes are used instead of pressure-sensing devices to monitor negative pressure in the TB isolation room, then the TB isolation room needs to be checked daily with a smoke tube. By using a pressure-sensing device you eliminate the need for a staff person to conduct a smoke test every day. TSI's room pressure monitors and controllers continually measure the pressure differential between the TB isolation room and the corridor.

Does this cover everything in the guidelines?

No.

This application note only covers the portion dealing with room pressure. The guideline also covers various design issues including air changes per hour, air flow mixing, and filtration. Many other issues are addressed in the guideline including administrative measures and personal respiratory protection. Since the guidelines are extensive, it is important to understand those areas impacting the HVAC design and operation of the health-care facility TB isolation room.

How do I obtain a copy of the guidelines?

Guidelines can be obtained by calling the Centers for Disease Control at (404) 639-1819.

How do I obtain information on TSI monitors and controllers?

Contact your local TSI Manufacturer's Representative or contact TSI directly.

TSI Incorporated – 500 Cardigan Road, Shoreview, MN 55126 U.S.A

USA	Tel: +1 800 874 2811	E-mail: answers@tsi.com	Website: www.tsi.com
UK	Tel: +44 149 4 459200	E-mail: tsiuk@tsi.com	Website: www.tsiinc.co.uk
France	Tel: +33 491 11 87 64	E-mail: tsifrance@tsi.com	Website: www.tsiinc.fr
Germany	Tel: +49 241 523030	E-mail: tsigmbh@tsi.com	Website: www.tsiinc.de
India	Tel: +91 80 41132470	E-mail: tsi-india@tsi.com	
China	Tel: +86 10 8260 1595	E-mail: tsibeijing@tsi.com	
Singapore	Tel: +65 6595 6388	E-mail: tsi-singapore@tsi.com	



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