Not-So-Dead Air Space

by Dean K. Wilson, P.E.

Question: **As the Authority Having Jurisdiction for my township, I have just received plans for a new fire alarm system in a renovated downtown multiple-story building. In reviewing the plans, I note that the designer has located the smoke detectors very tightly in the corner of certain rooms. I thought that the space where the wall meets the ceiling constituted a dead air space where detectors would not work properly. Can you explain this to me?**

You have come upon a subject that has long existed as a part of the common knowledge regarding detector placement. "Keep out of the 'dead air space'!" In other words, don't located detectors in the immediate vicinity of the joint between the wall and ceiling of a room. They will not work properly in that location. The "dead air space" will prevent the fire plume from driving enough heat or smoke into the area of the wall-ceiling joint to initiate the operation of a detector.

However, a change has occurred in NFPA 72-2010, *National Fire Alarm and Signaling Code*. Previous editions of the *Code* treated heat detectors and smoke detectors the same with regard to location in the space immediately adjacent to the joint where the wall meets the ceiling. Since heat detector requirements appear first in the detection portion of the *Code,* the heat detector section stated certain principal requirements. The smoke detector section of the *Code* then made reference back to the heat detector section and applied those same requirements for smoke detectors.

This requirement to avoid the so-called “dead air space” originated with a rather interesting fire test program in 1959 in Los Angeles, CA, called “Operation School Burning.” These tests followed the tragic deaths of 92 children and three nuns on December 1, 1958, at the Our Lady of the Angels school fire in Chicago, IL.

During subsequent inspections of the Los Angeles school buildings, the Robert Louis Stevenson Junior High School became available for use in a research program on school fire safety because the city officials had scheduled this school for demolition. A significant series of fire tests in this building formed the basis for several critical pieces of information that subsequently found their way into the various codes and standards. The so-called “Dead Air Space Rule” appeared among that information.

During the tests, observers noted that a “dead air space” at the joint between the wall and the ceiling appeared to prevent the thermal plume from raising the temperature sufficiently to cause operation of heat detectors—actually thermocouples—installed in that location. By placing the heat detectors at least four-inches, either horizontally or vertically, away from the wall-ceiling joint, this observed phenomenon did not prevent operation of the detectors and, thus, did not apply. Out of this research, a *Code* requirement appeared, that still exists today for heat detectors:

> **17.6.3.1.3.1*** Unless otherwise modified by 17.6.3.2.2, 17.6.3.3.2, or 17.6.3.7, spot-type heat-sensing fire detectors shall be located on the ceiling not less than 4 in. (l00 mm) from the sidewall or on the sidewalls between 4 in. and 12 in. (l00 mm and 300 mm) from the ceiling.
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> **A.17.6.3.1.3.1** Figure A.17.6.3.1.3.1 illustrates the proper mounting placement for detectors.

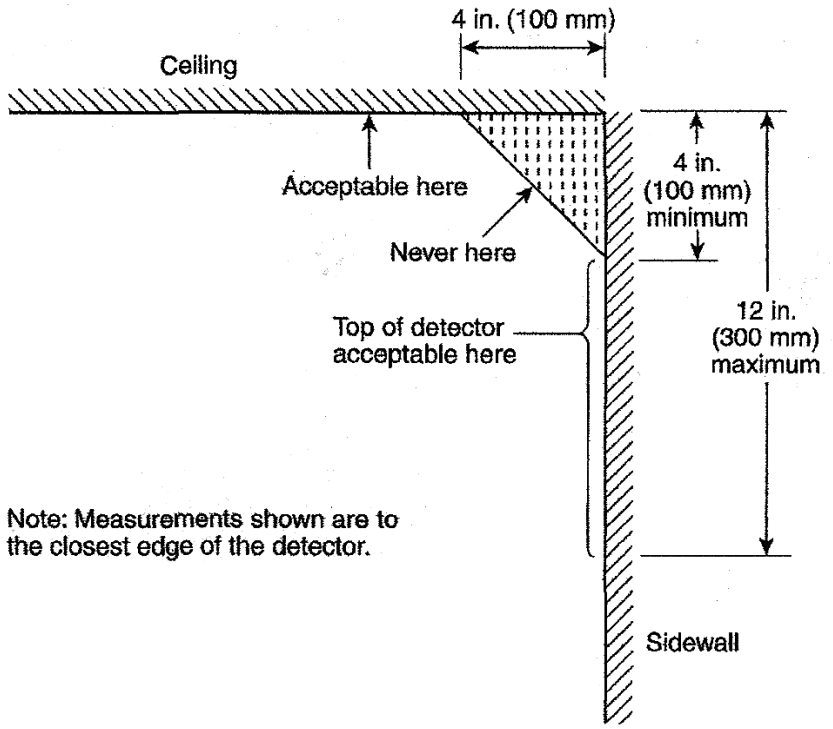

FIGURE A.17.6.3.1.3.1 Example of Proper Mounting for Heat Detectors.

Particularly in the Figure A.17.6.3.1.3.1, you can clearly see the outline of the "dead air space." When placing heat detectors, avoid this space in order to comply with the *Code* and derive benefit from the lessons learned during the "Operation School Burning" tests.

However, in your question you specifically referenced the use of smoke detectors. Until NFPA 72-2010, the *Code* gave smoke detector placement the same treatment as heat detector placement. But, a major change took place in this most recent edition. Notice this requirement:

> **17.7.3.2.1*** Spot-type smoke detectors shall be located on the ceiling or, if on a sidewall, between the ceiling and 12 in. (300 mm) down from the ceiling to the top of the detector.
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> **A.17.7.3.2.1** Refer to Figure A.17.7.3.2,1 for an example of proper mounting for detectors. Sidewall detectors mounted closer to the ceiling will respond faster.

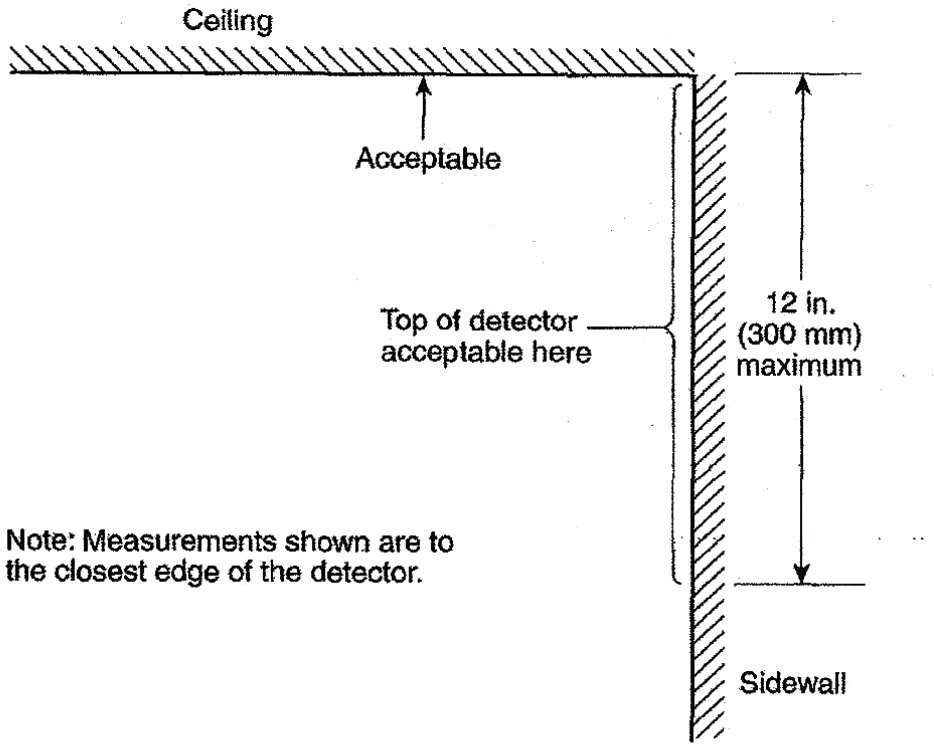

FIGURE A.17.7.3.2.1 Example of Proper Mounting of Smoke Detectors.

As you can see from Figure A.17.7.3.2.1, the *Code* has now decided to ignore the possible influence of the dead air space on smoke detector operation. This determination has come from more recent computational fluid dynamics modeling of smoke plumes that illustrated an inconsequential influence of the dead air space on the speed of smoke detector actuation. Thus, the *Code* has removed the restriction that appeared in previous editions. So, the *Code* no longer treats smoke detectors the same as heat detectors in this specific regard.

This change illustrates a greater problem that faces designers, installers, and authorities having jurisdiction. When a new edition of the *Code* hits the street, everyone must carefully review the changes to see if any of them affect the common knowledge lore that surrounds the

implementation of fire protection. We all have acquired this common knowledge lore over the course of our careers. But, that lore can change rather quickly when research brings new information to light.

Rather than relying on what we think we know, we should all make every effort to follow the process involved in changing the *Code*. That way, we won't become surprised at changes when the NFPA publishes the new edition of the *Code*.

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