# Why Not Reduce The Spacing?

by Dean K. Wilson, P.E.

**Our firm recently received a Request For Proposal to design and install a fire detection system inside a large freezer building at an ice cream manufacturing facility. The freezer occupies a room 60 feet wide, 80 feet long, and 27 feet high. The fire detection system will actuate a double-interlock preaction sprinkler system with automatic sprinklers installed at the ceiling level and at two intermediate levels within the storage racks inside the freezer. In trying to apply Table 5.6.5.5.1 from NFPA 72-2002, *National Fire Alarm Code*, we have been trying to understand the Exception to Section 5.6.5.5.1. Can you explain why the Table does not apply to heat detectors that "rely on the integration effect?"**

First of all, my most sincere congratulations on one of the more challenging fire protection design projects. Providing adequate and properly engineered protection for a freezer always presents the designer with unique opportunities for great success and also for enormous failure. On the one hand you must select appropriate heat detection devices that will operate properly in the very cold environment and detect a hostile fire without causing any false actuations. The double-interlock preaction sprinkler system basically consists of a UL listed dry pipe valve mounted on top of a UL listed deluge valve trimmed for preaction service.

In many cases, dry nitrogen will serve in place of compressed air to fill the sprinkler piping to both supervise for leaks and also to allow the actuation of a sprinkler head to cause a drop in pressure that will, in turn, actuate the dry pipe valve. However, until the fire detection system detects the hostile fire and actuates the preaction valve, no water will flow to the underside of the dry pipe valve, causing it to trip into an open position and flooding the sprinkler piping with water. Hopefully, this double-interlock arrangement will keep the piping from flooding prematurely. Once the piping floods with water, the water will likely freeze unless actuated sprinkler heads give the water an outlet through which to flow out of the piping and onto a hostile fire.

The Exception from NFPA 72-2002 to which you refer to reads as follows:

> *Exception: Table 5.6.5.5.1 shall not apply to the following detectors, which rely on the integration effect:*
>
> *(1) Line-type electrical conductivity detectors (see 3.3.43.10)*
>
> *(2) Pneumatic rate-of-rise tubing heat detectors (see 3.3.43.12)*

Table 5.6.5.5.1 of NFPA 72-2002, *National Fire Alarm Code,* offers multiplying factors to reduce the linear listed spacing between heat detectors based on the height of the ceiling above the floor. For normal heat detectors, once the ceiling height exceeds 10 feet above the floor, an installer must reduce the linear spacing between the heat detectors by multiplying the listed spacing in accordance with the values contained in this Table for a specific ceiling height.

The data which the NFPA Technical Committee used to construct this Table came from research conducted by the Fire Detection Institute (FDI) in the middle 1970’s. The FDI sponsored the actual fire tests that provided this data at the Factory Mutual Research Center in West

Glocester, Rhode Island. The Research Center had two basic test sites: a 60-foor test site and a 30-foot test site. Researchers conducted all of the FDI tests at the 30-foot test site. This explains why the data in the Table stops at 30 feet. While FDI had hoped to conduct additional tests at the 60-foot test site, the available funds ran out before the researchers could conduct those tests.

The reduction in spacing presumes a point-source type device where the design of the detection element positions it at a specific point on the ceiling. Thus, the typical spot-type heat detector would require the reduction in linear spacing as required by the Table.

However, not all heat detector designs employ a detection element with a specific point-source configuration. Some designs detect over their entire length in a manner that accumulates the influence of heat and makes a detection decision based on the integration of some change in temperature along a specific plane for some distinct length.

The pneumatic rate-of-rise tubing, for example, consists of a small diameter metal tubing filled with air at atmospheric pressure, or, in some cases, with either air under pressure or dry nitrogen under pressure. Heat from a hostile fire will cause the gas in the tube to expand and press against a diaphragm faster than it can escape out a compensating vent. The extension of the diaphragm will operate a linkage that causes a switch contact to close to initiate a fire alarm signal. Because heat may act on the gas contained in the tubing over the length of the tubing, the resulting pressure may either result from heat at a specific point or may actually result from the integration of heat over some portion of the length of the tubing. In such a case, a designer or installer cannot really treat the reduction of spacing to account for ceiling height in the same manner as spot-type heat detectors.

A similar scenario would exist for any type of heat detector that integrates a response to heat over its length. Thus, the *Code* also includes a reference to line-type electrical conductivity heat detectors. Such a detector causes a change in resistance to current flow based on the effect of heat from a hostile fire acting on the composition of one or more conductors inside a cable assembly. The same kind of effect would apply to such a detector as applies to the pneumatic tubing heat detector.

Whenever a designer chooses to use an integrating-type heat detector, he or she must base any reduction in spacing between lengths of the detector on the manufacturer's recommendations. Thus, the installation manual for the integrating-type heat detector must include such information.

One caution: not all line-type heat detectors use a design that integrates the effect of the heat from a hostile fire over the length of the detector. Some line-type heat detectors really consist of a long string of single-point detectors connected together. Heat applied at one point, or over the entire length of such detectors, has the same effect. Because the design does not respond to any integration effect, the detector will operate within the same time frame whether heat impacts a single point or the entire length of the line-type detector. When in doubt, check the manufacturer's literature for the particular detector.

And, good luck with your freezer project. Just be certain you get all your testing done before they turn on the compressors and start dropping the temperature inside. That way if you accidentally release water into the piping, you will not have to dismantle all the piping, thaw it out and reassemble it.

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