

TechNotes Issue # 368
March 7, 2017

The following issue of TechNotes has been written by Louis Guerrazzi E.I.T., Manager of Product Standards for the NFSA.

A Snapshot of Sprinklers and Ambient Heat

Summary of Sprinklers' Operating Mechanism

The first widely accepted "automatic fire sprinkler", developed by Henry Parmelee in 1874, was a perforated shell covered by a brass cap solder that melted at 160°F. Following Parmelee's sprinkler, the industry eventually moved to the eutectic solder link as the operating element for sprinklers. These eutectic solders keep their strength up to a specific temperature at which point they transition quickly from a solid to a liquid. Eutectic solder alloys were discovered at 135°F, 165°F, 212°F and 286°F which would eventually go on to correspond to Ordinary (135°F), Ordinary (165°F), Intermediate(212°F), and High(286°F) Temperature classifications, respectively. In addition to these original solder link type sprinklers, the industry eventually started to employ glass bulb sprinklers which can be engineered to operate at a wider range of temperatures compared to their metallurgic counterparts. Regardless what the operating element is, a fire sprinkler is designed to operate when it reaches a specific temperature.

Automatic fire sprinklers are engineered to respond to these specific temperatures such that in the event of a fire, a sprinkler located near the source will operate early enough to perform adequate control or suppression of fire. In addition to engineering the temperature of a sprinkler, manufacturers can also adjust the thermal sensitivity of the sprinkler by altering material thickness, exposed surfaced area or a combination of factors. Each sprinkler is associated with a response time index (RTI) based on laboratory testing to indicate its relative response time; an RTI value to indicate faster response sprinklers (low RTI) or



slower response sprinklers (high RTI).

In short, sprinklers operate when they reach a specific temperature regardless of the type of operating mechanism and how quickly they operate depends on physical characteristics of the operating mechanism. However, to ensure an installed system is truly successful, it is also important that sprinklers do not activate in the absence of fire. We accomplish this by taking into consideration maximum ambient temperatures of the environment as well as addressing local heat sources.

Considering Ambient Temperature

When we talk about ambient temperature with sprinklers, we are looking at the environment the sprinkler is going to be installed in. Table 6.2.5.1 of NFPA 13-2016 provides temperature rating, classifications, and color coding for our seven temperature classifications of sprinklers. On this table we see that for Ordinary Temperature sprinklers, sprinklers designed to operate between 135°F and 170°F, are limited to maximum ambient temperature of 100°F.

You may find yourself asking, "Why is a sprinkler that operates at 135°F limited to ambient temperature of 100°F or less?". The answer is because while these sprinklers are engineered and tested to operate at specific temperatures, repeated or long-term exposure to elevated temperatures can weaken the sprinklers operating element. Over time, this weakening may lead to a false operation during a non-fire event.

Another question you may be asking yourself is, "So if Ordinary Temperature sprinklers are defined as having a temperature rating between 135°F and 170°F are both are limited to that 100°F maximum ambient temperature?"

That official answer is "Per the requirements of NFPA 13-2016, that is correct. Both a 135°F and 170°F rated fire sprinkler are limited to maximum ambient temperature of 100°F".

The less official answer is that depending on the operating element, the higher range of temperatures in each classification may be able to adequately perform at temperatures somewhat above the maximum ambient temperature for its classification. What we are trying to get at here is that if there is a project where ceiling temperatures are expected to go above 100°F, intermediate type sprinklers should be selected. However, if you have installed 165°F sprinklers, which is at the upper range of Ordinary rating, ambient temperature reaching 107°F may not be a cause for concern. Future options may permit for certain glass bulb sprinkler rated at 165°F to be



Upcoming Technical Tuesdays

March 21

Piping and Valve Requirements

NEW REDUCED PRICE FOR MEMBERS!

Register Here



View older issues in the "Member's Only" section

Upcoming In-Class Seminars

March 21-23

Pataskala, OH

-Coordinating NFPA 25&72

-Fire Service Mains

&

-Installation Requirements

(Each a One Day Class)

exposed to ambient temperatures of upwards around 120°F rather than its current limitation of 100°F in NFPA 13-2016. While the standard provides prescriptive requirements for sprinkler types by their temperature classification, it may be acceptable to go beyond the standard when appropriate analysis is performed. If and how this happens is to be seen, as this is an evolving concept which may come to fruition in the future editions of NFPA 13. Until then must use what the installation standard requires along with our common sense.

Specific Circumstances of Note

Beyond being exposed to typical ambient conditions, there are some events to be aware of that may also adversely affect fire sprinkler performance. Most sprinklers installed will be of ordinary or intermediate type, as NFPA 13-2016 allows for those types to be installed throughout an occupancy unless a higher temperature rating is specifically required. The following are some situations which would adversely affect ordinary temperature rated sprinklers and weaken their operating element:

Construction or Alteration-Related Heating

In some climates, heaters are placed in areas where sprinklers are already installed to help cure plaster or dry paint more quickly, which can easily raise ceiling temperatures above 100°F.

"Hot Yoga"

Hot yoga studios have significantly grown in popularity over the last several years in the US and other parts of the world. While there are many variants of hot yoga, Bikram style yoga operates at an average room temperature of 104°F, with other styles maintaining room temperatures from 85°F to 117°F.

"Bed Bug Remediation"

A common approach to dealing with the remediation of a bed bug issue is to heat the room to temperatures between 113°F to 122°F for some duration. The NFSA has published a white paper on appropriate treatment procedures. [Here](#) is the link to the paper.

Register Here

Did You Know??

The NFSA keeps a member of the Engineering Department staff on duty every business day to answer your technical questions live.

We call this the Expert of the Day (EOD) program and it is available to our members by phone, fax or e-mail. Call us at (845) 878-4200 and press 2, or you can send a fax to (845) 878-4215, or you can e-mail us at eod@nfsa.org.

Last year we answered more than 2600 requests for assistance.

NFSA TechNotes is c. 2017 National Fire Sprinkler Association, and is distributed to NFSA members on Tuesdays for which no NFSA Technical Tuesday Online Seminar is scheduled. Statements and conclusions are based on the best judgment of the NFSA Engineering staff, and are not the official position of the NFPA or its technical committees or those of other organizations except as noted. Opinions expressed herein are not intended, and should not be relied upon, to provide professional consultation or services. Please send comments to Mark Hopkins, P.E. at Hopkins@nfsa.org.

