The Renaissance of NFPA 13

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Abstract

For over 100 years the National Fire Protection Association has published the *Standard for the Installation of Sprinklers,* NFPA 13. The newest edition, the 2019 edition, was completely reorganized for enhanced readability, elimination of redundancy, and to include new sprinkler technology.

Similar to other codes and standards, many of the provisions of NFPA 13 migrated from previous editions. Fire sprinkler technology has advanced greatly since these early days. As a result of the technological advances in the industry, the validation of technical requirements found within NFPA 13 has advanced as well. NFPA 13 is currently undergoing a renaissance to upgrade or validate technical provisions through the use of modern technology.

The use of water as a fire extinguishing agent likely correlates with the discovery of fire itself. The favorable attributes of water include a boiling point of 482 °F (250 °C), which is below the pyrolysis temperature for most solid combustibles, and a latent heat of evaporation of 970.3 btu/lb (2,256 kj/kg) which results in high heat absorption capabilities. Other attractive features include a relatively low cost and abundant availability. Designing a delivery system which would automatically activate in the early phases of fire development however, was a challenging proposition.

In 1874 Henry S. Parmelee received the first United States patent for an automatic sprinkler. Soon after, the property insurance industry began requiring sprinklers to protect industrial occupancies. By 1895 the various property insurance groups had created their own rules for the design and installation of sprinkler systems. This resulted in several different sets of sprinkler standards. Each standard consisted of different requirements for sprinkler system design and installation [1].

To resolve this problem, the National Fire Protection Association (NFPA) was formed in 1896. Located in the New England region of the United States, the nonprofit organization’s primary purpose was to publish the first unified sprinkler standard [2].

The first United States sprinkler standard created by the NFPA was published in 1896. The inaugural issue of NFPA 13, was state of the art for its time, including requirements for steam powered fire pumps and other 19th century technology. As sprinkler technology improved, so did NFPA 13.

Most provisions found within the early editions of NFPA 13 were based upon the experience and knowledge of the fire protection engineers working within the insurance industry. Scientific analytical methods, such as the use of computation fluid dynamic modeling, hydraulic network modeling, or fire testing were in their infancy. As time progressed, a large number of legacy requirements of NFPA 13 were migrated from edition to edition. The 2019 edition of NFPA 13, for example, contains sprinkler spacing requirements which appeared in the 1896 edition.

The use of fire testing as a methodology to evaluate sprinkler performance began in the late 1970's. During this time, sprinklers were required by the insurance industry for property protection in storage and other industrial occupancies. The first major United States non-proprietary fire-testing program began in the early 1970's, and focused on the rack storage of material. Funding for the program was predominantly received from affected industry groups [3].

The project was intended to provide data to the newly formed NFPA storage committee. Over 100 full- scale fire tests were completed. A new commodity class was created for the testing, Class II commodity, which was comprised of a cardboard doubled tri-carton with a metal liner. This test commodity was indicative of the material stored at this point in time, primarily cellulose based material. Storage heights up to 25 ft. (7.6 m), mainly in rack array, were tested. The testing of plastic materials, which included collaboration with FM Global, followed shortly afterwards [4].

This work provided a scientific basis for the sprinkler design criteria (water flux and design area) found in NFPA 13. Variables such as solid shelving, vertical barriers, and flue space width were also explored. Sprinkler technology at this time consisted of standard response 1/2 in. (15 mm) orifice sprinklers. While these tests provide insight into the performance of the legacy sprinklers, newer sprinklers with much large orifice sizes required additional testing [5].

The first step towards larger orifice size storage sprinklers occurred with the introduction of the 5/8 in. (15.9 mm) extra-large orifice sprinkler in the early 1990's. This test series focused on retail storage arrays found within Big Box retail occupancies. Storage heights to 27 ft. (8.2 m) were tested. Funding for the program was predominantly received from affected industry groups [6].

While these early tests programs provided valuable data for inclusion in NFPA 13, the high cost of full- scale fire testing was a major deterrent. Recognizing this problem, the Research Foundation, an NFPA affiliate,

was established in 1982 in response to a growing need for research that better informed NFPA's expanding body of codes and standards [7]. The Foundation's work significantly improved the validation needed to successfully add new requirements to NFPA 13. In addition, the Foundation commissioned numerous projects intended to confirm various legacy requirements presently found within the current edition of NFPA 13.

New storage situations, such as those of the Big Box Retail Industry, created new and unusual challenges for automatic sprinklers. Riding a wave of expansion, the Big Box Retail Industry funded numerous full- scale fire testing programs upon which many NFPA 13 requirements are based.

As the depth of NFPA 13 expanded, the specificity of the fire testing projects increased. Examples of these unique applications include the protection of storage of paper records with compact mobile storage arrays, the effect of high volume low speed fans on sprinkle performance, and the use of horizontal and vertical barriers in rack storage of plastic commodities.

Summary

This paper presents a collection of significant fire testing projects (1990- 2019) and their contribution to current NFPA 13 requirements. The presentation will include data from projects completed by the Research Foundation, private industry, and the property insurance industry. Examples include; the protection of exposed expanded plastic, compact storage protection, high volume low speed fan protection, Early Suppression Fast Response Sprinkler protection requirements, and others.

Keywords: Full-scale fire test, Compact storage, Early Suppression Fast Response sprinkler, Expanded exposed plastic

References

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[2] Ibid

[3] Summary of the Historic Notes of Chester Schirmer, Aon Internal Research Project, Palenske, Garner, 2000.

[4] Ibid

[5] Ibid

[6] National Fire Protection Association Standard for the Installation of Sprinklers, NFPA 13, 2019 edition, Appendix C.

[7] https://www.nfpa.org/news-and-research/resources/fire-protection-research-foundation