



# TechNotes

Editor - Roland Asp, CET

#536

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This edition of TechNotes was written by Jon Nisja, Fire Protection and Data Specialist with NFSA.

## Keep the Home Fires Burning (NOT!): Residential Fire Sprinklers

Back in World War I, there was a patriotic song that encouraged people to “keep the home fires burning”. It was intended to encourage support for the armed forces fighting abroad in hopes that the war would end, and everyone would safely return to the comforts of their home. Of course, 100-plus years ago, the thought of a home fire was probably a quiet evening gathered around a fireplace. The notion of a home fire today conjures up completely different thoughts.

Residential fires are the most common type of building fire. They kill and injure the most people and do the most damage. Here we will review residential fire loss data, examine the history behind residential fire sprinklers, look at the growth of the residential sprinkler market, and assess residential fire sprinkler performance and effectiveness.

### Fire Sprinkler History

Fire sprinklers have been around for a long time. Coincidentally, 2024 is the 150th anniversary of the first sprinkler patent by Mr. Henry Parmelee in 1874. If you remember your fire sprinkler history, Mr. Parmelee owned a piano factory in Connecticut and wanted a device to protect his business from a fire.

America Burning<sup>1</sup> was a report published by the National Commission on Fire Prevention and Control in 1973. The goal was to identify measures that would reduce the negative impact of fire in the United States. American Burning made 90 recommendations; one of the recommendations was that “... the proposed U.S. Fire Administration support the development of the necessary technology for improved automatic extinguishing systems that would find ready acceptance by Americans in all kinds of dwelling units.”<sup>2</sup>

Even though fire sprinklers had been in existence for almost a century when America Burning was published, they were primarily installed in commercial buildings where the objective was to reduce property loss and business interruption. America Burning introduced a new concept: fire sprinkler systems with an emphasis on life safety.

In conjunction with the America Burning report, the National Fire Protection Association’s (NFPA) technical committee on automatic sprinklers appointed a subcommittee to develop a fire sprinkler installation standard for one and two-family homes. “The basic design objectives



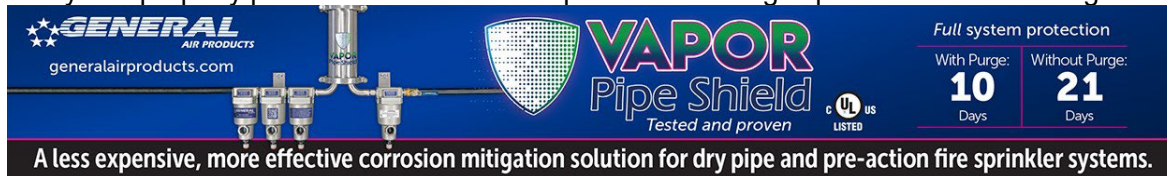
Henry Parmelee  
(Courtesy of Edubilla.com)

for the dwelling sprinkler system were to provide: (1) a system that would allow the occupants sufficient time to ensure their survival, and (2) a system that would be inexpensive.”<sup>3</sup>

NFPA 13D became the installation standard for fire sprinklers in one- and two-family dwellings and mobile homes. It was first published in 1975 and the first edition used standard spray sprinklers. Under federal funding, the Factory Mutual Research Corporation (now known as FM Global) worked on the development and testing of a residential sprinkler using quick-response (QR) technology. These sprinklers operated about five times faster than standard sprinklers. This technology was validated in a series of full-scale tests in 1979 and 1980.

Over the decades of the late-1900s, fire sprinklers became a building and fire code requirement for newly built schools, places of public assembly, apartment buildings, hotels, and health care occupancies. The emphasis in these occupancies was more on life safety where traditional sprinkler protection in factories, manufacturing, industrial, office, and mercantile uses was geared more toward property protection or minimizing business interruption.

In 1989, NFPA published NFPA 13R, a standard for low-rise residential buildings. NFPA 13R was something of a hybrid between NFPA 13 and NFPA 13D and allowed for a mix of both life safety and property protection in hotels and apartment buildings up to four stories in height.



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## Residential Fire Loss

There are about 500,000 structure fires each year in the U.S. About 375,000 (or 75 percent) of these structure fires occur in residential buildings. These are defined as one- and two-family homes, apartments, townhomes, dormitories, lodging homes, hotels, condos, and barracks; places where people live and sleep.

Over the past five years, residential occupancies have been where 76 percent of the fire deaths, 77 percent of the fire injuries, and 71 percent of the structural fire loss have occurred.

## Commercial vs Residential Fire Sprinklers

It was recognized that the residential sprinkler developed from the 1970s' research and testing had to perform differently than the classic fire sprinkler in use. For one thing, the make-up of a typical residential room was different than most rooms in a commercial building. While in commercial buildings most of the furnishings (the things that can burn) are located more in the center of the space, in residential settings, the furnishings tend to be along the perimeter walls. This meant that the residential sprinkler needed to throw water higher to provide that “wall-wetting” capability.

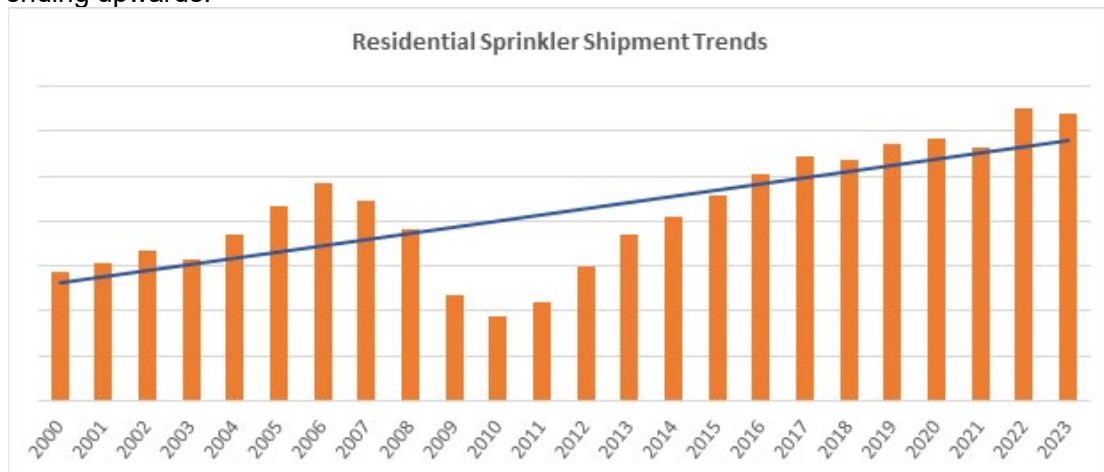
Also, in order to provide the life safety benefits desired, occupant tenability had to be considered, so different testing and listing criteria were developed. Nationally recognized testing laboratories – such as Underwriters Laboratories (UL) – had been testing and listing fire sprinklers going back to the early 1900s. The standard used for testing and listing fire

sprinklers is UL 199. The standard used for testing and listing residential fire sprinklers originally was UL 1626, but it has now been incorporated into UL 199.

To be a listed residential sprinkler, certain criteria must be met which include a full-scale fire test. In that test, the sprinkler must operate fast enough to limit temperatures at both the ceiling and at eye level to tenable conditions and that only one or two sprinklers activate. Testing over the years has also shown that faster activation leads to the production of fewer toxic fire gases – especially Carbon Monoxide (CO) – thereby improving occupant survivability.

## Residential Sprinkler Shipments

The NFSA has tracked residential sprinkler shipments since 2000. Residential sprinkler shipments now represent about a quarter of all fire sprinklers shipped in the U.S. and is trending upwards.



## Residential Sprinkler Performance and Effectiveness

Both NFPA 13D and 13R were somewhat based on data analysis. Both standards exempted fire sprinklers in areas where fires were unlikely to originate and, if they did, fire growth would be limited and have a limited negative impact on the occupants. The following table shows the data from earlier studies and compares contemporary data on the number of fires.

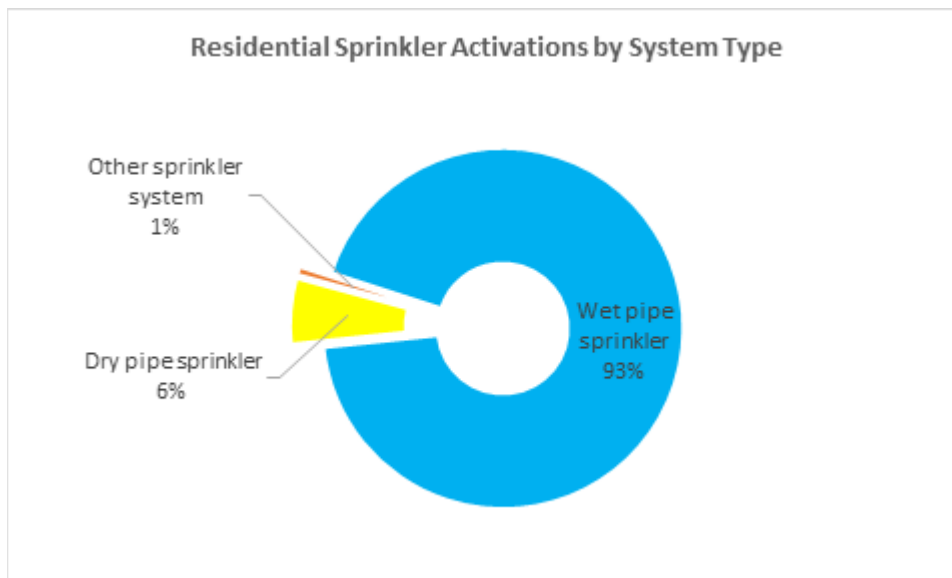
Area or Room	Deaths – 1980-1984	Injuries – 1980-1984	Fires – 1980-1984	Fires - Current Data
Bathrooms – 55 sq. ft. or smaller	1.2%	1.9%	1.7%	3.9%
Closets for clothes and linen or pantries – 24 sq. ft. or smaller	0.9%	1.3%	1.2%	2.5%
Garages & carports	1.1%	3.7%	3.4%	3.3%
Attics	0.5%*	0.7%*	2.7%*	0.3%
Concealed spaces	1.3%	1.2%	3.1%	2.7%
Crawl spaces	1.5%	2.9%	3.2%	1.5%

\* Attic data is from 1994-1998

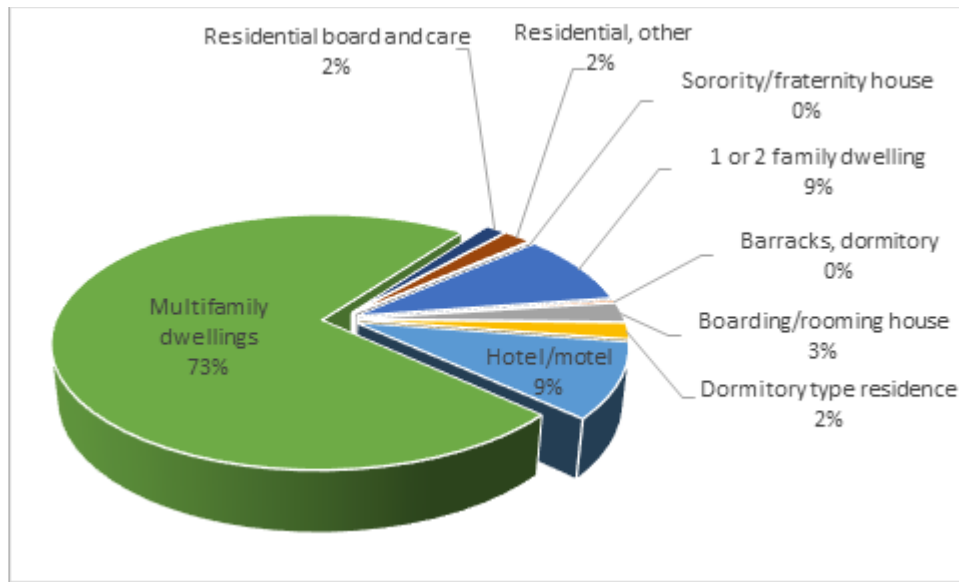
NFSA looked at residential sprinkler performance and effectiveness for the recent five-year period of 2018-2022. The majority of successful sprinkler activations (56 percent) occurred in residential occupancies; here is a breakdown of those activations:

- Apartments / multifamily dwellings: 41 percent
- Hotels / motels: 5 percent
- One and two-family dwellings: 5 percent
- Other residential (dorms, lodging, etc.): 5 percent

The vast majority of the successful sprinkler activations in residential occupancies were wet-pipe systems.



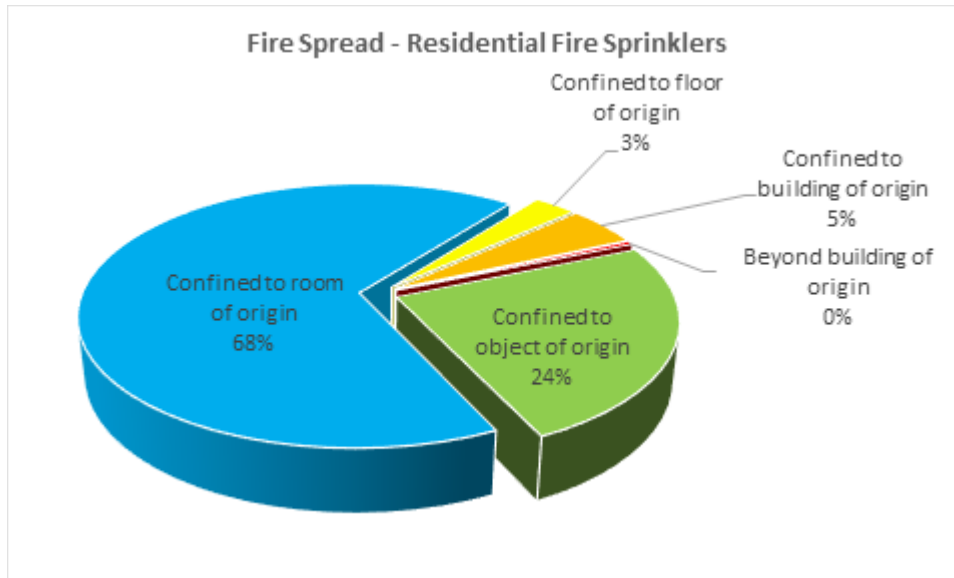
Of the residential occupancies where sprinklers operated and were effective, here is a breakdown by the type of residential property:



Out of the 8,202 fires in residential occupancies where the sprinklers were deemed effective, the vast majority were controlled by one or two sprinklers.

Number of Sprinklers	Fires	Percent	Cumulative %
1 sprinkler	7,018	85.6%	85.6%
2 sprinklers	833	10.2%	95.8%
3 sprinklers	182	2.2%	98.0%
4 sprinklers	83	1.0%	99.0%
5-10 sprinklers	63	0.8%	99.8%
11 or more sprinklers	23	0.3%	100%
Total	8,202	100.0%	100%

Even though a minimal number of sprinklers were successful in controlling residential fires, the sprinklers kept the fires contained to the area of origin or room of origin 92 percent of the time.



## Where Do Most Sprinkler-Controlled Residential Fires Occur?

Here are the ten most common areas where sprinkler-controlled fires happened in residential occupancies; these represent 85 percent of the sprinkler-controlled residential fires:

Area or Room of Origin	Percent
Kitchen or cooking area	43.6%
Bedroom	14.5%
Living room or family room	5.9%
Laundry room or area	4.6%
Balcony or porch	4.1%
Bathroom or lavatory	4.0%
Garage or carport	3.3%
Closet	2.5%
Chute (trash or rubbish)	1.7%
Patio, porch, or courtyard	0.9%

## Summary

Residential structure fires kill and injure more people than all other types of fires. In addition, they are responsible for over 70 percent of the structural fire loss in the U.S. The development of residential fire sprinklers was recommended by the America Burning report in the early 1970s. Based on that report, residential sprinklers were developed, standards were produced, and the model codes started requiring them to be installed.

Automatic sprinkler systems have been shown to be effective in controlling fires in residential occupancies. In the vast majority of sprinkler-controlled fires in residential settings, one or two sprinklers are activated. Once activated, sprinklers contained the fire to the object of origin or room of origin 92 percent of the time.



## References

- [1] [America Burning: The Report of The National Commission on Fire Prevention and Control](#) (PDF). *U.S. Fire Administration*. Federal Emergency Management Agency. May 4, 1973.
- [2] *Ibid.* Recommendation 75, page 170.
- [3] Dr. John Bryan, "Automatic Sprinkler and Standpipe Systems" (Quincy, MA: National Fire Protection Association, 1990), page 371.

## Training and Education



### Sign-Up for one of our Layout Technician Pathway Courses

NFSA's newly updated fire sprinkler Layout Technician Pathway (LTP) prepares fire sprinkler layout and design professionals for NICET Levels I & II certifications. It also provides a great refresher for those who have been designing systems but need a comprehensive refresher. Students will receive a hard copy of the recently updated and revised "Layout Book" as well as a copy of the 2022 edition of the NFPA 13 standard.

The LTP consists of two parts. Students must first complete the on-line Part 1: Fundamentals before attending the in-person Part 2: Application session. The 25 self-paced online modules cover everything from "Parts of a Sprinkler" to "Introduction to Fire Sprinkler Calculations." The 3-day in-person instructor-led Part 2: Application class applies the content learned in the previous Fundamentals course. There are four in-person and one virtual session offered in 2023.

**NOTE: Students must register for Part 1: Application at least one month before the start of in-person Part 2: session in order to allow enough time to complete the on-line modules.**

Layout Technician Pathway cost:  
Members: \$2,200.00  
Non-members: \$4,400.00 – Join here to save 50%!

Registration Deadline for Fundamental & Application	Layout Technician: Fundamentals Completion Deadline	Layout Technician: Application Class Dates	Location
1-Jul-24	28-Jul-24	July 29-31, 2024	CO
23-Sep-24	11-Oct-24	October 12-24, 2024	Virtual

[Check Out All Options](#)

## Tech Tuesday: (Let's not) Keep the Home Fires Burning

Our next Tech Tuesday will be June 18, 2024, from 12:30 pm to 1:30 pm eastern time. The topic will be (Let's not) Keep the Home Fires Burning.

"Keep the home fires burning" was a motto to encourage soldiers and their families during World War I. Today it would have a totally different meaning. Fires in residential occupancies are by far the most common type of fire and kill more people each year than all other fires combined. Residential occupancies include homes, duplexes, townhomes, and apartments. Residential sprinkler technology emerged in the 1970s and early 1980s in response to the U.S. government's report called "America Burning" that encouraged the development of a quicker-activating sprinkler that could provide life safety benefits in addition to property protection. This seminar will review the history of residential sprinkler technology, identify the differences between commercial and residential sprinklers, and evaluate sprinkler performance in residential settings.

Member Cost: Free  
Non-member Cost: \$50.00 Learn more about membership.

\*\*\* As of October 2023, NFSA has transitioned back to Microsoft Teams using the Webinar client to deliver Tech Tuesdays.

With this process, once you have registered for the event you be sent an email with a Microsoft link that will bring you to the Microsoft Teams Event registration page. You must provide simple identifying information here to generate your email with the "Join" link to the Webinar.

We must be able to identify each participant as accessing, being present, engaging, and evaluating the course to issue a CEU Certificate.



Thank you for your patience, we will continue to improve the user experience as we continue this transition back to Microsoft Teams. Your feedback is always welcome!

**Register for the next Tech**  
Tuesday, Nov 12, 2024

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