Lately it seems that every plumbing magazine has run an article about residential fire sprinklers, providing you with all of the information you need to install these systems. I want to take a different approach and talk about the history of residential fire sprinklers and answer some of those difficult questions: Why? What? Who? and of course How? and How Much? I’ll also debunk some of the myths that are being spread around about residential fire sprinkler systems.

A LITTLE HISTORY

Some of the first attempts at fire protection laws were made to protect the small businesses that flourished in London back in the 1600s—such as candle makers and bakers who used fire to operate their trades. Ordinances concerning the type of roof coverings at such businesses were enacted to prevent the many thatched roof fires at that time. At the same time in New Amsterdam (later changed to New York), ordinances were created to indicate the proper building and inspection of wooden chimneys. Unfortunately, these rules did little to prevent loss of life and property due to fire.

Ironically, almost 300 years later in 1979, the city of Houston debated the need for fire safety legislation covering wood-shingle roofs. At the same time the issue was being put to vote to postpone the legislation, a fire broke out on the wood-shingle roof of an apartment building, eventually destroying 26 buildings in the complex. The next day, the Houston City Council unanimously passed legislation regulating wood-shingle roofs.

THE PROBLEM WITH FIRE SUPPRESSION

Early attempts to control fires were purely suppression, or controlling the fire after it started. Unfortunately, these suppression methods were unable to contain fires once they raged out of control. Responders in the late 19th century were hindered by old water pipes with low pressures, inadequate numbers of hydrants and cisterns, and non-standardized fire hydrant couplings, among other problems.

We all have heard of the fires that destroyed large parts of many of America’s cities. For example, on December 17, 1835, a fire broke out in New York City’s financial district and destroyed nearly 700 buildings. In 1871, the Great Chicago Fire, which lasted from October 8 to October 10, killed at least 300 people and destroyed approximately 17,500 buildings. Also on the night of Oct. 8, 1871, a fire in Peshtigo, Wisconsin, killed more than 700 people and destroyed the entire village. One of the most costly fires in American history occurred in Boston on Nov. 9, 1872, destroying 776 buildings in the downtown area and causing $73.5 million in property-related damage.

THE ADVENT OF FIRE PREVENTION

The first known fusible link fire sprinkler head was invented in 1874 by Henry Parmalee to protect his piano manufacturing business. The textile industry was one of the first industries to really grasp the idea of a fire prevention system. The textile industry, due to its very nature, was especially susceptible to fire and suffered huge losses throughout history, of both employees and property. The idea of fire sprinkler systems spread rapidly throughout the industrial world.
NFPA 13: Standard for the Installation of Sprinkler Systems was introduced in 1896. The first standard committees were comprised of insurance executives who attempted to bring some conformity to the ordinances that would control losses due to fire. Since then, fire personnel, manufacturers, engineers, and contractors have been brought into the NFPA process.

A SLOW START FOR RESIDENTIAL SPRINKLERS

However, it wasn’t until the 1930s, when Grinnell Company began designing and installing “junior” fire protection systems for the basements of apartment buildings, that fire sprinklers showed up on the residential market. Grinnell developed a “Speedex” fire sprinkler head that had a much quicker response time than the conventional industrial head. All of the technology for these systems came from the knowledge gained from the installation of industrial systems. Unfortunately, for many reasons this concept was not readily accepted by building owners, fire services, or anyone else for that matter.

It took many years for residential fire sprinkler systems to begin a comeback. Individual systems were being installed in a few residences here and there but with no standard criteria for the installation. The systems typically were installed in the homes of contractors or engineers using their knowledge of industrial fire sprinkler systems.

In 1973, an NFPA subcommittee was formed to begin the development of what we know today as NFPA 13D: Standard for the Installation of Sprinkler Systems in One and Two-family Dwellings and Manufactured Homes. The first edition of the standard was adopted in May 1975 and published soon thereafter. Compared to NFPA 13, the first version of NFPA 13D was very simple and easy to understand. It had only 13 pages dedicated to general design requirements, with the balance of the text covering lead-in information, as well as 11 pages of annex information. (Another NFPA document on this topic is NFPA 13R: Standard for the Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height, but this article only discusses NFPA 13D.)

One of the original requirements of NFPA 13D was a 10-minute supply of water for the design and proper operation of the system. With the available fire sprinkler heads of the time, this required the storage of thousands of gallons of water. The sprinkler heads designed to cover large areas within commercial and industrial buildings could control the spread of fire, but their slow response time did not prevent the buildup of the products of combustion: carbon monoxide and smoke. Life safety and flashover were not really of great concern in industrial and commercial occupancies.

However, many people within the fire industry understood that life safety and flashover were vital considerations in residential occupancies. Communities around the country, laboratories, and manufacturers began researching different methods and materials to lower the risk of death of residential occupants. This early research proved that residential fires produced a sufficient amount of carbon monoxide and dense smoke to jeopardize the safety of the occupants. This research resulted in the development
of the quick-response residential fire sprinkler head and significant changes to the design of residential systems. All of these developments, along with many more during the past 30 years, were incorporated into the revision process of the current 2007 edition of NFPA 13D.

WHY INSTALL RESIDENTIAL FIRE SPRINKLER SYSTEMS?
Here are some interesting statistics that may help answer that question.

According to the latest NFPA data, in 2008 more than 403,000 residential fires resulted in more than $8.5 billion in damage. Ninety percent of all fire injuries and 84 percent of all deaths are from residential fires. In 2008, there were 2,780 civilian deaths as well as a number of firefighter deaths. More firefighters are hurt and killed in residential fires than any other.

Why are these numbers so out of sync with the numbers from nonresidential fires? There are many reasons, with the most obvious being that a greater percentage of commercial and industrial buildings are protected by fire sprinkler systems than residential buildings. Why is that? In many areas, commercial and industrial buildings are required to be sprinklered. Another reason is purely from the financial perspective. The potential for loss to the insurance company is so much greater in the commercial/industrial setting than in the typical residential setting. Is the motivation there for the insurance companies to mandate residential fire sprinkler systems?

Another reason for the disparity in numbers and one that really irks me is the advent of lightweight construction materials in residential construction. I understand that this helps control the cost of housing, but in a fire these lightweight materials do not have enough mass to withstand a fire and support a load for any length of time. There have been many reports of firefighters falling through the first floor into the basement of a residence, with the fire falling on top of them. Some areas of the country have mandated a two-hour fire rating for the piping. If running the piping above a ceiling in an unheated space is problematic, use sidewall heads and keep the piping within the walls of the heated space.

A residential fire sprinkler system will accomplish the same thing.

WHAT TYPES OF RESIDENTIAL SYSTEMS ARE AVAILABLE?
The two basic types of residential systems are stand alone and multipurpose.

A stand-alone system is just what the name implies. It is very similar to the standard commercial/industrial system, which serves only one purpose. The water service from the source splits into two systems within the structure, one for the stand-alone fire sprinkler system and the other for the domestic water service to the plumbing fixtures.

Two types of multipurpose systems are available. One is simply a piping system that serves both domestic and fire protection requirements. The other is a network system, which is a multipurpose system that utilizes a common piping system supplying domestic plumbing fixtures and fire sprinklers, where each sprinkler is supplied by a minimum of three separate paths. Network system designs differ depending on the manufacturer’s guidelines. It is best to have the manufacturer assist in the design of the system. Only in network systems is ½-inch pipe allowed to be used.

Being a plumber by background, I like to refer to multipurpose systems as domestic water systems that supply water to the fire sprinkler system. The reality is exactly the opposite: It is a fire sprinkler system that happens to supply water to the domestic plumbing fixtures as it passes by.

Another part of this question is the type of heads that may be used. There are two temperature ratings for residential heads. Ordinary temperature-rated heads have a rating of 135°F to 170°F (57°C to 77°C), and intermediate temperature-rated heads have a rating of 175°F to 225°F (79°C to 107°C). Some of the places that the higher temperature-rated heads typically are used include under skylights, near specific heat sources, in unventilated areas, and where the ambient ceiling temperature is between 101°F and 150°F. Also, there are two types of heads within the two temperature ratings—pendent and sidewall—as well as many styles, in the range of a hundred or so, depending on the application and the manufacturer.

HOW ARE RESIDENTIAL SYSTEMS DESIGNED?
I’m not going to get into much detail here since so many articles have dealt with the layout, sizing, and hydraulics of these systems. With both of the multipurpose system types, you first must lay out the sprinkler heads and then look to feed the plumbing fixtures to determine a path for the piping. If running the piping above a ceiling in an unheated space is problematic, use sidewall heads and keep the piping within the walls of the heated space.

Some of the things that determine the type and location of the head include:

- Is the ceiling flat or pitched (and at what angle)?
- Are there any soffits, pockets, trays, ceiling fans, lighting fixtures, or other obstructions that may affect the spray pattern of the head?
- Always consult the manufacturer’s data sheet for head performance characteristics. The proper layout of the heads is truly an art to be mastered. Your only target to have in mind while laying out the heads is life safety. Your goal is to give the occupants enough time to escape. The idea is to provide wall wetting and air cooling for a period of 10 minutes.

WHO CAN INSTALL THESE SYSTEMS?
Again, being a plumber by background, I may appear to be biased in my opinion. For stand-alone systems, it depends on the jurisdiction, but I see no problem with sprinkler fitters installing these systems since they essentially are separate from the domestic water system. Multipurpose systems, since they are part of the domestic water system, should be installed by plumbers, but it is not that simple. Just because a plumber knows how to install pipe and fittings does not give him the qualifications to install a fire sprinkler system.
Education is the key. Whether the installer is a plumber or a pipefitter, they need to understand that the requirements for residential fire sprinkler systems are quite different than for systems installed under NFPA 13. Since the piping in a multipurpose system feeds both the fire sprinklers and the plumbing fixtures, all of the materials must be compatible with the standards for drinking water.

The American Society of Sanitary Engineering Series 7000: Professional Qualifications Standard for Plumbing-based Residential Fire Protection Systems Installers and Inspectors is the only ANSI-accredited installer standard. This standard includes the basic educational requirements that qualify a mechanic to become certified to install or an inspector to inspect residential fire protection systems. The minimum requirement is successful completion of a 40-hour training course, including a written and a practical examination covering all facets of the particular standard. The candidate shall have a minimum of five years of documented practical experience in the installation of plumbing and/or sprinkler systems. Certification and recertification to the standard shall be through a recognized third-party certification agency.

**HOW MUCH DO RESIDENTIAL SPRINKLER SYSTEMS COST?**

This sounds like a cop-out, but the cost totally depends on the size of the residence and the complexity of the system. Simple ranch-style homes such as those that Habitat for Humanity builds are being completed for about 50 cents per square foot. Sure, they are small homes, but it proves that the cost can be kept to a minimum. In Scottsdale, Arizona, where residential fire sprinkler systems have been mandated for many years, quite a few experienced contractors are competing for the work, with the cost currently running about 90 cents per square foot. All of the published data that I have read sets the cost of a residential sprinkler system between 50 cents per square foot (for small ranch-style homes) and $1.75 per square foot (for much larger two-story homes with many obstructions). The industry average is running about $1.35 per square foot.

**A FEW REMINDERS**

I would like to end with a few reminders. You must understand that residential fire sprinkler systems are philosophically different from commercial/industrial systems. Commercial/industrial systems are concerned with life safety, but they also are very concerned with protection of property. Residential fire sprinkler systems are designed to get the people out of the building quickly, within 10 minutes, which happens to be the criteria for the water supply duration. These systems accomplish this by wetting the walls and cooling the air. While life safety is the primary and only goal, these systems do provide a considerable amount of property protection.

Hopefully, in another 10 years residential fire sprinkler systems will be commonplace and installed in every home, and then we can sit back and wonder what the controversy was all about.

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**REBUTTING THE MYTHS**

Let’s debunk some of those myths being spread by the naysayers.

**Myth:** All of the heads go off at once and cause considerable damage throughout the residence, and the insurance companies will not pay for the water damage.

**FACT:** We all know this to be very untrue. In fact, most (90 percent) of residential fires in sprinklered homes are extinguished by one sprinkler head. A single sprinkler head discharges about 18 gallons of water per minute, and the minimum flow for two or more sprinkler heads is 13 gallons per minute each, while a fire department hose can discharge more than 100 gallons per minute. It stands to reason that when a sprinkler head discharges to control a fire, there will be less water damage than if the fire department must put out the fire. In fact, most insurance companies will issue a 5 to 12 percent discount for sprinklered homes.

**Myth:** Smoke alarms are good enough.

**FACT:** Smoke alarms, by themselves, are very good, but they are only warning devices. Looking at the statistics, they do decrease residential fires, but smoke alarms alone have not decreased fire deaths. Are 2,780 deaths acceptable? Many new smoke alarms have a 10-year life span, and only hardwired smoke alarms that are interconnected provide a reliable warning. If a fire occurs in the basement of a two-story colonial-style home, the alarm may not be heard by occupants in a deep sleep in the second-floor bedrooms. In fact, statistics indicate that only 58 percent of children are awakened by smoke alarms.

**Myth:** Annual maintenance fees are expensive.

**FACT:** There is no maintenance on a multipurpose system since water is continually flowing through the system to feed the plumbing fixtures. You know that the fire sprinkler part of the system is functional if the plumbing fixtures are receiving water. For stand-alone systems, the homeowner can do the monthly flush or blowdown of the system by opening the drain valve and observing the flow of water outside the building. If there is no flow, then the system must be checked and repaired, but there are no maintenance costs.