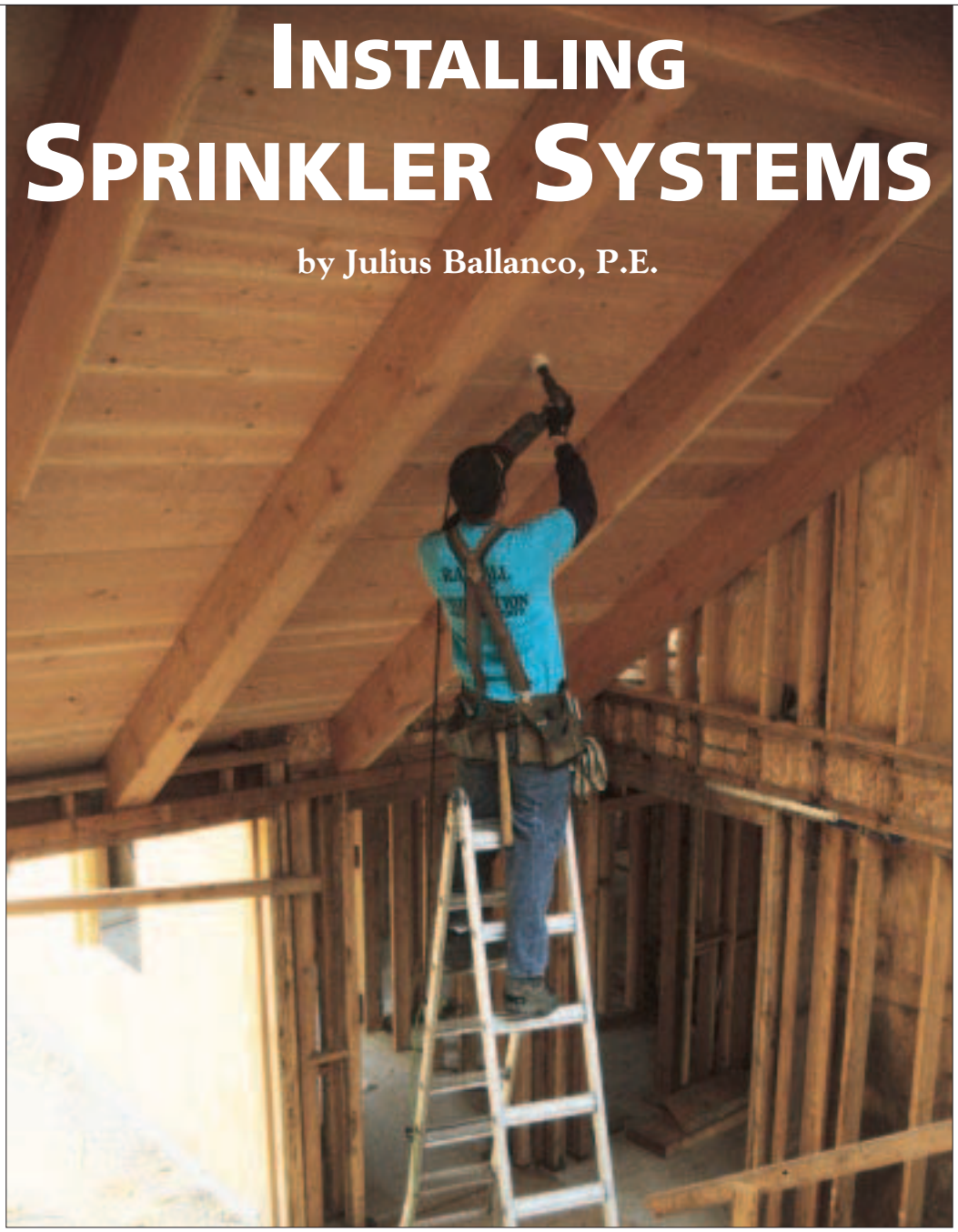
Installing Sprinkler Systems

by Julius Ballanco, P.E.



Properly designed fire sprinkler systems are affordable and inconspicuous — and they save lives

Mention the words "fire sprinkler system" and most builders are skeptical, voicing concerns about cost, reliability, and the aesthetic impact on the home. But as this article will show, residential sprinkler systems are economical, aesthetically pleasing, and rarely fail. Most important, they can save lives.

NFPA Standards

Residential fire sprinkler systems are regulated by two similar National Fire Protection Agency standards that were developed for systems designed for the home. NFPA 13D ("D" for dwelling) regulates one- and two-family dwelling sprinkler systems, while NFPA 13R ("R" for residential) is for residential buildings up to four stories in height.

Whereas commercial sprinkler systems focus on property protection, residential sprinkler systems are designed primarily to save lives and prevent injuries in case of a fire. In residential sprinkler design, property protection is a secondary goal.

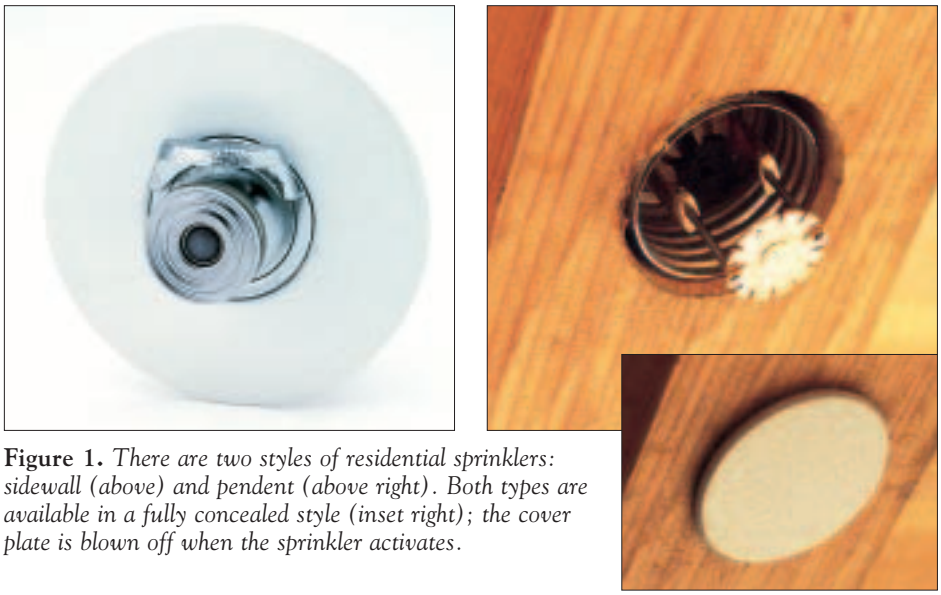


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Figure 1. *There are two styles of residential sprinklers: sidewall (above) and pendent (above right). Both types are available in a fully concealed style (inset right); the cover plate is blown off when the sprinkler activates.*

Sprinkler Types

The defining element of a residential fire sprinkler system is the sprinkler head. Sprinklers typically activate at ceiling temperatures between 200°F and 250°F. The thermal response device is either a glass bulb or fusible link, which when activated, opens the flow of water.

Residential sprinkler systems can be smaller than their commercial counterparts because they respond very quickly to a fire. Since less heat is needed to activate them, less water is needed to contain the fire.

There are two styles of residential sprinklers: pendent, which are mounted on the ceiling, and sidewall, which are placed on the wall within 6 inches of the ceiling (see Figure 1). Pendent sprinklers are more popular with homeowners because they are less conspicuous. Certain recessed sprinklers have cover plates that hide the sprinklers. The cover plates come in a variety of colors to match interior finishes; in some cases, cover plates can be custom color-matched by the manufacturer.

An ordinary pendent residential sprinkler will cost about $5, but you may pay as much as $25 for a decorative one.

Sprinkler Layout

When planning a residential fire sprinkler system, the sprinklers are placed so as to protect all of the floor area in a given room or space. Each sprinkler is designed to provide a specified area of coverage. The minimum area of coverage for residential sprinklers is 12x12 feet. As an example, a pendent sprinkler located dead center in a 12x12-foot square room would protect the entire room (including the corners).

Sprinkler manufacturers also make "extended coverage" sprinklers that cover 14x14-foot, 16x16-foot, and even 20x20-foot areas (the largest available sidewall sprinkler covers 16x20 feet). As the area of coverage for a sprinkler increases, the required flow rate and pressure also increase, meaning the pipe size must increase. As a result, it's often easier and cheaper to install a second sprinkler rather than install a single extended-coverage sprinkler.

The goal in laying out sprinklers is to get complete coverage of a room with the fewest number of sprinklers and the least amount of piping. You can use a simple "line of sight" method. Picture yourself lying down on the floor. If you can see the sprinkler, and it is located within the specified acceptable distance of coverage, you have achieved complete coverage. If the sprinkler is out of sight, you need to add a sprinkler (Figure 2).

Where sprinklers aren't needed. Because residential fire sprinkler systems are designed to save lives, not property, the NFPA standards permit certain spaces to go without sprinklers — areas of the home where statistically fewer fires resulting in deaths occur. In a single-family dwelling, this includes clothes closets less than 24 square feet in area (with the shallow dimension being 3 feet or less), bathrooms less than 55 square feet in area, attics and crawlspaces not used for storage or living areas, garages, and the entrance foyer in homes having another exit.

Piping and Plumbing

Residential fire sprinkler systems are typically piped in either copper, CPVC, or polybutylene (Figure 3). When polybutylene is used, it must be placed in a wall or ceiling behind a layer of gypsum wallboard. (Because polybutylene will no longer be available in the U.S., crossed-linked polyethylene plastic pipe will probably replace it in the near future.) CPVC is permitted to be exposed when it is installed tight to a smooth, flat ceiling.

Pipe size. The amount of water required, or hydraulic demand, is the major factor in determining the pipe size for the sprinkler. Most residential systems use 3/4- and 1-inch pipe, though NFPA is working on a proposal for 1/2-inch pipe for residential systems, which could help to reduce costs.

Based on the idea that the fire will start (and be put out) in one room only, the NFPA standards make it easy to determine the hydraulic demand of the sprinkler system. First, the standards specify that the system must be designed to handle the hydraulic demand of all the sprinklers in any given room. In addition, NFPA 13D states that the maximum number of sprinklers per room is two (the maximum number under NFPA 13R is four). Therefore, since every room is treated separately, the sprinkler demand ends up being based on the largest room. Finally, a room is defined as an area enclosed by walls and doors, or separated from adjacent areas by a lintel that extends downward from the ceiling 8 inches or more.

Piping rules of thumb. Piping systems should always be engineered, but one way to estimate the pipe sizing for a single-family dwelling is to assume that if one sprinkler is required, it is supplied by a 3/4-inch pipe, and if two sprinklers are required, a 1-inch pipe will be needed. While not always accurate, this conservative sizing will normally supply standard residential fire sprinklers. As an example, if a home doesn't have a room or coverage area larger than 12x12 feet, the maximum demand on the home system is one sprinkler. So the entire system can be installed using 3/4-inch pipe.

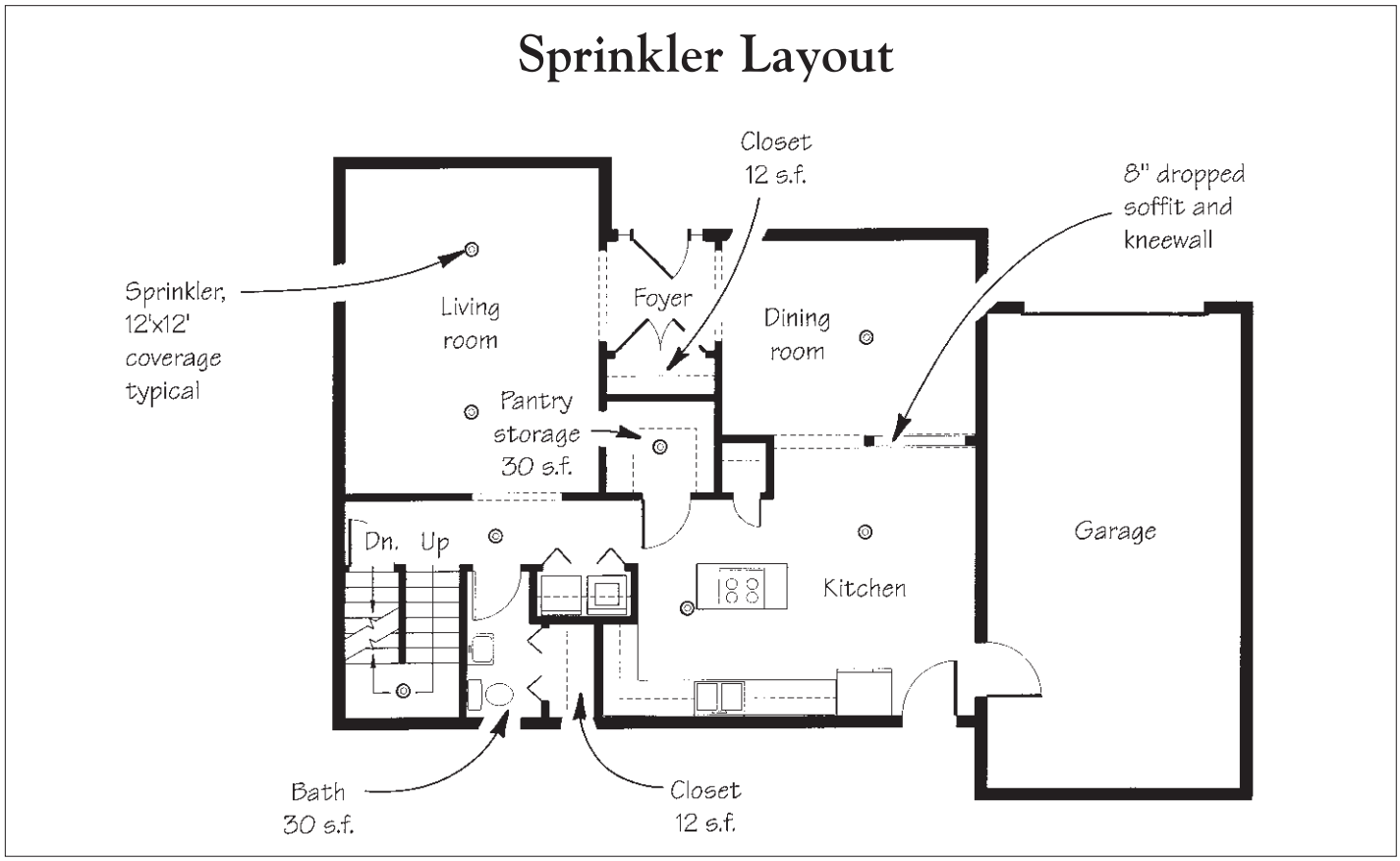

Figure 2. *The goal in sprinkler layout is to provide complete coverage with the fewest sprinklers and the least amount of piping. Certain spaces are permitted to go without sprinklers, including small closets and bathrooms, attics and crawlspaces not used for storage or living, garages, and the entrance foyer in homes having another exit.*

With a residential sprinkler system installed, the water service to the house typically needs to increase to 1 inch — a cost that shouldn't be overlooked, since most residences have 3/4-inch mains.

Flow rate. Water flow rate in residential systems doesn't have to be large. A sprinkler's flow demand is based on the manufacturer's test rating. Until recently, NFPA standards listed a minimum water flow rate of 18 gallons per minute (gpm) for one sprinkler activating and 13 gpm for multiple sprinklers activating (multiply the flow rate by the number of sprinklers). New standards take into account more efficient sprinkler designs and allow sprinklers rated for lower water demands. For example, typical new 12x12 sprinklers require 10 to 13 gpm for one sprinkler, and as little as 10 gpm for multiple sprinklers. So even for an upscale single-family dwelling with large rooms, the water demand could be as low as 20 gpm (two sprinklers in one room at 10 gpm).

Pressure. Typical household pressure of around 50 psi is adequate for most sprinkler systems. When the water supply pressure is lower, an important design goal is to reduce pressure loss, either by reducing the length of piping or by increasing the size of the pipe.

Private water systems. For wells and other private water supplies, there are special requirements for standby water storage. NFPA 13D requires a ten-minute supply of water. For example, if a system requires 26 gpm, a 260-gallon storage tank would be needed (26 gpm x 10 minutes = 260 gallons). NFPA 13R requires a 30-minute supply. However, if the system relies on a pump, it must be capable of delivering the flow rate and pressure required by the sprinklers. It is assumed, under 13D, that the system will contain the fire before it affects the electrical service to the pump.

Multipurpose Piping

Usually, a residential sprinkler system is required to have separate piping from the potable water supply, starting from where the water comes into the house. However, in a recent departure from that requirement, NFPA 13D permits the fire sprinkler system to be part of the potable water system in a "multipurpose" piping system. In this single-pipe system, it's permitted, for example, to tee off the cold water supply to a bathroom sink for a sidewall sprinkler

Figure 3. *Residential sprinkler systems can be piped in CPVC, polybutylene, or copper. As polybutylene disappears from the U.S. market, cross-linked polyethylene is expected to take its place.*

in the room on the other side of the bathroom wall (Figure 4).

Some water utilities do not permit multipurpose piping systems, probably because they mistakenly assume that the sprinkler system presents a contamination hazard. In truth, sprinkler piping is no different than water lines that are roughed-in for future plumbing; there's no risk of contamination.

System Costs

Residential systems don't have to be expensive. Quotes often come in high because they are bid by commercial sprinkler subcontractors at commercial prices — typically around $3.50 per square foot. But when knowledgeable residential sprinkler subs or plumbing contractors do the work, residential systems should range from 50¢ to $1.50 per square foot.

In many areas, the sprinkler system can be installed as a part of the potable water distribution system and installed by a plumber. The National Association of Plumbing, Heating, and Cooling Contractors has a nationwide education program to train plumbing contractors to install residential fire sprinkler systems; for more information, call 800/533-7694.

Special Design Requirements

Whereas commercial sprinkler systems are quite involved, requiring pressure gauges, check valves, drain valves, alarms, and backflow preventers, residential systems usually don't need sophisticated controls (although there are a few local areas where residential systems are more strictly regulated). The residential sprinkler system in a newly constructed single-family dwelling typically requires nothing more than a separate drain valve for the sprinkler system (independent smoke detectors are also required). And if a multipurpose piping system is installed, the valve or faucet on a plumbing fixture qualifies as the drain valve.

Because there are no controls in the sprinkler system piping to warn of pressure loss or of someone turning off a valve, it's not permitted to install any valves that can isolate the sprinkler piping from the domestic system. Any valve in the water piping must shut off both the plumbing and sprinkler water supply. In other words, when occupants try to flush the toilet and there is no water, they know the sprinkler system is also shut off.

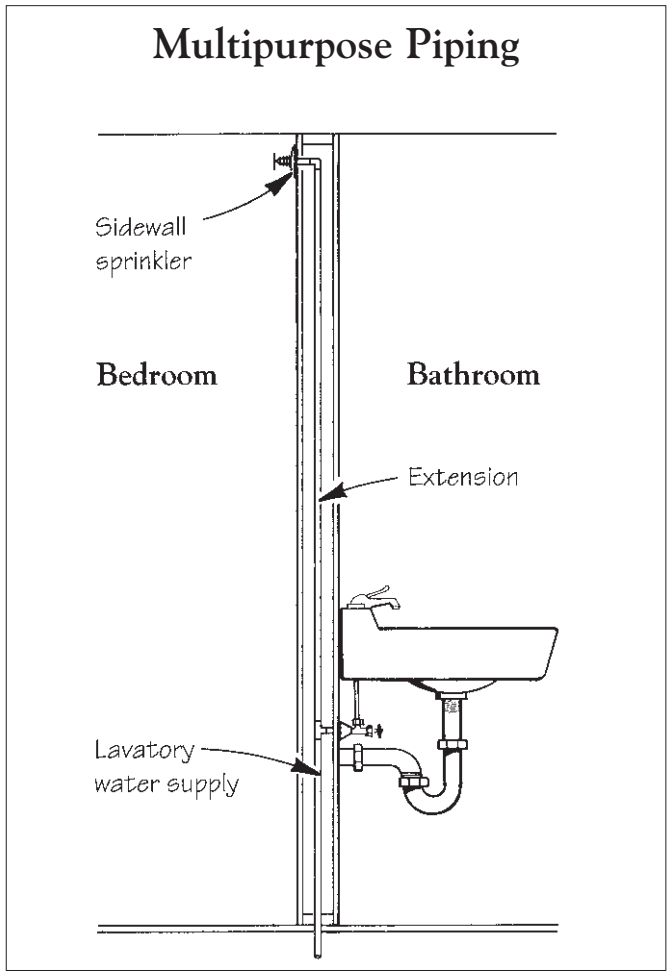

Figure 4. *Under a recent change to the regulations controlling residential sprinkler systems, it's permitted to tee off the drinking water supply to supply the sprinkler system.*

False Activation

Many homeowners fear that sprinklers will accidentally activate, causing significant water damage. It takes a continuous temperature of 165°F for five hours for a sprinkler to activate, but unfortunately, this myth continues to be reinforced by Hollywood's depiction of sprinklers showering people at a party when someone lights a match. In fact, there is only a one-in-three-million chance of a sprinkler malfunctioning and falsely activating. The odds are pretty good that the sprinklers in a home will perform as intended, safely and without problems. ■

Julius Ballanco is author of The Plumbing of Residential Fire Sprinklers, *available from the National Association of Plumbing, Heating, and Cooling Contractors (800/533-7694).*

Sprinkler Manufacturers

Central Sprinkler Corp.
451 N. Cannon Ave.
Lansdale, PA 19446
800/523-6512

Grinnell Corp.
3 Tyco Park
Exeter, NH 03833
603/778-9200

Globe Fire Sprinkler
4077 Airpark Dr.
Standish, MI 48658
800/248-0278

Star Sprinkler Corp.
307 W. Layton Ave.
Milwaukee, WI 53207
800/558-5236