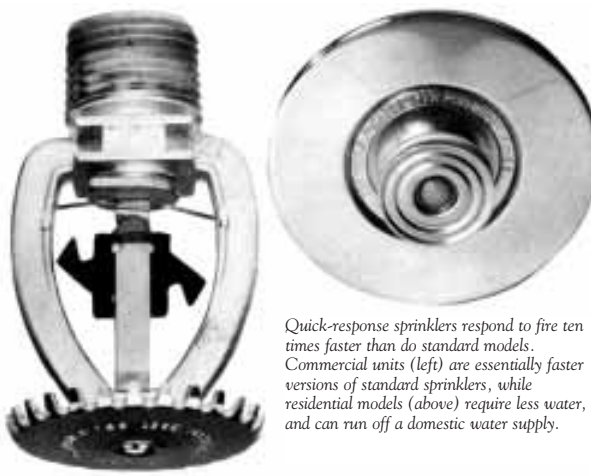
QUICK-RESPONSE SPRINKLERS

by Michael McClain & Clinton Summers



Quick-response sprinklers respond to fire ten times faster than do standard models. Commercial units (left) are essentially faster versions of standard sprinklers, while residential models (above) require less water, and can run off a domestic water supply.

New technologies and changing codes are bringing more sprinklers to light construction

Our company, Fire Safety Protection, Inc., has been installing fire sprinkler systems in commercial and residential projects for five years. Many of these projects use the new plastic piping and quick response sprinkler heads developed over the last ten years. These materials have revolutionized the sprinkler industry, making sprinklers far more effective, easier to install, and more appropriate for use in light-commercial and residential buildings.

They have also led to broader sprinkler code requirements in some areas. Here in Scottsdale, Ariz., for example, sprinkler systems are required not only in commercial projects and all apartments and motels, but even in townhouses, condominiums, and single-family homes.

Sprinkler System Classification

Sprinkler installation is standardized by the National Fire Protection Association (NFPA). Its standards NFPA 13D and 13R were created only in the last two years to cover the use of quick-response heads in one- and two-family dwellings (13D) and low-rise multi-unit dwellings (13R) (see "Sprinkler Codes A'Changing"). Though some of these buildings, such as motels and apartments, might be considered ``commercial'' jobs by a builder, the sprinkler industry considers them ``residential,'' since the codes require they use quick-response residential sprinkler heads. NFPA 13, an older standard, covers all other applications, including high-rise dwellings.

Sprinkler System Basics - Materials and Layout

If all these items confuse you, take heart in the fact that all these sprinkler systems have similar components and are laid out and function in roughly the same way - they just use different materials.

Sprinkler heads. Sprinkler heads have changed a lot over the last ten years, as the standard commercial models have been supplemented by quick-response heads, which come in both ``commercial'' and ``residential'' form. Residential-rated heads require less water than commercial heads do, allowing the use of ordinary domestic water supply and 1-inch piping. These are the heads used in all 13D and 13R dwellings. Commercial systems, depending on their size, can require piping up to 4 inches across and the installation of a separate water supply.

Quick-response heads react about ten times faster than standard heads do. At a given temperature, usually 160∞F, a fusible link in the head melts, allowing the pressurized water to exit. Heads not exposed to that temperature will not react. A flow detector tied into the system, however, will sense the movement of water and sound an alarm. Once the fire is controlled, the sprinkler is turned off by cutting off its main water supply. The head is then replaced, and the system tested and reactivated.

Quick-response heads are approved for all types of buildings and cost roughly $6 to $8 each, about twice what standard heads cost. For this reason, they are generally used only where required by code.

Several manufacturers make quick-response heads. We prefer heads made by Central Sprinkler Corporation (Lansdown, Pa.) and by Grinnell Corp. (Providence, R.I.). Star Sprinkler Corp. (Milwaukee, Wis.) and Viking (Hastings, Mich.) are two other leading manufacturers.

Piping. Sprinkler system piping comes in four varieties: steel pipe, copper tubing, and two types of plastic.

Most contractors use steel pipe for large commercial systems because it has the lowest material cost of the four and it is the sturdiest. In lighter commercial jobs and in dwellings, however, which use a greater proportional amount of labor, copper or plastic are better choices.

Copper pipe is widely code-approved, and some sprinkler contractors use it for all their light-commercial and residential work. However, we prefer plastic for such jobs, for two reasons. First, copper prices are less stable than plastic pipe prices, making estimating tricky. Second, soldering joints with torches poses a fire hazard. Needless to say, the publicity resulting from such an accident would be unflattering; when we use copper, we make sure a fire extinguisher is handy.

Plastic pipe comes in two types and each requires a different method of joining pipe to fittings. Polybutylene pipe is joined by a heat fusion method requiring special tools and great care. The newer CPVC pipe is joined using glue in the same manner that PVC plumbing piping is. We use CPVC for much of our light-commercial and all of our residential work because we feel it is the fastest, most cost-effective material for smaller jobs (see Figure 1).

Figure 1. *Piping made of CPVC costs more but keeps installation time down. Joints are glued in the same manner as PVC plumbing pipe.*

The riser. Along with sprinkler heads and piping, every sprinkler system has a riser, a group of components that controls and monitors the flow of water to the system (see Figure 2). A riser consists of a check valve that lets water flow in only one direction, a pressure gauge, a pressure relief circuit and drain, and a flow switch. The flow switch detects flow when a head is triggered and activates the alarm. Each system also has a test valve at one of its far reaches so the operating pressure can be tested there. In projects where pressure from the water supply isn't sufficient to drive the system, an auxiliary pump may also be installed. In large buildings, several independent riser systems may be required.

Design and layout. For NFPA 13 systems - that is, large commercial work, non-dwelling light commercial, and high-rise dwellings - the riser or risers are installed on a separate, dedicated water line, usually 4 inches in diameter. In NFPA 13R and 13D systems, the riser can branch off the building's regular water supply. The diameter of this branch depends on how many heads it feeds. It is always the first branch off the main supply and is controlled by the same shutoff valve.

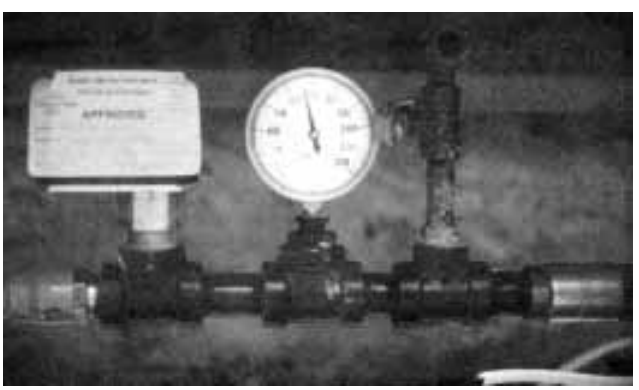


Figure 2. *The riser, which feeds the system, also monitors and controls the flow of water. Large jobs may require several risers, each feeding an independent sprinkler array.*

Sprinkler Codes A'Changing by William E. Koffel

The last few years have seen a growing movement among model code bodies and local jurisdictions toward requiring sprinklers in smaller multi-unit dwellings such as hotels, motels, dormitories, and apartments. The minimum size threshold for sprinklered dwellings is dropping and will probably drop even more in the next few years, possibly to include one- and two-family dwellings.

Why Sprinklers Now?

Two main factors are driving the rising call for more sprinklers. The first is the residential fire problem. In 1987, residential fires caused 80.2% of all fire deaths, 72.5% of fire injuries, and 59.4% of the fire property loss in the U.S. These statistics, which are among the worst in the industrialized world, have been crucial in enlisting the fire-fighting industry's support for expanded sprinkler codes.

The other factor is the development in the early 1980s of quick-response sprinklers. Their faster response and more uniform water distribution pattern make them much more effective than previous, slower systems at saving lives.

The development of quick-response sprinklers led to the development, by the National Fire Protection Association (NFPA), of standards for their installation. While the long-standing NFPA 13 covers commercial buildings and high-rise dwellings, the new standards cover smaller dwellings. These are NFPA 13D (for one- and two-family dwellings) and NFPA 13R (for multi-unit dwellings up to four stories high). The new standards are directed at the use of the new quick-response heads. Both 13D and 13R call for sprinklers in all living and sleeping areas, but omit garages, attics, crawl spaces, and certain closets and bathrooms from the requirement.

NFPA 13D and 13R give code bodies a ready-made package of standards to adopt if they want to require sprinklers in dwellings. This is precisely what the sprinkler industry, fire chiefs association, and some life safety advocates are pushing for.

Current Code

Presently there is little uniformity among the model codes' sprinkler requirements.

BOCA National Building Code. In 1988, BOCA voted to require sprinklers in all new apartment buildings and dormitories. In June 1989, it adopted NFPA 13R as the standard for such dwellings. The membership also agreed that when an NFPA 13R system is installed, other fire-related code provisions may be modified or foregone, allowing for greater building height and area, reduction of attic draftstopping, one exit instead of two for three-story buildings, reduced corridor wall fire ratings, and exempting sprinklered buildings from a new requirement that all bedrooms have smoke detectors. These changes will be included in the 1990 code.

SBCCI Standard Building Code. The Southern Building Code Congress International, Inc. (SBCCI) presently requires sprinklers only in high-rise dwellings. In July 1989, however, SBCCI's Building Code Revisions Committee considered adopting increased residential sprinkler requirements similar to BOCA's. The Committee voted to hold the changes for further study by a committee that will be charged with developing a recommendation. Their report is expected in early 1990.

ICBO Uniform Building Code. The 1988 Uniform Building Code requires a sprinkler system in any apartment building three or more stories in height or containing more than 15 units. Current code provisions permit using a two-hour area separation wall to subdivide a complex into separate ``buildings,'' making it relatively easy to avoid the 15-unit restriction. A proposed change that would have required a four-hour separation wall was recently rejected by the ICBO.

Life Safety Code NFPA 101. NFPA's Life Safety Code, NFPA 101, is often adopted by jurisdictions in addition to or instead of one of the model codes' fire-related provisions. The 1988 edition of NFPA 101 requires sprinklers only in new high-rise apartments. However, the NFPA is currently considering a variety of proposed changes aimed at reducing the threshold limits for sprinklers. How far they will drop remains to be seen, but some reduction seems likely.

Future Directions

The issue of residential sprinkler systems has been debated fiercely in the various code development forums. The primary proponents of increased code requirements have been the fire service and the sprinkler industry. These groups have successfully brought this issue to the fore, and as time goes on, more code officials seem to be persuaded by their arguments.

The National Association of Home Builders and other building industry groups, on the other hand, argue that sprinkler requirements will aggravate the affordable housing problem by adding $1,000 to $4,000 to the cost of a dwelling unit. They also point out that over half of residential fire deaths occur in buildings more than 40 years old, and 90% of them in buildings more than 10 years old, suggesting that sprinklering new buildings will save few lives. Sprinkler opponents also argue that alternative strategies such as controls on furnishings, improved construction and materials, public education, and increased use or hand wiring of smoke detectors should be further explored before requiring the expense of sprinkler systems.

The next two years should be key indicators of which way the issue will go. It is possible the expanded sprinkler requirements will be soundly defeated in the model code forums and the issue put to rest. Given the movement's momentum, however, we are more likely to see sprinklers soon required not only in apartments, but also in townhouses and possibly even one- and two-family dwellings. A proposal affecting town houses, for instance, will probably be considered by BOCA in the next few months. Such code changes would be based, in part, on the argument that the occupants of townhouses are entitled to the same protection that occupants of apartments receive. The same proponents argue that there is little technical justification for a threshold of 15 units or three stories.

Also forcing the issue is the increasing adoption of sprinkler requirements by local jurisdictions. More than 200 jurisdictions have adopted residential sprinkler system ordinances already, some of them extending to single-family homes. While the motivations at the local level are similar to those in the model code groups, savings on fire department budgets also play a critical role. San Clemente, Calif., for example, has reportedly avoided drastic increases in fire department budgets through sprinkler requirements.

It seems safe to say that the three major code bodies are headed toward increased requirements. But how far they will go is the question. Even if the model codes choose to fully adopt 13R and/or 13D for their intended dwellings, local adjustments to the codes will likely have a moderating effect. Some local code officials have already indicated that if the model codes adopt NFPA 13R or 13D, they (the officials) will modify the sprinkler provisions to allow a nonsprinklered option. If a significant number of jurisdictions do this, the model code organizations might well re-evaluate the issue.

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This makes it impossible to have running water without having an active sprinkler system.

From the riser, piping runs through the building and branches off to sprinkler heads in all rooms required by code to have sprinkler heads. In offices or warehouses, sprinklers are required in virtually every room; in dwellings, code usually exempts bathrooms, closets, and attics.

Bidding and Planning

The most common bidding problem we run into is getting called in too late. We should be contacted when the footings are being poured or, at the latest, when the rough plumbing is going in. Working up a price may require doing a complete layout and rough design, which requires at least two weeks. Fire department approval of the plans typically takes another two weeks. The estimate itself can sometimes be drawn up more quickly if a contractor and sprinkler sub have worked together a few times or if the sprinkler sub is familiar with the building design.

Here in Scottsdale, where prices are quite competitive, typical costs range from 50 cents to $1.25 per square foot. Smaller projects cost more per square foot than larger ones do, because you still have fixed costs for design, permits, risers, alarm bells, and other basic equipment.

As for framing, trussed construction is the least expensive to sprinkle; conventionally framed designs with 2x8 or 2x10 roof framing, where we have to drill holes to run piping, cost more; and custom designs with unusual or cathedral ceilings cost the most (see Figure 3). Retrofitting an existing building runs 40% to 50% higher than a comparable new installation.

Design and Permits

To plan a system we need floor plans, roof framing plans, and details of any ceiling lighting, fans, soffits, or anything else that might obstruct spray patterns. A static-pressure reading of the water supply is also needed; this can be obtained from a hose bib or a fire hydrant close to the project.

Once we have all that, we make a tracing of the floor plan. Then we fix the sprinkler head locations, using both the applicable NFPA standard and the specs for the sprinkler head chosen.

Figure 3. *The cost of a sprinkler system depends largely on how much time is spent running pipe. Truss construction (left), which requires little drilling, costs the least to sprinkler. Custom jobs like this log-beam ceiling (right) take more time and some fine coordination with the building crew.*

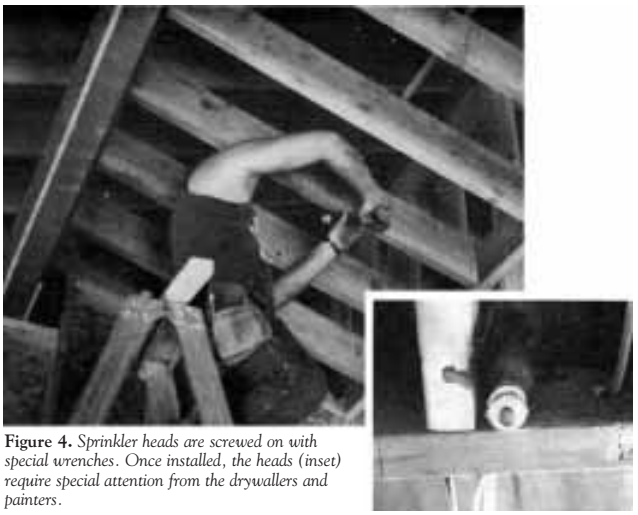

Figure 4. *Sprinkler heads are screwed on with special wrenches. Once installed, the heads (inset) require special attention from the drywallers and painters.*

After establishing the riser locations, we use either hydraulic calculations or a ``pipe scheduling'' to make sure the piping's resistance will not reduce the water pressure to a rate too low to operate the sprinklers. The longer and the narrower the piping, the more the pressure will drop. Smaller jobs require only 1-inch piping. Larger jobs may require riser pipes up to 4 inches across, with progressively smaller pipes running to the heads.

When we finish the drawings and calculations, we submit them to the fire department for review. Approval takes about two weeks.

Before starting on the job, we like to meet with the job superintendent to discuss any unusual circumstances, to see how he wants our sprinkler heads to line up with lights or other ceiling fixtures, and to verify the location of the riser or risers. The most common location for the riser is a garage or other utility area where it can be sheltered but remain accessible for testing and monitoring.

We ask the contractor to frame two openings for each riser system - an 8x8-inch access door for the inspection valve at the system's far end, and a 16x20-inch door at the riser location.

Installation

Then we're ready to work. The scheduling we're most familiar with is: rough framers, rough plumbing, rough hvac, and then us. We go in with the electrician or follow shortly thereafter. That way we can start where the electrician has finished. By coordinating with the electrician we can avoid putting things in his way. Installation takes roughly two days for every 2,000 square feet for jobs with interior partitions; open, warehouse-type projects go faster.

Once at a site, we lay out the sprinkler locations on the floor. Then we check for glulam beams or anything else that might block us from certain areas. To avoid penetrating a beam, we may have to go up to the next floor, into a wall, and back down.

Once we know we can run our piping, we mark all the hole placements and drill. Architects and designers can reduce the drilling required by leaving an extra 2 or 3 inches in duct chases and cathedral ceilings for piping. This makes our job easier and saves the contractor some money.

After we run the piping, we install the heads, which simply screw on with a little glue. Some sprinkler contractors wait until the trim-out stage to put them in, but we like to install them when we rough in the system (see Figure 4). That way we have a finished system, except for escutcheons, when we finish roughing in.

This means, however, that the drywall contractor has to cut in around each head. Sometimes drywallers push their drywall up against our heads to mark it; this either ruins the heads or pushes them above their proper level. We've even had drywallers hang their board over the heads without cutting holes for them! This usually stops after they get hit with a few back charges.

Testing

Once installation is done, we give the electrician the electric alarm bell and weatherproof box to wire and install. The next morning we pressure-test the system at the required pressure, which ranges from around 150 psi to 225 psi, depending on system type and code. Then we let it sit 24 hours, during which time the fire inspector comes to witness the pressure and look the system over. Once the system is approved, we bill for 85% of the contract price.

We are now finished until trim-out time, which is after everything is painted but before the flooring is installed. Trimming out is usually just a matter of attaching escutcheons. When that's done, we call for a final inspection of the pressure and alarm. We verify that the heads haven't been damaged or painted. Barring any problems, we're done.

Maintenance

Each month the owner should do the following:

- Visually inspect all sprinklers to ensure against obstruction of spray.
- Check that all valves are in proper position.
- Test water flow and alarms for proper operation. (Warn neighbors first, and the fire department if necessary.)
- Make sure no sprinklers are painted. When painting in areas next to sprinklers, the sprinklers may be protected by covering them with a plastic bag, which should be removed immediately after the painting has been finished.

Finally, it should be remembered that if a quick-response sprinkler is exposed to heat of 160°F or more, it will open. ■

Michael McClain and Clinton Summers have 25 years of combined experience installing sprinkler systems. They are co-owners of Fire Safety Protection, Inc., of Scottsdale, Ariz.