# COMPARATIVE STUDY DOCUMENTS COST ADVANTAGES OF CPVC FIRE SPRINKLER SYSTEMS

## Piping Material and Design of System Shown to Impact Bottom Line

**By Terri S. Leyton**

In the highly competitive residential construction market, cost has always been a primary consideration when choosing various building materials—even when deciding on something as critical as life-saving fire sprinkler systems. Cost is at the center of the controversy surrounding legislation requiring fire sprinkler systems in newly constructed homes. It is also a focal point in the debate as to which piping material to use—CPVC or PEX—as well as which type of system to install—stand-alone or multipurpose.

Of course, cost alone should never be a deciding factor, especially when choosing something as important as a life safety system. Builders and contractors need to also consider the overall performance and reliability of the systems, their proven track records in the field, their hydraulics (flow capabilities) and their safety ratings.

However, since economic realities dictate that costs remain a primary consideration, this article, and the study behind it, are designed to provide valuable insight into the economics of a CPVC vs. a PEX fire sprinkler system, as well as a stand-alone vs. multipurpose design. A recent cost study conducted in Southern California confirms that CPVC, in all cases—whether in a stand-alone or multipurpose configuration—provides the most cost-efficient choice currently available. The study further negates the perception that a multipurpose design is always less expensive than a stand-alone system. Rather, as you'll see in the numbers presented in the cost study, the true cost advantage of one design over another can depend on local code requirements.

### Parameters of the Material Cost Study

It is appropriate that this cost study was completed in California, the largest state, to date, to adopt codes that mandate the installation of fire sprinkler systems in newly constructed single-family dwellings. California has long been recognized for its high standards relative to

environmental and safety performance and often leads the country in the adoption of new regulations designed to maximize safety. Long before the adoption of the new codes requiring fire sprinkler systems in new home construction, approximately 25 percent of single-family homes in California were built with a fire sprinkler system.

Given the new California mandate for residential fire protection systems, there is a tremendous focus on how to best meet the stricter new requirements. Builders who may have not previously thought much about fire sprinkler systems, the materials or the design, now must consider the various options. As a result, documented cost studies, such as this one, provide a credible and fast means for comparing the options and choosing the one that makes the most sense.

The overriding objective of this particular cost study was to understand how piping configurations and materials affect the total cost of a residential fire sprinkler system. To do so, we designed a fire sprinkler system six different ways for the same home. All six designs met the specific requirements of the California Residential Code.

The test site was a typical two-story, slab-on-grade home with three bedrooms and two-and-a-half bathrooms. The 2,412-square-foot home is supplied with municipal water at 80 psi (at the street). It's important to note that while this level of water pressure is common in Southern California, it is somewhat higher than what is found throughout many other regions of the country.

The design contractor responsible for designing the system within the state adopted codes was Symon's Fire Protection, Inc., located near San Diego. Symon's is an established C-16 licensed contractor (per California code) specializing in residential installations with more than 15 years in the business. All sprinkler designs in the study utilized 16X16 spacing. This assumed the use of standard coverage heads covering a 16-foot area.

The six designs created by Symons include:

- Stand-alone CPVC tree
- Stand-alone CPVC loop

- Multipurpose loop with CPVC
- Multipurpose loop with PEX
- Multipurpose tree with CPVC
- Multipurpose tree with PEX

(A stand-alone PEX system was not estimated since, as of the time of the study, PEX tubing was only permitted for use in multipurpose designs.)

In designing these systems, one of the first challenges was that the multipurpose PEX tree system needed fire-listed PEX in 1-1/2" diameter Copper Tube Size (CTS). At the time of this study, fire-listed PEX tubing was not available commercially in this size. As a result, we dropped this design from the study.

Another challenge was that the marketplace dictated that we consider a design known as a passive purge or a flow-through system. This is a design in which one plumbing fixture (typically a toilet) is connected to the fire sprinkler system. This type of system includes a ½" regulator that is located in the attic for pressure regulation of the supply line to the master toilet. Because of market demand, we added this design to the study.

In order to price out the material of the various designs referenced above, we wanted to obtain real numbers from real contractors that reflected average new construction contractor pricing and discounts. For the CPVC, we obtained pricing from CPVC fire sprinkler suppliers. For the fire-listed PEX, we obtained pricing from new construction contractors that have both fire sprinkler and plumbing licenses. All of the other material was priced out from other sources, including wholesalers and manufacturers' representatives.

We felt we could not expose actual contractor material costs in order to protect the residential fire sprinkler contractors. So how could we communicate the data without exposing actual numbers? This was a serious challenge. We decided to establish a baseline system, which is the system with the lowest material costs. All other systems are presented as incremental costs above the baseline.

**The Results**

The following incremental material costs were estimated for each design:

| | | |
|---|---|---|
| Passive purge/flow-through system using CPVC | $ 0 | |
| Stand-alone CPVC tree | + | $ 129 |
| Stand-alone CPVC loop | + | $ 157 |
| Multipurpose tree with CPVC | + | $ 899 |
| Multipurpose loop with CPVC | + | $ 911 |
| Multipurpose loop with PEX | + | $1,749 |

What accounts for the difference in costs? The passive purge/flow-through system is the least expensive system because it does not include a pressure regulator or a back flow device on the main water service line. The design for the stand-alone system included a DCDA testable backflow preventer. Even though this is not required by Code, it is required by many water departments. Pressure regulators are required by California Plumbing Code for high-pressure systems and are typically set at 60 psi. The cost for the pressure regulator was included on all multipurpose systems.

In comparing the stand-alone to the multipurpose designs, it's important to note that the two stand-alone systems utilized primarily ¾" and some 1" CPVC pipe. All three multipurpose systems required pipe sizes of primarily 1" and some 1-1/4" due to lower inlet pressure from the use of the pressure regulator (which is required by the California Plumbing Code and is factored in to the total cost comparison). In addition, low-lead sprinkler heads were estimated for the multipurpose systems since California has a law restricting the level of lead in drinking water systems—a trend that is gaining momentum in other states, as well. Low-lead heads were only estimated for the multipurpose systems because they supply drinking water. This is not a problem or concern with a stand-alone system.

The material cost for the PEX system is considerably higher since PEX systems must have all brass, UL-Listed T's for the plumbing drops, as well as brass head adapters.

**How Much Is Saved From Combining the Cold Water Plumbing and the Fire Supply?**

In order to represent current market conditions and real costs, we decided to determine the material cost savings between a regular domestic water system and a multipurpose fire sprinkler system. When comparing the plumbing side of the systems, it is important to note that the cost to install the hot water loop is the same for either a stand-alone or multipurpose system. As a result, the only material cost differential is between the complete cold water supply line in a stand-alone system and the cold water drops off the fire sprinkler supply line in a multipurpose system.

For purposes of this cost study, a local tract plumbing contractor provided a design for the cold water plumbing system. In the design, all of the cold water piping was installed in the first floor ceiling (overhead) and fed up to the second floor and down to first-floor fixtures. Using this design, it was possible to compare the material cost of the cold water plumbing design to the cost of the plumbing material in the multipurpose tree system, which is our least expensive multipurpose system. From this comparison, we found that the material savings resulting from the use of a multipurpose system was calculated at $144.

After subtracting the estimated material savings for the plumbing portion of the multipurpose designs, the revised comparison numbers still demonstrate a cost advantage for the CPVC stand-alone systems.

| | | |
|---|---|---|
| Baseline (passive purge/flow-through system) | | $ 0 |
| Stand-alone CPVC tree | + | $ 129 |
| Stand-alone CPVC loop | + | $ 157 |

| | | |
|---|---|---|
| Multipurpose tree with CPVC | + | $ 756 |
| Multipurpose loop with CPVC | + | $ 768 |
| Multipurpose loop with PEX | + | $1,606 |

**The Impact of Low-Lead Sprinkler Heads**

For years, California has led the fight against lead-based building products. Beginning January 1, 2010, companies that manufacture plumbing components for sale in California must demonstrate compliance with new, stricter low-lead requirements set forth by California Assembly Bill 1953 (AB 1953.) This includes the need for low-lead sprinkler heads. However, in the interest of keeping building costs affordable, debates continue as to whether low-lead sprinkler heads should be mandated or simply recommended. In order to present the most balanced and accurate cost study, we recalculated the incremental costs of the various systems assuming that low-lead heads are *not* required (as might be the case in a number of areas). Given the high cost of low-lead heads, their removal had an impact on the cost hierarchy of the six designs studied. The below numbers indicate that the CPVC multipurpose systems are more affordable than the PEX multipurpose system or the stand-alone configurations when low-lead heads are not required.

| | | |
|---|---|---|
| Baseline (passive purge/flow-through system) | | $ 0 |
| Stand-alone CPVC tree | + | $129 |
| Stand-alone CPVC loop | + | $157 |
| Multipurpose tree with CPVC | + | $ 51 |
| Multipurpose loop with CPVC | + | $ 63 |
| Multipurpose loop with PEX | + | $901 |

(*Note that these numbers also include the cost savings on the plumbing side.)

**Conclusion**

Despite the fact that the concept for a multipurpose system has been around for decades, the design is seldom used. Why? There are many reasons. First, AHJs are not as familiar or comfortable with the concept. That's why, in many areas, multipurpose systems are not allowed.

Second, a multipurpose system requires significant trade interaction between the fire sprinkler and plumbing licensed contractors, as well as some additional hidden costs.

The one factor that continues to drive limited interest in multipurpose systems and, hence, the interest in PEX fire sprinkler tubing (which is only approved for use in multipurpose systems at the time of this study), is the possibility for cost savings. As this study has demonstrated, however, in most cases a stand-alone system is more economical. Even in those situations where a multipurpose design does make sense, it is the CPVC, not the PEX, system that results in overall lower costs—saving the builder hundreds of dollars per installation. Furthermore, even if you assume some type of labor savings for installing PEX pipe (although there are still many in the industry who argue that CPVC pipe and fittings are actually faster to install), the perceived savings does not make up the difference in the higher material costs.

As further proof that the use of CPVC pipe and fittings results in a more cost-effective installation than a PEX fire sprinkler system, it's important to note that this particular cost study was conducted in such a way to provide PEX with every cost advantage possible and to reflect current Southern CA market conditions.

In the study we included a testable backflow device on the stand-alone designs, even though this is not usually required. In addition, the higher water pressure of 60 psi inside this particular home actually provided the PEX tubing with an advantage it would not normally have. To understand why this is so, consider the fact that PEX piping has a significantly smaller internal diameter than comparably sized CPVC pipe. In fact, the internal diameter of a 1" PEX pipe is more comparable to the internal diameter of a ¾" CPVC sprinkler pipe. That's because CPVC sprinkler pipe is manufactured to Iron Pipe Size (IPS) SDR 13.5 dimensions whereas PEX piping is only manufactured to Copper Tube Size (CTS) SDR 9 dimensions. As a result, similarly sized CPVC pipe allows for significantly greater water flow than PEX.

In order to achieve the same water flow, larger PEX pipe is required. The larger size increases costs and minimizes the flexibility of the pipe during installation. Since the test site had higher water pressure, it was possible to meet water flow requirements using 1" and 1-1/4" PEX tubing.

Had the test site been supplied with the lower pressures that are found in many other areas of the country, larger-diameter PEX tubing or additional cross mains would have been needed, creating an even greater material cost differential between the CPVC and PEX options.

Another reality is that a CPVC system, because of its superior hydraulics, can often use extended coverage heads or sidewall pendants, which would increase the cost savings for the CPVC system even more than what the cost study reflects with its use of standard-coverage sprinkler heads across-the-board.

Of course, cost studies are specific to the home being studied. All residential fire sprinkler installations are unique due to available water pressure, the layout and design of the home, and local code requirements. Although this study is specific to the home studied in Southern California, it provides valuable insight into the debate whether to use a CPVC or PEX system or stand-alone or multipurpose design. In addition, it puts to rest the one argument that PEX has made to try to gain market share in the booming residential fire sprinkler market. With the cost issue settled, builders and homeowners can focus on the many other attributes that make CPVC a preferred fire sprinkler piping material, including a long, successful track record for performance and superior flame and smoke characteristics that make it a more fire-safe material than PEX.

About the Author

Terri Simmons Leyton is president of Terri Leyton Consulting, Inc. (TLC Fire), a San Diego, California-based firm specializing in fire service relations and education. A well-known fire sprinkler advocate, Leyton has more than 23 years of experience in the industry and is a member of a variety of industry associations, including NFPA, NFSA, AFSA, The California Fire Chiefs Association, San Diego Fire Protection Association, and The International Code Council. She received a small stipend from The Lubrizol Corporation for her contributions to this article.