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# Plumbing Engi

A TMB Publication | August 2010



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# Heating Season PREVIEW

## Inside this issue:

- The Boiler 411
- Backflow Prevention
- The Water Reclamation Imperative
- Smart, Efficient, Near-boiler Piping

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BOILER



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PATENTS PENDING

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Circle 1 on Reader Reply form on page 49





# Her Safety Is your Responsibility!

**• 14,700 fires per year\*  
in non-adult schools**

- 6,300 structural school fires per year \*
- The leading area of fire origin of structural school fires is the lavatory
- 100 injuries due to school fires\*
- Plastics ranked second as materials first ignited in school structural fires

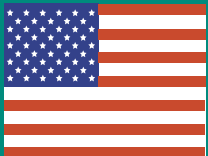
U.S. Fire Administration Report on School Fires,  
August 2007, Vol 8, Issue 1 findings.

\*Average per year

#### Laws, Codes & Standards Compliance

- ADA 4.19.4, ICC/ANSI A117.1, ADAAG 606.5,
- International Building Code (IBC) Sec. 719.7,
- General Services Administration (GSA) P-100
- 2009 US Army Corps of Engineers/Military Facilities Specification (ASTM E84)
- IAPMO PS94 2008 Sec. 3.5 ASTM E84 25/450 Testing Laws, Codes & Standards Compliance

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Volume 38, Number 8, August 2010

## FEATURES



### The Boiler 411

Plumbing Engineer obtains the inside scoop from the top boiler manufacturers about new product introductions and industry news and notes.

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### Backflow Prevention

An essential part of any domestic water system, backflow prevention protects the water we drink from the hazards connected to the potable system.

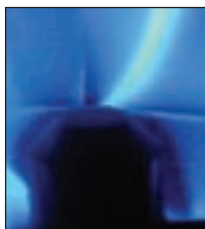
Story on page 36



### The Water Reclamation Imperative

Greywater systems in commercial uses pull from sinks condensation lines from HVAC systems and rooftops.

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### Smart, Efficient, Near-boiler Piping

As boiler technology has pushed operating efficiencies to new heights, the need for correct near-boiler piping has become more critical.

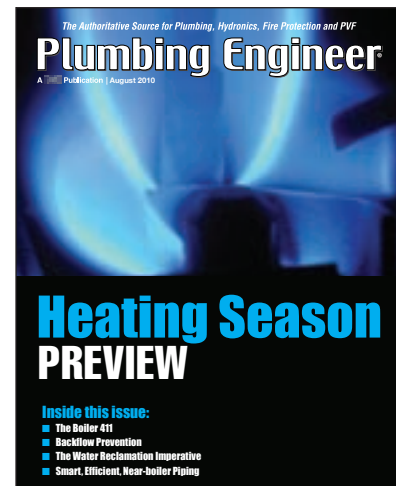
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# Plumbing Engineer

A TWE Publication



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# Editor's Letter

John Mesenbrink  
editor@plumbingengineer.com

## Watermelons and stale beer

Every year about this time I go searching for answers — for *Plumbing Engineer's* Heating Season Preview — on how the economy will shake out in the water heating market. Experts tell me that all indicators point to a flat and soft Q4 2010 and up slightly in early 2011. Soft and flat — I'm not referring to feeling out fruit in the produce aisle and guzzling a stale pint at the local watering hole.

For the most part, let's take soft, flat and up slightly for now, because it isn't DOWN! Let's take what we can get as the water heating industry begins to dust itself off and readies itself for short-term and long-term future recovery.

"We expect the water heater market to be up 5-7% in Q4 2010 and flat to up slightly in Q1 2011," said Charles (Chuck) Rohde, wholesaler market manager, Rheem Water Heating.

The residential water heater market is making strides in recovery. "In general, the water heater market has recovered nicely in the first half of 2010. The total market is up about 7% year over year through June, with growth in residential gas outpacing residential electric by about 3-to-1," said Bruce Carnevale, vice president of sales and marketing, Bradford White.

I wish it was better news, but really the biggest ally you'll need is time. There are some solutions out there that can stem the tide, however. "With the ongoing trend toward green building, Lochinvar is at the forefront of offering high-efficiency water heaters that keep energy usage and operating costs to an absolute minimum. In addition, we are now offering new solar indirect water heaters, which draw heated water from a separate solar energy collector," said Sterling Boston, director of marketing, Lochinvar Corporation.

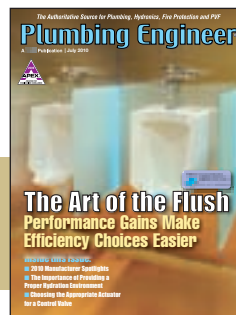
Therefore, this general trend of new technology is being driven by the demand for high-energy efficiency products. This trend is impacted by a number of factors: government and state incentives, utility rebates, consumer awareness, energy costs, etc. "Likewise, with this new technology, advanced electronic controls and diagnostics are also emerging," said David Chisolm, brand manager, A.O. Smith.

"Trends include the development of high energy factor (EF), alternative technology products (heat pump, solar, condensing gas and other hybrid gas), as well as ENERGY STAR and compact/small footprint combo water/air heating products. Also, partnerships with off-grid, electric generation appliances (i.e., wind generation) are gaining momentum. Trends for the consumer include interconnectivity of HVAC appliances — energy management and demand response management," said Jeff Haney, product manager, Rheem Water Heating.

Let's not project all doom and gloom, for the market is picking up, although perhaps not to the point where it once was — pre-2008 numbers. Let's face it, we might not see that for some time. "We see the general water heater market staying relatively flat for the balance of 2010 with modest recoveries in 2011. It will be quite some time before the market recovers to the previous level that we experienced," said Chisolm. ■

### Editor's note:

The cover of the July 2010 issue of *Plumbing Engineer* was provided courtesy of Sloan Valve Co.



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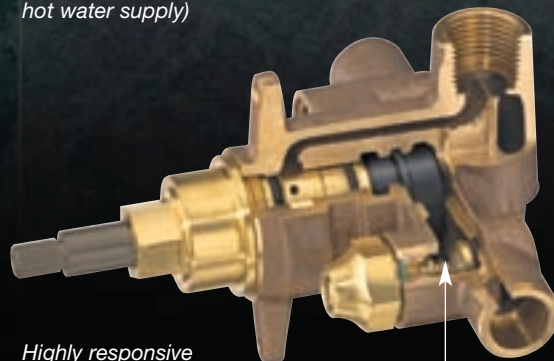
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# Industry News

## NFPA issues alert on residential fire sprinkler systems

THE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) issued a safety alert related to buildings equipped with residential fire sprinkler systems containing antifreeze solutions. Following a recent fatal fire incident, which prompted a research study and a series of fire tests, there has been concern raised over the potential for the antifreeze solution in the residential fire sprinkler system to ignite in certain fire situations.

According to the NFPA, any system that contains antifreeze should have the antifreeze drained from the system and replaced with water. NFPA is recommending that those who are responsible for a residential occupancy with a fire sprinkler system should have a fire sprin-

kler contractor test their system for antifreeze. NFPA also advises that all residential fire sprinkler systems currently being installed should avoid designing or installing a system that would require antifreeze.

Antifreeze systems were first recognized and approved for use in residential occupancies in the 1989 edition of the NFPA fire sprinkler installation standards. More information regarding NFPA's safety alert on antifreeze in residential fire sprinklers or the list of recommended action to take for systems containing antifreeze can be found at [www.nfpa.org/antifreeze](http://www.nfpa.org/antifreeze). If you believe you are affected by this alert you are urged to contact your local building or fire official for more information.

## Bradford White sponsors 2010 NFL Alumni Philadelphia Chapter Charity Golf Classic



Bradford White's vice president — sales & marketing, Bruce Carnevale, presents Ron Jaworski with a check for \$25,000 to the NFL Alumni Philadelphia Chapter during the 2010 NFL Alumni Philadelphia Chapter Charity Golf Classic

The net proceeds from the Philadelphia Chapter NFL Alumni tournament are donated to various local youth charities.

AMBLER, PA. — Bradford White was the Presenting Sponsor of the 2010 NFL Alumni Philadelphia Chapter Charity Golf Classic. The fundraising event was hosted by Ron Jaworski's Running Deer Golf Club in Pittsgrove, N.J.

In the fund raising efforts, Bradford White donated \$25,000 to the

outside the stadium, distributing fire safety literature to attending fans, UL's partner, Radio Disney, broadcasted live before the game promoting a joint "I Am Safety Smart" theme. The local Central Islip Fire Department was on hand displaying local fire apparatus. Safety literature — on a variety of topics ranging from smoke detectors to CO detection to the need for a home fire escape plan — were available to all fans, and the first 1,500 fans entering the ballpark received Ducks three-ring binders.

## ITT Bell & Gossett offers hydronic balancing solutions bulletin

MORTON GROVE, ILL. — ITT has published a new bulletin that provides a comprehensive summary of its Bell Gossett brand solutions for hydronic balancing. Included in the bulletin is a Balancing System Selection Guide which allows users to identify the valves most suitable for their specific projects from manual valves to field adjustable, automatic temperature control valves.

The new bulletin (A-509) also helps users select the most efficient balancing solutions for reducing energy and operating costs while increasing comfort. The six categories of balancing valves covered in the bulletin include: • OPTIFLO™ (PICV) — field adjustable control valve • ULTRASET — externally field adjustable automatic valve • CIRCUIT SENTRY — automatically maintains set flow rate • CIRCUIT SENTRY LOW FLOW — internally field adjustable automatic • CIRCUIT SETTER PLUS — externally field adjustable manual • VENTURI BALL/BUTTERFLY VALVE — standard valve providing venture flow accuracy. Also included in the bulletin is detailed information on Bell & Gossett coil kits, including: • coil supply line options • union ended ball valve/Y-strainer UBY UBL) • union ended ball valve (UBV) • coil return line options • union accessory (Model UA) • temperature control valves • bypass control valve options • hose kit assembly.

For more information, visit [www.balancevalves.com](http://www.balancevalves.com).

## UL sponsors 2nd Annual Community Fire Safety Day

MELVILLE, N.Y. — Underwriters Laboratories (UL), a recognized global leader in fire research, standards development and the testing and certification of products, has once again joined with the Long Island Ducks baseball team to promote a community Fire Safety Day. The event was held at Suffolk County Sports Park, home of the Long Island Ducks baseball on Thursday, July 15, 2010. The Long Island Ducks are a Long Island-based independent, minor league professional baseball team and a staple of the Long Island, N.Y. community.

In addition to UL volunteers manning tables inside and

More Industry News on page 10



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## Industry News

Continued from page 8

### ICC-ES and UL announce first client to complete dual PMG listing program

ICC EVALUATION SERVICE, Inc. ® (ICC-ES®) and Underwriters Laboratories (UL), announced that Measurement Specialties, Inc., has successfully completed the dual listing program for plumbing, mechanical and fuel gas (PMG) products. The Dual PMG Listing Program provides authorities having jurisdiction and construction professionals with the validation that PMG products are code-compliant and meet the rigorous testing requirements of both ICC-ES and UL.

For more information about ICC-ES® PMG Listings, visit [www.icc-es.org/pmg](http://www.icc-es.org/pmg). For more information on UL's water programs and services, visit [www.ul.com/water](http://www.ul.com/water).

### GreenPlumbers USA's Megan Lehtonen joins IAPMO

ONTARIO, CALIF. — Megan Lehtonen has vacated her position as president of GreenPlumbers USA and has joined the International Association of Plumbing and Mechanical Officials (IAPMO) as the association's new director of program development.

For more info, [www.iapmo.org](http://www.iapmo.org).

### New green building book published

JERRY YUDELSON, PE, MS, MBA, LEED AP BD+C/O+M, announced the publication of his latest book, "Dry Run: Preventing the Next Urban Water Crisis" (New Society Publishers, June 2010). This book explains water issues and proposes design solutions for homes, buildings, facilities and schools, as well as policy changes for public agencies. It is the first book to link the green building movement to the emerging water crisis in North America and to showcase actual solutions.

For more information, [www.greenbuildconsult.com](http://www.greenbuildconsult.com).

### NFPA awards scholarships to fire safety students

THE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) Fire Safety Educational Memorial Fund Committee has awarded scholarships to four exceptional fire safety students based on their contributions to fire safety activities, academic achievements, and leadership abilities. The scholarships are awarded each year to recognize students for their pursuit of careers in fire safety.

David Yates is the recipient of the Arthur E. Cote Scholarship; he is a junior at the University of Maryland.

Bryant Hendrickson, a senior in the Clark School of Engineering at the University of Maryland (UMD), is the recipient of the John L. Jablonsky Scholarship.

Clayton James is the recipient of the George D. Miller Scholarship.

Jamie Stern-Gottfried, one of 32 PhD students at the University of Edinburgh, is the recipient of the David B. Gratz Scholarship.

For more info, [www.nfpa.org](http://www.nfpa.org).

### Protect yourself from Legionnaires' disease

JULY MARKS 34 YEARS since the infamous outbreak in Philadelphia that made 221 persons sick with what is now called Legionnaires' disease, and claimed 34 lives.

Until now, books on Legionnaires' disease have been written for scientists, engineers, healthcare workers, water treatment specialists, facility managers, or other professionals whose work relates to the disease or the control of Legionella bacteria. The new book, "Protect Yourself from Legionnaires' Disease: The waterborne illness that continues to kill and harm," is for a general audience.

Author Matt Freije gives important facts about Legionnaires' disease and explains how to avoid it.

For more info, [hcinfo.com](http://hcinfo.com).

### MSI's William Dillard honored

ORLANDO, FLA. — William M. Dillard, CEO of Mechanical Services, Inc. (MSI), has been honored by ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) with an Exceptional Service Award for 2010, established to recognize members who have served the organization faithfully and with exemplary effort.

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Circle 7 on Reader Reply Form on page 49

# Designer's Guide

Timothy Allinson, P.E., Murray Co., Long Beach, Calif.



## Aquatherm, ProPress smack-down

A few months ago I was on an airplane en route to the Bay Area when the fellow next to me ordered a “Jack on the rocks.” The flight attendant soon handed him one of those plastic airline cocktail cups filled to the brim with Jack Daniels and one ice cube. We both looked at this lethal libation and laughed at the absurdity of it and the fact that he had about five minutes to drink the thing.

This introduction got us talking; it turned out that we work in the same industry and that he had just met with a gentleman I know well at the Department of Water and Power in Los Angeles. I asked what the meeting was about. He said that he was seeking approval of the product he reps, Aquatherm Pipe, for use in the City of Los Angeles.

Our meeting was quite karmic, as I had recently been giving a lot of thought to plastic pipe, and the possible benefits it may provide for our plumbing industry. We exchanged business cards and agreed to stay in touch.

A few days later, I e-mailed my new friend, Marty Hayes, with a request for pricing information, as I had started an exercise comparing the relative cost of various piping materials. He sent me a spreadsheet with unit material and labor costs for Aquatherm, comparing it with soldered copper pipe and Viega ProPress copper (the copper fittings that are pressed onto the pipe with mechanical jaws).

My company uses a lot of ProPress. We are big fans of the product because of how quickly and easily it goes together. As I looked at the labor units for Aquatherm (a thermal fusion product) versus ProPress, the numbers weren't making sense. The spreadsheet implied that the Aquatherm product goes together 10 times faster than ProPress does. I questioned Marty on this. He said that the labor units were given to them by subcontractors who had used both products; they had not been determined by Aquatherm.

I said, “Well, those plumbers must be mistaken. There's no way it could go together that much faster than ProPress.” In fact, I would have bet it went together slower than ProPress did.

Having no other basis for comparison I suggested a competition, here in my company's shop, fabricating two identical manifolds, one out of copper ProPress and one out of Aquatherm. “One of our guys can do the ProPress and one of yours can fab the Aquatherm, since we have no experience with it yet.” Marty thought this sounded like a great challenge, and we set about the details of getting it done.

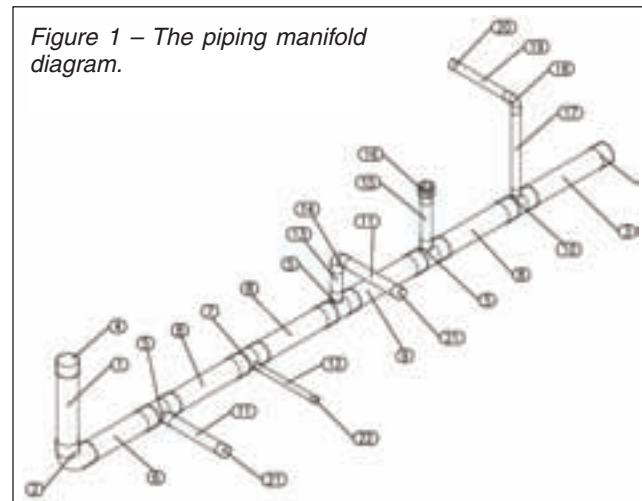
I consulted with our vice president of field operations, who thought it was a neat idea. He gave me a bill of materials to share with both teams so that they would each have the necessary pipe and fittings on hand the day of the competition. We prepared a drawing of the manifold each team would create but didn't share the drawing with either team until the day of the competition.

Marty's team included Geoff Babbitt, president and owner of Sustainable Building Products, the western states vendor for Aquatherm, and Adam Clark, director of training and marketing resources at Aquatherm. Adam coordinated the event from their end and brought three video cameras to

document the process.

Both teams gathered in our shop on May 11. Our shop foreman, Frank Hargrove, set up two identical workstations for the teams. Their fabricator was Bernie Forsee, Aquatherm's Canadian-based head trainer for North America. Our fabricator was Marty Ricco, one of our best foremen.

Fabrication began at 7:30 a.m. It was immediately apparent that there was a difference in processes between the two systems. Since the ProPress goes together with a series of tees, the copper pipe was first chopped into seven pieces that were then pressed together with elbows and tees. The Aquatherm has drilled branches, so the pipe stayed in one piece (except for the upturned elbow). (See Fig. 1).



To my surprise, the Aquatherm fittings went together faster than I expected. The heating and cooling process was quite rapid, especially since the heating paddles are two-sided, allowing the fabricator to heat the male and female side of the drilled tee at the same time.

When all was said and done, the ProPress did win the race, but not by much: 28 minutes, versus 34 minutes for the Aquatherm. Both manifolds were pressure-tested with 100 psi and passed. It should be noted that the relative speed of the two systems would vary depending on the particular fabrication. There might be instances where the Aquatherm could go together faster — or even slower.

To its credit, although the Aquatherm took 20% longer to fab, the manifold was 60% lighter (8 lbs. vs. 20 lbs.) and less expensive — from 34% to 46% less, depending on the temperature and pressure requirements of the system. Aquatherm has several different domestic water products — SDR 7.4 for hot water and higher-pressure cold water and SDR 11 for lower-pressure cold water, both available with or without “faser,” which contributes to the temperature and pressure rating.

The bottom line is that there are pros and cons to each product that are worth considering if Aquatherm is approved


*Continued on page 14*



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# Designer's Guide

Continued from page 12

in your municipality. Aquatherm is lighter and less expensive. It has an R value of 1, meaning that it might require thinner insulation for hot water and none for cold water, even in cold weather climates, but the insulation might be larger in diameter since the plastic OD is greater than copper. Also, it is resistant to the chemicals that are sometimes found in local water supplies that can be aggressive toward copper. ProPress goes together a little faster, requires fewer hangers and does not require the power connection that Aquatherm requires for its heating paddles. And, of course, it is copper, not plastic, which has a history in our industry. Then again, to quote the movie *The Graduate*:

*Mr. McGuire:* I want to say one word to you. Just one word.

*Benjamin:* Yes, sir.

*Mr. McGuire:* Are you listening?

*Benjamin:* Yes, I am.

*Mr. McGuire:* Plastics.

*Benjamin:* Just how do you mean that, sir?

Clearly, what Mr. McGuire meant was that for Benjamin, a recent college grad, there were great opportunities in the future of plastics. I think the same holds true today for our plumbing industry.

If, after weighing the pros and cons, you are leaning toward Aquatherm, be sure you select the appropriate material for your pressure and temperature conditions and zone your systems accordingly. When properly selected, the Aquatherm pressure rating is equal to or greater than



The Aquatherm, ProPress smack-down in process.

the 200 psi rating of ProPress. For pressures greater than that you may need to revert to soldered or brazed copper, or perhaps select Corzan CPVC or another higher-pressure plastic pipe. ■

**Timothy Allinson** is a senior professional engineer with Murray Co., Mechanical Contractors, in Long Beach, Calif. He holds a BSME from Tufts University and an MBA from New York University. He is a professional engineer licensed in both mechanical and fire protection engineering in various states, and is a LEED accredited professional. Allinson is a past-president of ASPE, both the New York and Orange County Chapters. He can be reached at [laguna\\_tim@yahoo.com](mailto:laguna_tim@yahoo.com).

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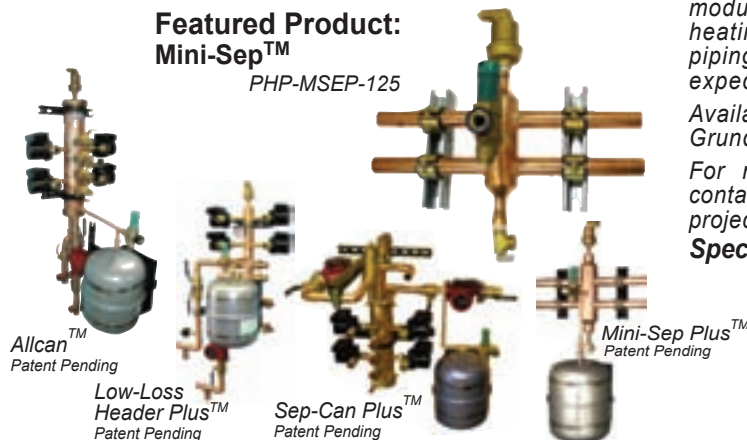
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# Code Update

Ron George, CPD  
President, Ron George Design & Consulting Services



## 22 pitfalls to avoid when designing or installing a combined heating hot water and domestic hot water system

A combined heating hot water and domestic hot water system is a hybrid system that utilizes a boiler or boilers to heat water for heating the building environment, and it uses boiler water to heat domestic hot water for bathing, washing and cleaning uses. The two systems are often combined in an effort to reduce the initial cost of installation, but there are a lot of differences between the two that, if not accounted for, could result in someone getting seriously injured.

Over the years, I have investigated numerous combined systems and found that there are a lot of mistakes or pitfalls that seem to occur. Since there are many opportunities to make mistakes with combined systems, someone very familiar with how both systems are supposed to operate should design them. Heating hot water generally needs to be at a very high temperature, while domestic hot water should be at a lower temperature. If the domestic water gets too hot there are scalding dangers, so proper controls are very important.

I have been investigating scald incidents since the mid 1990s, and I have seen a significant number of these combined systems involved in scald litigation cases because they are often not designed, operated or maintained properly. There are only two plumbing code sections that address combined systems. One section calls for the piping and components in a combined system to be approved for use in potable water systems. The other code requirement calls for a thermostatic mixing valve if the system temperature exceeds 140 F.

There are many more issues than the two mentioned above that need to be addressed. Following is a list of problems or pitfalls that I have found over the years that are related to combined heating hot water and domestic hot water systems. If you can avoid these pitfalls you will have a much safer system:

### Pitfall number 1: Open system vs. closed system

There are two versions of a combined heating hot water and domestic hot water system. Systems with domestic hot water flowing from the city water supply through the heating hot water system components such as pumps, control valves and heating coils are often called open systems. Open systems utilize the domestic hot water flowing through the heating coils or baseboard heaters for heating the building. The same water flows to the plumbing fixtures for bathing and washing. These systems provide a significant challenge, because the fluid in the system must be potable water. It is difficult to circulate domestic hot water through many hydronic components without having scale, corrosion, buildup of air pockets and oxidation problems

Systems with a double wall heat exchanger to separate

the fluid of the heating hot water system from the domestic hot water are referred to as closed systems. Closed systems use a heat exchanger to provide a closed loop for the heating hot water. The closed loop flows through the boiler, the heating coils and the heat exchanger serving the domestic hot water. Most hydronic systems have pumps, valves, coils and components that are not approved for drinking water service. Closed hydronic heating systems allow the heating hot water to be chemically treated to prevent corrosion and scale buildup on heating surfaces and are preferred because they eliminate a lot of opportunities for systems problems.

### Pitfall Number 2: System operating temperatures

The next challenge is the system operating temperatures. Heating hot water systems are generally designed to operate between 180 F and 210 F. Domestic hot water systems are designed to operate between 85 F to 140 F.

*Tempered water* is water having a temperature range between 85 F (29 C) and 110 F (43 C). *Hot water* is water at a temperature greater than or equal to 110 F (43 C). Domestic hot water for bathing and showering is usually limited to a maximum of 120 F. Domestic hot water for dishwashing and laundries can be higher. Generally, domestic hot water systems operate around 140 F and heating hot water systems operate around 190 to 200 F.

### Pitfall Number 3: Not including all of the required components in the combined systems

A combined system requires many components to operate properly. If all of the components are not installed in the proper location, the system will experience problems. These components include, but are not limited to the following: the boiler, expansion tank, isolation valves, unions, dielectric waterways, circulating pumps, air eliminators or air vents, control valves, relief valves, balancing valves, heating coils, fin tube radiators, thermostats, pressure gauges, temperature gauges, flushing connections, plumbing fixtures, etc. All of these components must work in concert and must be designed to work together as a system. If any one or several of the components are not installed, or if they are undersized or installed improperly, problems and safety issues can occur.

### Pitfall Number 4: Seasonal pumping and pump sizing

During the winter heating season, all of the components in a combined system will require a simultaneous peak demand in the morning when it is showering time. The circulating pump must be sized for the simultaneous peak heating and showering loads. During this time it does not make sense to circulate a large quantity of water. I often see a smaller circulating pump that is piped around the

*Continued on page 18*  
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# Code Update

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large circulating pump so it can be used in the winter months when the large circulators are not needed for building heating.

Systems with domestic hot water flowing from the city water supply through the heating hot water system components such as pumps, control valves and heating coils are often called open systems. Systems with a double wall heat exchanger separating the fluid of the heating hot water system from the domestic hot water are often referred to as closed systems.

When a significant portion of a system is being used seasonally for heating and the remainder of the system is being used year round for domestic hot water, open systems are susceptible to bacteria growth in stagnant sections of heating coil piping. Heating coils have huge potential for bacterial amplification when hydronic systems are coupled with potable hot water systems where no physical barrier or heat exchanger exists between the two fluids.

## Pitfall Number 5: Dead legs

During the summer months, the fan coil units and branches to baseboard heating units are shut off with a solenoid valve or the circulating pump on these branches does not run all summer long. It is not unusual for a heating system to sit idle for more than six months in southern climates. When the first call for heating is made, there is

usually a slug of brackish and foul tasting water that is high in debris, metals and bacteria content. Combined systems are by design creating very large dead legs. This is a violation in many plumbing codes. Controls on combined systems need to incorporate a periodic flushing of the zones by operating the solenoid valves and circulators on each zone on at least a weekly basis if not more often.

## Pitfall Number 6: Peak load problems

The early morning is generally the coldest time of day. It is also when guests at a hotel or residents of an apartment building or condominium take their morning showers. Equipment, piping, pumps and valves must be sized to handle this simultaneous peak load. If the equipment is not sized big enough the temperature of the space will fall and the shower water temperature will fall. Either condition is likely to result in calls and complaints.

## Pitfall Number 7: Sizing

Sizing problems can arise when engineers, owners or contractors try to be thrifty and save a few bucks by rounding down on their peak load calculations and downsizing pumps, piping, valves or coils. This is when the phone starts ringing with complaints of spaces being too cold or there not being enough hot water for a shower. The maintenance men usually do what comes naturally when they receive calls of not enough heat: They go to the boil-

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er and turn the temperature up. Turning up the temperature will not cause problems for the heating coils, but it does significantly increase the risk of scalding if the maximum temperature limit stops in the showers and tub/shower valves are not readjusted.

If the shower has an old two-handle or single handle non-compensating type shower valve that compensates for changes in incoming temperature or pressure the risk of scalding is even greater. The best solution is to have a thermostatic mixing valve on the hot water supply to limit the hot water to a safe temperature. If the hot water and heating water piping are still separated, and the system uses one boiler, then a temperature actuated master thermostatic mixing valve conforming to ASSE 1017 or the appropriate CSA B-125 mixing valve can be located at the water heater to lower the hot water to a safe delivery temperature. If the combined system utilizes the same piping for heating hot water and domestic hot water, a temperature limiting valve conforming to ASSE 1070 should be used in-line to mix cold water with hot water to provide a safe temperature of hot water for bathing or showering fixtures.

#### **Pitfall Number 8: Maintenance**

The main problem with a combined system is that the system includes components and controls for two different mechanical trade disciplines. Often, if there is a service

call, the service technician may be familiar with one system or the other. If the system was designed with a specific operating temperature, it is not uncommon for a service tech familiar with only one system to set the temperature to that of the system he is accustomed to.

There are also many components in the system that one trade or the other may be unfamiliar with. For example, in one case the owner called an HVAC technician to work on his combined system. The technician was used to setting hydronic systems for building heating at 190 to 200 F. He set the temperature to 190 F, and a woman was scalded when she got into her shower. The technician did not know that he needed to reset the maximum temperature limit stop on all of the ASSE 1016 shower valves when he readjusted the boiler set point temperature. ■

*Pitfalls 9-22 will appear in the September issue of Plumbing Engineer.*

*Ron George is president of Ron George Design & Consulting Services. He has served as Chairman of the International Residential Plumbing & Mechanical Code Committee. To contact Ron, write to him at [rgdc@rongeodesign.com](mailto:rgdc@rongeodesign.com).*

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wall construction



# FPE Corner

Samuel S. Dannaway, PE,  
President, S.S. Dannaway Associates, Inc., Honolulu



## Protection of sprinklers against damage by earthquakes – Part 3

The general requirements pertaining to seismic bracing were discussed last month. This article will look at the detailed design of sway bracing. For those not involved in the design of sway bracing but responsible for review and approval of sprinkler system designs, I will try to point out things you should be looking for.

**Step 1.** The first step is to lay out your bracing.

This will likely be an iterative process. In your first pass, it may turn out that you need more or less bracing. Locate lateral and longitudinal bracing such that the bracing falls within maximum distances between braces and maximum distance from the end of mains. For lateral bracing, that would be 40 feet between braces and six feet from the ends of mains. For longitudinal bracing that would be 80 feet between braces and 40 feet from the ends of mains. Also, include four-way braces at the tops of risers.

It might be prudent to space the bracing a little closer. We are finding out that, with the current load requirements pertaining to bracing, designers are required to space bracing much closer than maximums. This will allow some flexibility in the field in the event that a brace needs to be relocated if it cannot be installed exactly at the location shown. In such a case, one may wish to start with lateral brace spacing at maximum 30 feet intervals. Also, as with locating pipe hanger attachments, the designer must know enough about the structure to know where the bracing can actually be installed.

**Step 2.** Determine the loads to be applied to each brace.

First, establish the zone of influence (ZOI) for each brace. The ZOI will be all the piping that will be assigned to the bracing. The diagram provided in Figure A.9.3.5.6 (e) of NFPA 13 shows the load distributions or ZOIs for bracing graphically by clouding the piping within the zone. Note that the ZOI for lateral bracing includes all mains and branch lines, whereas the ZOI for longitudinal bracing is limited to the mains.

For four-way braces at risers, add the longitudinal and lateral loads within the ZOI of the brace. For the four-way bracing at the top of a riser,  $C_p$  times the height of the riser should be assigned to both the lateral and longitudinal loads as they are separately considered. When a single brace has a combined load from both lateral and longitudinal forces, such as a lateral brace at the end of a main that turns 90 degrees, only the lateral should be considered for comparison with the load tables in 9.3.5.3.2.

Determine the weight of the system for each ZOI. This is referred to as  $W_p$ , which equals the total weight of water-filled pipe in each ZOI multiplied by 1.15. The added 15% is to account for the additional weight of pipe fittings and sprinklers. In ASCE 7 the term  $W_p$  is actually more generic and represents Component Operating Weight, which is used in the calculations of seismic demands for non-structural components. Table A.9.3.5.6

provides water-filled weights in units of lb/ft and kg/m for Schedule 40 and Schedule 10 steel pipe. For copper tubing, you can find this information at [http://www.copper.org/publications/pub\\_list/pdf/copper\\_tube\\_handbook.pdf](http://www.copper.org/publications/pub_list/pdf/copper_tube_handbook.pdf). For CPVC piping you can link to <http://www.aktivsprinkler.no/CPVC%20ror%20og%20delel.pdf> For other piping used in sprinkler systems, you will have to look to manufacturer's data for this information.

Determine the seismic coefficient,  $C_p$ . In order to find this value, you must know the Spectral Response Accelerations for short period ( $S_s$ ). As discussed in the June issue, this can be done using seismic maps published in the IBC, or it can be calculated using maps or software that can be downloaded from the Java Ground Motion Parameter Calculator found on the U.S. Geological Survey website at <http://earthquake.usgs.gov/hazards/designmaps/javacalc.php>. With the  $S_s$ , one can determine  $C_p$  from NFPA 13 Table 9.3.5.6.2. It is acceptable to interpolate the values on this table. Another option is to calculate the  $C_p$  from the following ASCE 7 formula for seismic design force  $F_{pw}$ :

$$F_{pw} = \frac{0.4a_p S_{Ds} W_p (1+2z/h)}{(R_p/I_p)}$$

$$\text{Since: } F_{pw} = C_p S_{Ds}$$

$$C_p = \frac{0.4a_p W_p (1+2z/h)}{(R_p/I_p)}$$

Where  $a_p$  = component amplification factor, which is 1.0 for sprinkler systems

$R_p$  = Component response modification factor, which is 3.5 for sprinkler systems

$I_p$  = Component importance factor, 1.5 for sprinklers

$z$  = height of bracing attachment point with respect to the base

$h$  = average roof height with respect to the base

It would be conservative to select  $z/h$  as equal to 1.0.

If there is not adequate information to determine the  $C_p$  and it is acceptable to the AHJ, then a  $C_p$  equal to 0.5 may be used.

Calculate  $F_{pw}$  for each ZOI.

**Step 3.** Select brace shapes and sizes from NFPA 13 Tables 9.3.5.8.7(a), 9.3.5.8.7(b), and 9.3.5.8.7(c).

These tables provide maximum horizontal loads for steel sway braces with maximum brace lengths for slenderness ratios ( $l/r$ ) of 100, 200 and 300 respectively. The maximum slenderness ratio  $l/r$  cannot exceed 300, and the angle from vertical may be no less than 30 degrees. When designing sway bracing it is desirable to choose values for angle from vertical in the range from 30 to 45 degrees. This is a conservative choice and will provide some flexibility if varying field conditions force you to this condition.

**Step 4.** Check to ensure that  $F_{pw}$  supported by each brace does not exceed the load permitted by NFPA 13 Tables

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# FPE Corner

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9.3.5.3.2(a) through (e) for the type and diameter of sprinkler piping to which the brace is attached.

Because these tables are based on some conservative assumptions and typical conditions the designer can exceed the distances indicated but only with a detailed engineering analysis. Some have argued that the seismic bracing calculation software provided by various manufacturers constitutes the detailed engineering required to supersede this table. Sorry, no dice, unless you are a structural engineer or have one available, I recommend that you use this table as an upper limit.

**Step 5.** If the total expected loads in the ZOI for a given brace is less than those permitted in Tables 9.3.5.8.7(a), (b) or (c) and less than the maximum values permitted in Tables 9.3.5.3.2 (a) through (e), then move on to the next step to check fasteners.

If not, then either add additional braces or select a brace shape and size that can support the load.

**Step 6.** Lastly, check that fasteners connecting the braces to structural supporting members are sized to adequately support the expected loads on the braces in accordance with Figure 9.3.5.9.1.

If not, again add additional braces or additional means of support. Note that, if powder driven, fasteners must be listed for resisting earthquake loads. Also, it is not permitted to use C-clamps, even with retaining straps, to support bracing.

Now a few items for those checking sway bracing calculations by others. It is likely you will be getting the calculation for review on a form similar to the one shown as Figure A.9.3.5 (b). As you review the calculation, be sure that the values for maximum horizontal load for the brace, maximum load for the fastener and the total load in the ZOI (Fp) is correct. Also, check to make sure that the loads are within the maximum limits of Tables 9.3.5.3.2(a) through (e). It appears that some bracing calculation software offered by the manufacturers does not offer this important check, so you must do it yourself.

This concludes our three-part discussion of protection of sprinkler systems from seismic events. ■

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# Solar Solutions

Bristol Stickney, technical director, Cedar Mountain Solar Systems, Santa Fe, N.M.

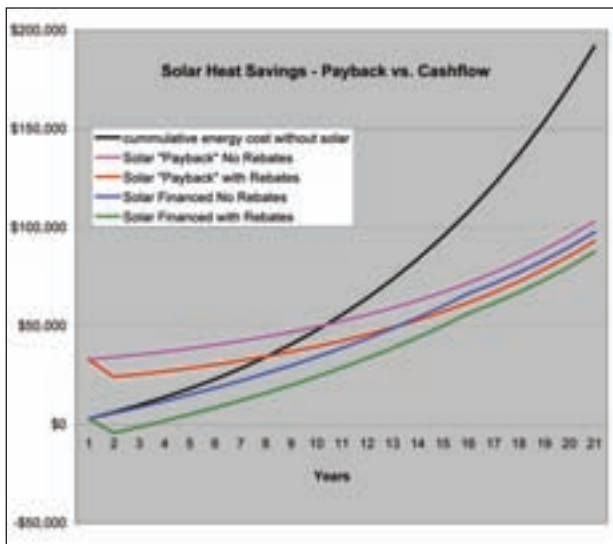


## Solar economics – look at cash flow, not payback

Whenever a solar heating project is under discussion, someone always brings up the concept of “payback.” This idea is based on the assumption that the extra cost of installing solar equipment must pay for itself in energy savings in some fixed amount of time. If it doesn’t, then it is not worth installing the solar equipment. The payback period is often picked at random, say five, seven or 10 years. This “simple payback” analysis (so often scribbled on a paper napkin during lunch) is easy for everyone to understand because the math is elementary. I guess that’s why it is so popular. But it produces, at best, a factoid for an answer and, at worst, a completely false representation of the economic benefits of a solar heating system.

What if you were building or remodeling a heating system and you found out that, because of the way financing for construction and home improvements are structured these days, you could include solar heating with virtually no additional expense to the project? Suppose that, to top it off, the cost of operating the heating system for the next 20 years or more will be less than half of what a conventional heating system would require. And, even better, that, because of the ever-increasing cost of conventional energy over time, the cash flow benefit increases every year?

Most of the solar heating projects I have designed in recent years fit this description, in part or in whole.



Sometimes the owners are partly swayed by the more intangible benefits of being “green,” which doesn’t really fit into any kind of economic analysis. If the initial expense is insignificant, and the cash flow is positive and that benefit increases every year for the life of the system, then the payback is irrelevant.

At the very least, the investigation into solar heating should go beyond payback to include fuel inflation, interest rates on the project financing, national and local incentives for energy efficiency and all the other variables impacting a construction project today. The calculations

are not so simple; that is where computers come in handy.

In the past few months I introduced some of the computer software available to model and analyze solar heating installations such as SAM, Retscreen, TsoI and Polysun. All of these programs include an economic analysis section that allows an inspection of the effects of interest rates, incentives, fuel costs and the like. Many of these computer tools also try to put a value on the green benefits as well, by reporting on avoided carbon emissions and other pollutants.

### Multiple variables

Here at the SolarLogic Lab, Fred Milder and I have been comparing this kind of economic data on a spreadsheet that Fred created. Following is a brief description of the variables needed for a realistic economic model. We will be using an example project to illustrate a typical residential solar combi heating system in the United States.

- **The cost of borrowed money:** Most construction projects are financed. Home equity loans offering historically low interest are available today. The amount and terms of the loan for a solar installation must be included in an economic evaluation. For our example, we will borrow \$30,000 at 3% interest for 15 years to install a solar hydronic combi heating system in a typical residence.

- **Costs recovered from rebates and incentives:** The actual amount depends on the owner’s individual tax status and the state and local offerings. Remember that not all heating equipment is automatically eligible for a rebate. If a component is required as part of a conventional heating system, it may not qualify. In our example, we assume that \$25,000 worth of equipment qualifies for a rebate. Our tax bracket allows the full rebate to be collected in the first two years after installation, using the New Mexico rebate limits.

- **Heating energy required:** The domestic hot water and space heating needs for the residence each year must be estimated in order to put a value on that amount of heating fuel. In our example, the building consumes one million Btu per year.

- **Cost of fuel over time:** The cost of fuel changes all the time, and it is not possible to predict what will happen in the future for all sources. One commonly accepted method of estimating this is to look at the trends over the last ten years and project that forward into the future for economic comparison. A good resource for this information is the U.S. Energy Information Administration (EIA.gov). In our example, we use propane at \$3 per gallon, with a price increase of 10% per year.

- **Solar energy delivered to the heating load:** The solar heat that actually offsets conventional fuel use each year can now be compared to the cost of fuel to determine an economic savings. In our example, we install 320 square feet of flat plate collectors and use an SRCC collector rating that corresponds to a partly cloudy climate. Figure 25-1

*Continued on page 26*





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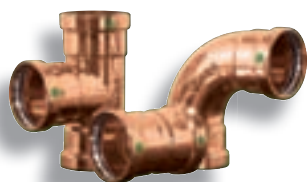
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# Solar Solutions

Continued from page 24

shows the results from our example project using the economic data described above. This graph shows the cumulative cost of heating with and without solar and with and without rebates more than 20 years.

## Compelling cash flow

The typical “simple payback” analysis is actually a special case, where the solar installation is paid for by the owner in a lump sum up front instead of using borrowed money. The fuel inflation rate and tax incentives may or may not be included (depending on the size of the napkin you are working on).

In our example, seen in Figure 25-1, I have included two payback graphs shown as pink and red lines. Notice that the initial cost is seen as a major expense, which is slowly offset by solar savings. The point of payback occurs when the accumulated solar savings cross the black line that represents the accumulated non-solar fuel costs. The solar rebate (red line) lowers the initial cost and causes payback to occur about two years sooner.

Even when no rebate is collected (the blue line), the financed system never costs any more from year to year than the non-solar option (the black line). The savings kick in by the third year and continuously increase for years to come.

The same data is plotted on Figure 25-1 for this example, when the project is financed for 15 years at 3% as described above. The results are much more compelling because there is no large cost up front and the savings are immediate. In fact, when a rebate is collected in the second year (the green line), the costs “go negative” which indicates cash flow into the owner’s pocket rather than out of it.

Even when no rebate is collected (the blue line), the financed system never costs any more from year to year than the non-solar option (the black line). The savings kick in by the third year and continuously increase for years to come.

In this example, a payback analysis shows a negative benefit for the first eight to 10 years, while the cash flow analysis for prudent financing shows continuous benefits right from the beginning. Of course, every project is different, by region, by climate, by fuel type and by type of construction, and each has its own economic fingerprint. The economic evaluation really must be personal. The powerful tools like those built into Retscreen and other computer models make this as painless as possible.

## Beyond economics

There are other advantages that owners experience from their solar heating systems besides economics. Abundant domestic hot water from the typically larger solar hot water tanks can provide a feeling of luxury. Extra heat in summer can be diverted to a hot tub or pool without any

added fuel cost. Night Sky Radiant Cooling (NSRC) can often provide extra comfort or savings. Solar heat can deliver extra LEED points for designers who are involved with high efficiency buildings. Solar heat provides a kind of insurance against the future cost and instability of conventional fuel. And, of course, solar heat offsets CO<sub>2</sub> and other emissions in a big way, so anyone concerned about their carbon footprint can use solar energy to improve their green impact.

Looking at these graphs, we can see that the annual savings steadily increase over the years as the cost of fuel increases. The biggest benefits occur over the long term. This implies that the solar components must function reliably and consistently over the expected lifetime of the equipment. In other words, the system must be designed, installed and maintained in accordance with the six principles of good solar design. The systems must especially be Reliable and Serviceable if they are going to deliver the economic goods over time.

## Final notes

At SolarLogic, we are developing integrated methods of design, installation, control and monitoring for Solar Combi heating systems based on our field experience from recent years. Our goal is not only to assure that a working system is installed but also that its proper performance can be monitored, verified and maintained over the years.

Special thanks to Dr. Fred Milder for the original economic insights included in this article.

Brand names, organizations, suppliers and manufacturers are mentioned in these articles only to provide examples for illustration and discussion and do not constitute any recommendation or endorsement. Calculations and estimates are for example only, and are not intended for any particular design application. ■

*Bristol Stickney has been designing, manufacturing, repairing and installing solar hydronic heating systems for more than 30 years. He holds a Bachelor of Science in Mechanical Engineering and is a licensed Mechanical Contractor in New Mexico. He is the Chief Technical Officer for SolarLogic LLC in Santa Fe, N.M., where he is involved in development of solar heating control systems and design tools for solar heating professionals. For more information, visit [www.solarlogicllc.com](http://www.solarlogicllc.com).*

In this series of articles, I have been making the case that the key ingredients for solar/hydronic design and installation can be divided into six categories, listed below, roughly in order of their importance.

1. RELIABILITY
2. EFFECTIVENESS
3. COMPATIBILITY
4. ELEGANCE
5. SERVICEABILITY
6. EFFICIENCY

The success of any solar hydronic home heating installation depends on the often-conflicting balance between any of these six principles. Finding the balance between them defines the art of solar heating design.

The views and opinions expressed in this column are those of the author and do not reflect those of *Plumbing Engineer* nor its publisher, TMB Publishing.



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# Energy Efficiency

By Bob 'hot rod' Rohr



## Specifying efficient equipment

Paging through trade publications these days I notice a common theme. Actually I notice a few common themes: “green,” or “green washing” to some, and “high efficiency.” I am all for increasing efficiency, be it in HVAC equipment, the structures we design, vehicles we travel in, or even our daily work regimen. “Green” is a little foggier to me. Show me a product that isn’t marketed under a green premise these days.

So where do we as designers, installers and manufacturers come together in the high efficiency arena? As I see it, all of our customers are hankering for efficient products and buildings. Manufacturers jockey to be on the cutting edge and leading, or close to the front of the pack, with offerings. Certainly, designers and installers want to provide high efficiency to their customers, who are demanding it.

Could it be that the media was early to grab “green” and run with it? I know for a fact that politicians drop the “green bomb” as often as possible. I’m not sure that this is a bad thing. In a struggling economy, any viable product or concept that generates a buzz and results in SALES

The challenge for us is to weed our way through the hype and find and install the products that truly do make life more efficient and, hopefully, less expensive to purchase and maintain, while accomplishing the task for which they were designed.

could be a great thing. Wiser use of our resources is a good thing, in my mind. So what’s not to like?

The challenge for us is to weed our way through the hype and find and install the products that truly do make life more efficient and, hopefully, less expensive to purchase and maintain, while accomplishing the task for which they were designed. It’s really easy to insert the words green or energy efficient into any conversation. Putting numbers to the advantages of these practices is a bit more involved.

In our industry, time is the true indicator. Does the product safely and reliably accomplish the work with less consumption? Would we all agree that mod con boilers would be a classic example? Maybe even condensing furnaces for that matter. There have been a few swings and misses, as we know.

High efficiency pumps and motors seem to be the hot button this year. As the offerings increase are you ready and willing to jump on board? The players are all known and trusted manufacturers: The technology has history in actual applications in Europe. The numbers sure do work out nice-

ly when you consider long term energy consumption.

My shop, as I walk through it this morning, is a living testimony to those swings and misses. I have a heavy brass “boat anchor” of a circulator that was billed as a game changer, a pile of radiant tubing and fittings that couldn’t get along with water and heat, several early condensing boilers, obsolete controls, igniters with less than six months of service and enough inducer fans and motors to circle the earth. I can’t think of one area of hydronics that I don’t have an R&D project component where the installer is the one who took the hit on the R&D. Most cost me out of pocket dollars to correct and replace. I figured my mortgage could be paid off by now with all those “refunded” dollars and time for repair and replacements on my nickel.

I guess the bottom line, the gist of this rant would be, “Would I, will I do it again? Am I willing to sell and install the newest and latest \_\_\_\_\_?”

I’m in a different part of the industry now. Working for a manufacturer, I get to see a product go from the ore, copper, iron, etc. to the finished product. I see what it takes to design, test, list, market and sell new and unique products. I understand that the product is directly equal to the people behind it and their goals and passion. I see the power of a well-equipped and staffed lab. I also understand the limitations of labs and accelerated testing. I understand how installation and jobsite conditions are often the largest unknown and uncontrollable piece of the puzzle. I now know the true meaning of “lifetime warranty.”

Be this as it may, I still say, “Yes, count me in to continue to push the envelope.” I’ve been to countries where 40-mpg requirements are currently in place. I’ve seen net zero buildings. I’ve discovered countries that have required solar thermal since the ’80s. I do wonder how much learning curve those early adopters rode out. That puts the Toyota debacle in mind.

The United States needs to step up and take the lead or at least get in the race. I’m watching China spend billions of their stimulus money on efficient transportation, solar PV and thermal mandates. They are cleaning up their coal plants and setting big goals. There are entire continents mandating energy efficient pumps and motors.

Are you with me? Willing to take the bruises, show the scars and move on? Could you make one change and spec only ECM pumps as a first step? Let me know your thoughts. ■

*Bob “hot rod” Rohr has been a plumbing, radiant heat and solar contractor for 30 years. A long-time RPA member, Bob is manager of training and education for Caleffi North America. He can be reached at hotrod@radiant@mac.com.*

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# LEAD FREE REPORT

## Uponor to offer lead-free brass fire sprinkler adapter for multi-purpose systems

APPLE VALLEY, MINN. — Easier to install and more cost-effective compared with traditional stainless-steel fire sprinkler adapters, the ProPEX® Lead-free Brass Fire Sprinkler Adapter from Uponor is an industry-first. Made of lead-free brass to effectively meet state lead-level legislation and conform to NSF Annex G for lead-free



plumbing requirements, the new adapter provides easier installation on a variety of mounting surfaces.

"The new ProPEX Lead-free Brass Fire Sprinkler Adapter offers installers flexible pre-assembly and mounting options with no blocking required," said Jayson Drake, senior product manager, plumbing and fire safety, at Uponor.

Available in ¾" and 1" tees, each assembly requires a

mounting bracket and a push-on locking nut (sold separately). The adapter also features Uponor's proven, cold-expansion ProPEX fitting system for strong, durable and reliable connections without the need for torches, glues, solvents or gauges.

## New lead-free potable water products bulletin available from Bell & Gossett

MORTON GROVE, ILL. — A new bulletin (A-151) describing the full line of Bell Gossett lead-free potable water products is now available at [www.bellgossett.com](http://www.bellgossett.com). Ranging from pumps and boosters to tanks and valves, the potable water products are offered in lead-free brass materials and meet the requirements of California's AB1953 and Vermont's S152 legislation, as well as exceed the current requirements in the other 48 states.

The new bulletin (A-151) explains how Bell Gossett's expanding line of potable water products provides efficient, safe, and responsible lead-free operation. Products described in the brochure include:

- Commercial Pumps — (Series 60 AB, Series 90 AB, Series 1522)
- Circulators — (ecocirc£, Series 100, LR, NBF, SSF, PL, PD, LD3, HD3, HV and PR)
- Packages — (Mini Boosters)
- Tanks — (PT/PTA, WT/WTA)
- Flanges — (Check-Trol®, companion flanges and installation flanges)

The new line of lead-free products reinforces ITT's ongoing commitment to green, energy-efficient solutions. For more info, visit [www.bellgossett.com](http://www.bellgossett.com).



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# The Boiler 411

**P**lumbing Engineer has obtained the inside scoop from the top boiler manufacturers about new product introductions and other industry news and notes. Here is a compilation of companies interviewed. They appear in no particular order.

## AERCO International, Inc. www.aerco.com

**Company profile:** AERCO International, Inc. (AERCO) is a leading supplier of boilers and water-heating products. Founded by Henry Angelery in 1949, the company introduced a revolutionary design for an indirect-fired water heater that heated water on demand, without storage, at a controlled temperature. This innovation became the standard for water heaters. In 1988, AERCO became the first U.S. manufacturer to offer a fully modulating and condensing commercial gas-fired water heater and extended this design to the hydronic boiler marketplace.

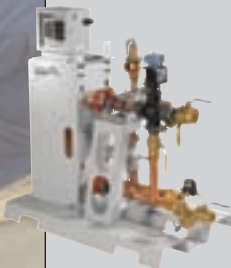
*SmartPlate water-to-water heaters help reduce system energy costs by utilizing innovative designs uniquely suited for use with high-efficiency condensing boilers.*

**What's new:** The new SmartPlate water-to-water heaters help reduce system energy costs by utilizing innovative designs uniquely suited for use with high-efficiency condensing boilers. Capable of supporting up to 90 gpm domestic loads at a 100° F rise,

these fully packaged, instantaneous heaters incorporate real-time load tracking capabilities and responsive controls to maintain accurate hot water temperatures under diversified load patterns common in commercial and institutional applications.

All SmartPlate water heaters incorporate a PID temperature controller and a high turndown, electronic control valve to maintain outstanding  $\pm 2^\circ\text{F}$  temperature control when operated under constant load conditions with variances held to  $\pm 4^\circ\text{F}$  under normal load changes. Each SmartPlate heater utilizes a counter flow, stainless steel, brazed plate or plate and frame heat exchanger — the most efficient heat exchangers available for indirect water heating — in an instantaneous design that eliminates the need for storage tanks and blending valves.

AERCO also has launched a new website (www.aerco.com) makes it easy to find information on high-efficiency boilers and water heaters, as well as on condensing technology. Plumbing engineers now have a convenient resource to determine what boilers and hot water heaters are best suited for their projects.



## HTP (Heat Transfer Products) www.htproducts.com

**Company profile:** Established in 1974, HTP is a full-fledged manufacturer on the cutting edge of energy-efficient space and water heating technology. HTP was the first U.S.-based manufacturer to release a condensing gas water heater domestically, unveiling the Voyager in 1994. In 1996, HTP delivered another breakthrough with the launch of the Munchkin boiler. This highly compact boiler coupled condensing technology with a modulating burner to further trim energy consumption. HTP's offerings include residential and commercial boilers, residential and commercial water heaters, indirect tanks, and a range of solar products. All offerings are high-efficiency.



**What's new:** HTP will be introducing a new heating boiler set for release in the fall of 2010. This new boiler will redefine the hydronics market by offering a product that is both highly combustion efficient and highly thermal efficient, coupled with enough hydronic mass to stabilize any system and eliminate the need for primary/secondary piping.

High efficiency boilers have continued to gain as a percentage of overall boiler market share. With federal and state legislation, as well as utility companies, encouraging upgrades and new installations through rebates and stimulus programs, an increase in sales of high efficiency boilers is forecasted.

## Hydrotherm, a Mestek Co. www.hydrothermkn.com

**Company profile:** Hydrotherm created a small cast iron boiler suitable for New York apartments. Playing off that same concept, Hydrotherm entered the commercial market by banking these smaller boilers together, thus forming the modular boiler concept. In the 1970s, Hydrotherm produced the first successful condensing boiler. In an age where typical efficiencies were 65-70%, Hydrotherm's Pulse boiler provided efficiencies of 90%. Hydrotherm joined the Mestek family of heating products in 1990 and continued its strong innovative path. The KN Series, Hydrotherm's flagship product offering is the industries first cast iron condensing boiler available with outputs ranging from 200MBH - 3,000MBH. KN Series units feature HeatNet control technology. Heat Net is a proprietary control platform ensuring optimum combustion performance offering superior system efficiency control and communication.



*KN-Series boilers feature HeatNet control technology, which eliminates the need for wall-mounted third-party control panels. Built into each KN-Series boiler, the plug-and-play HeatNet control maximizes operating efficiency and turndown rates to create substantial energy savings whether it is operating on a single unit, part of a Building Management System or as a member of a network of up to 16 boilers.*

**What's new:** Offering efficiencies of up to 99% with inputs of 200 and 400 MBH, the new KN-2 and KN-4 Series boilers offer the ultimate combination — the small footprint of modern low mass boilers and the long life and reliability of cast iron.



**Laars Heating Systems Co.,  
a subsidiary of Bradford White Corp.  
www.laars.com**

**Company profile:** In 1948, Laars engineers invented a way to improve the transfer of heat between metals, which led to the design of a new commercial boiler. Their concept was based on the principle that water could be heated rapidly through a finned copper tube heat exchanger exposed to gas flames, a technique that virtually eliminated the



*The NeoTherm® condensing boiler is a fully packaged, space-saving hydronic solution that offers 95% energy efficiency. Laars is now adding three additional commercial NeoTherm boiler sizes (600, 750, 850) to the full line-up of current residential sizes (80, 105, 150, 210) and commercial sizes (285, 399, 500), extending the NeoTherm range from 80 MBH all the way to 850 MBH.*

scaling and electrolytic corrosion that shortened the life of the cast iron and steel tube boilers.

In the 70s, the company expanded into residential hydronic systems. Laars Heating Systems Company (www.laars.com) was purchased by the Bradford White Corporation in 2005, greatly expanding Laars' scope and marketplace. Recently, Laars completed full consolidation of all manufacturing at its Rochester, N.H. plant, with facilities in Canada.

**What's new:** Laars has just introduced three new commercial sizes of our NeoTherm mod-con line, the NTH 600, 750, and 850, each with a 5:1 turn-down ratio and standard controls that will modulate and stage up to 8 boilers with outdoor reset and lead/lag boiler rotation. Also, Laars has just released 5 sizes of a new condensing volume water heaters, the NeoTherm NTV 150, 199, 285, 399 & 500. Also, in the new product category, Laars will soon introduce the Laars System Commander, an automatic "gateway" device that allows the Laars Integrated Control used on NeoTherm boilers to communicate directly with building automation systems with BACNET and LON protocols. The Laars System Commander is a "plug 'n play" control that auto-detects the BAS protocol and communicates seamlessly without having to map data points, and also auto-detects and names all Laars boilers connected to the system, with up to 12 burners.

**Lochinvar Corporation  
www.Lochinvar.com**

**Company profile:** Lochinvar's history dates back to 1919 with its founder Walter Vallett, Sr.'s entry into the water heater business. A true industry pioneer, Vallett was instrumental in the development of the first automatic gas fired water heaters early in his career. He founded the Walter Vallett Company May 16, 1946, which eventually became Lochinvar Water Heaters, and is known today as Lochinvar Corporation.



**What's new:** The latest addition to Lochinvar's family of commercial, stainless steel, condensing boilers is the CREST™ heating boiler, which will be available later this year.

*CREST will include the SMART TOUCH™ operating control platform enhanced with an eight-inch touchscreen display; this advanced control will offer ease of set-up and use by installing contractors and will include Modbus protocol for easy integration into Building Management Systems.*

This innovative new line has been developed to offer engineers more system design flexibility, sizes and distinctive performance characteristics to meet today's building standards for new construction and energy retrofit applications. The CREST heating boiler will be offered in five models with capacities of 1.5, 2.0, 2.5, 3.0 and 3.5 million Btu/hr inputs. Each of these models will feature an advanced burner and combustion system designed to provide exceptional turndown capabilities and improve overall seasonal efficiencies.

Lochinvar also announced their Solar Thermal Heating initiative, which is the result of a new partnership with TiSUN® GmbH of Tyrol, Austria. The partnership between Lochinvar and TiSUN has resulted in a winning team with smart strategies that provide the exact product, training and support that mechanical and plumbing design engineers and contractors need to provide renewable energy solutions for their clients.

Lochinvar has expanded upon its highly successful Squire® Indirect Water Heater line to include a total of 12 stainless steel models with capacities between 30 and 119 gallons. Among the new models are six solar units, each of which features a hybrid system incorporating solar thermal panels along with a secondary boiler heating coil or electric back-up.

**Slant/Fin Corp  
www.slantfin.com**

**Company profile:** Slant/Fin was founded in 1949 by Mel Dubin. He began manufacturing commercial fin tube in the back of a bakery in Brooklyn, New York. The company has since grown and is still a privately held company now manufacturing in Greenvale, N.Y. Slant/Fin manufactures a full line of residential and commercial fin tube radiators, as well as a full line of gas and oil boilers. Since 1949, heating contractors, engineers and builders have depended on Slant/Fin for products of the highest quality. Slant/Fin is dedicated to satisfying its customers through on-time delivery of quality products — along with the best technical and customer support in the industry.



*The specially designed three-pass heat exchanger maximizes heat transfer and delivers 87% AFUE. Plenty of room for thermal expansion of the flue gases to keep burner and flame noise to a minimum.*

**What's new:** The EUTECTIC Series is the newest high efficiency, cast iron, oil-fired boilers by Slant/Fin.

Made from proprietary cast iron, the heat exchanger is resistant to thermal shock and corrosion. Suitable for lower temperature oper-

ation and outdoor reset controls. The specially designed three pass heat exchanger maximizes heat transfer and delivers 87% AFUE. Runs quietly. There is plenty of room for thermal expansion of the flue gasses to keep burner and flame noise to a very minimum. It is easy to clean, the door is reversible, the baffles are removable and brushing the flueways is a snap. Cleans easily with a reversible swing-open door and removable baffles. Engineered to run clean under all ambient conditions. Available in sizes you need from 88,000 to 350,000 btuh.

The cast iron is flexible and resilient which allows for lower temperature operation especially with outdoor reset controls. This yields significant energy savings. The EUTECTIC boiler, like other Slant/Fin oil boilers, will operate cleanly under all the different operating conditions. It has done the testing and

has matched burners and components to this boiler to make sure the boiler will stay running clean after you leave the job.

**RBI, a Mestek Co.**  
www.rbiwaterheaters

**Company profile:** RBI built its foundation as a contract builder of copper finned heat exchangers. In the mid-1990s, RBI became a Mestek company. With the leverage of Mestek's marketing and technology resources, RBI was able to quickly grow and establish itself as an industry leader in copper finned-tube hot water supply equipment. The introduction of the near condensing XLF Series gives new meaning to "high output, small footprint" boilers with sizes up to 4000MBH. The condensing Fusion Series offers full input efficiencies of up to 98%. Select RBI units feature HeatNet control technology.



*Infinite Energy, high efficiency condensing boiler products, operates with combustion efficiencies as high as 97.3% and can be vented through standard schedule 40 PVC piping.*

**What's new:** Infinite Energy high efficiency condensing gas boilers, the latest addition to the RBI family of high efficiency condensing boiler products operates with combustion efficiencies as high as 97.3% and can be vented through standard schedule 40 PVC piping.

It's fully modulating LoNOx commercial-grade stainless steel burner configuration insures optimal efficiencies and superior performance throughout all firing rates.

The Infinite Energy's stainless steel heat exchanger assembly incorporates an integral condensate neutralizer with float switch protection for safe and efficient operation.

Units feature an exclusive on-board control platform allowing application versatility and master/member boiler communication of up to 16 units using outdoor reset as standard.

The direct-vent, sealed combustion Infinite Energy uses a small footprint with zero clearance to combustibles. Features:

- Up to 97.3% efficient
- Direct vent, sealed combustion
- Full modulation
- Pre-mix stainless steel burner
- Integrated boiler control platform (operate up to 16 boilers)
- ASME & ETL Certified
- Built-in condensate neutralizer and float switch protection
- Outdoor reset capable
- PVC venting approved
- Environmentally friendly — Low NOx.

**Weil-McLain**  
www.weil-mclain.com

**Company profile:** Weil-McLain is a leading designer, manufacturer and marketer of heating and cooling equipment in residential, commercial and institutional buildings. Building on a tradition of quality and innovation, the mission is simple: to design and build the best products on the market, to make them first and to make them last — for decades. In September of 2010, Weil-McLain will celebrate its 130th anniversary. With a corporate headquarters nestled alongside the beaches of Lake Michigan in Michigan City, Ind., and a state-of-the-art manufacturing facility, as well as a world-class customer training facility in Eden, North Carolina, Weil-McLain is a leader in the comfort heating industry. Weil-McLain is now taking its expertise beyond North America's borders, as well — with approximately 700 employees worldwide.



*Available in two sizes (550 & 750 MBH), the Ultra Commercial offers an efficiency rating of 94%. The Ultra Commercial is CSD-1 compliant and is lightweight and require minimal clearance, making for a fast & easy out-of-the-box installation.*

**New products:** Weil-McLain unveils Ultra Commercial: Available in two sizes (550 & 750 MBH), the Ultra Commercial offers an efficiency rating of 94%. The Ultra Commercial is CSD-1 compliant and is lightweight and require minimal clearance.

Key features include:

- 93.9% thermal efficiency
- 94% combustion efficiency
- CSD-1 Compliant is standard
- Lightweight and requires minimal clearance
- Fast & easy out-of-the-box installation
- Low NOx Certified
- PVC venting for direct vent and direct exhaust
- Compact design packaged boiler
- 20% - 100% modulation
- U-Control flexibility

**U.S. Boiler Co., Inc.**  
www.usboiler.burnham.com

**Company profile:** The Burnham Brand made by U.S. Boiler Company has introduced more new, high efficiency products over the last several years than any other company at any time in the history of hydronic heating. From new energy star® certified, gas-fired residential boilers — to high efficiency oil-fired boilers including advanced-design, three-pass, cast iron boilers — along with the industry's only 3-pass, oil-fired, steam boiler. Taken together, U.S. Boiler Company's expansive lineup of Burnham hydronic heating products boasts the highest average efficiency, exceeding 85%, with maximum efficiencies more than 95%.



*The Burnham brand continues to set the new standards for hydronic heating equipment in residential and commercial products for gas-fired and oil-fired applications — with water and steam boilers — and super high efficiency condensing boilers.*

U.S. Boiler Company now offers the broadest line of Burnham condensing boilers available from any manufacturer anywhere including both cast aluminum heat and stainless steel heat exchangers. Also, many Burnham products now boast exclusive leading-edge boiler control technology with both the Burnham IQ™ control system and the advanced Burnham Sage2™ boiler control system. Both systems have been specifically designed by U.S. Boiler engineers for unmatched control of Burnham boilers.

To provide this extensive and industry-leading product lineup, U.S. Boiler Company has invested in world class manufacturing facilities along with the Burnham Foundry, LLC in Zanesville, Ohio and new assembly operations in Lancaster, Pa. with state-of-the-art computer numerical controlled machines providing exacting product tolerances.



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**WATTS<sup>®</sup>**  
 A Watts Water Technologies Company

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# Backflow Prevention



An essential part of any  
domestic water system  
BY PETER KRAUT

**B**ackflow prevention protects the water we drink from the hazards connected to the potable system, including pollution (low hazard) and contamination (high hazard). It is required to separate private water supplies from public water supplies and to isolate individual systems or equipment within private water supplies. Backflow prevention became law under the Safe Drinking Water Act in 1974 and was amended in 1986 and 1996. The requirements specified in this act, however, are widely misunderstood by plumbers, engineers and code officials. With dozens of classifications and hundreds of models, it is not surprising that so much confusion exists.

## Air gaps

The air gap (ASME A112.1.2) is one of the most effective means of protecting the water supply. An air gap is merely the elevation difference between the faucet and the fixture. A lavatory, for example is fixed at no less than 1" above the flood level rim of the basin. A toilet has a fill assembly 1" higher than its overflow. But homeowners and designers alike often combine faucets with vessel sinks and replace the fill assembly on toilets. They could be thinking about aesthetics, or they may be rightly concerned about water conservation. Either way, when backflow prevention is overlooked, the results can be disastrous.

## Vacuum breakers

Even less thought is given to the simple hose connection vacuum breaker (ASSE 1011). This device should only be used to protect against back siphonage, although some jurisdictions will allow it for low head back-pressure. The integral type of vacuum breaker is preferred. If it is being installed on an existing device, the non-removable type with a break-off set screw should be used. This deters the user from removing it later. The user may not know that vacuum breakers are not very effective when a valve is installed downstream. It is not unusual for a

homeowner to leave a dirty hose on with a garden sprayer (valve) downstream. In an industrial application, where pressure washers and other pumps are likely to be connected to hose bibs, consider an industrial loop to be protected with a reduced pressure principle backflow prevention device (to be discussed later).

Integral vacuum breakers are also used on mop sink spouts with threaded hose ends. In a kitchen, an elevated vacuum breaker (ASSE 1001) is used to protect the water supply from a pre-rinse sprayer. It should be installed in accordance with its listing, typically 6" above the flood level rim of the fixture and 6" above the highest point that the sprayer can be raised. Irrigation too, is typically isolated with vacuum breakers. One for each zone is used to ensure that there are no valves downstream. Unfortunately, all too often they are installed at a low point in the landscaping. What the installer has overlooked is that the water in sprinkler piping above is standing on the vacuum breaker, which should be located 6" above the highest sprinkler so that water drains out at the end of the cycle.

These devices discharge water. In the case of hose bibs, draining to grade is generally acceptable. In the case of mop sinks, draining to the basin below will suffice. In the case of an independent elevated vacuum breaker, be sure to locate it over a fixture or drain board. Pressure vacuum breakers (ASSE 1020) and spill-resistant vacuum breakers (ASSE 1056) are also available. The latter may help eliminate nuisance water. A good example of an application for these is a swimming pool fill valve located below the water line. Note that both types need to be accessible for annual testing.

## Dual check valves

To protect public water supplies from low hazards in places such as single family residences, a dual check valve (ASSE 1024) is used. These devices are typically

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# Backflow

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buried with the meter. Similar vented devices (ASSE 1022) are used to isolate carbonated beverage dispensers and cappuccino machines. It is often necessary to provide manufacturer's information about these devices to the authority having jurisdiction (AHJ). If such a parts diagram is not available, additional external protection will need to be provided.

## Double check valves

Better protection for low hazards can be achieved with a double check valve (ASSE 1015). These valves do not discharge water, so they can easily be installed indoors. This is beneficial in freezing climates. In the past, it was common to install them in underground vaults, but this practice is diminishing, due to problems with vault construction, such as rainwater intrusion. Moreover, vault



ASSE 1022 vented devices are used to isolate carbonated beverage dispensers, for example. It is often necessary to provide manufacturer's info to the AHJ.

installations are difficult to access for annual testing.

For a long time, double check valves have been the standard for isolating fire protection systems. They protect against back siphonage and back pressure and are available with a "detector" meter to assist utility providers in monitoring water use. This small meter is fed by a  $\frac{3}{4}$ " pipe outside the main waterway. As a fire protection system, it should not register flow outside of testing or an actual fire. This allows for a reliable water supply in an emergency, without the obstruction of a water meter and its internal components. Another advantage of double check valves in fire protection systems is the low pressure drop, typically between 3 and 8 psi.

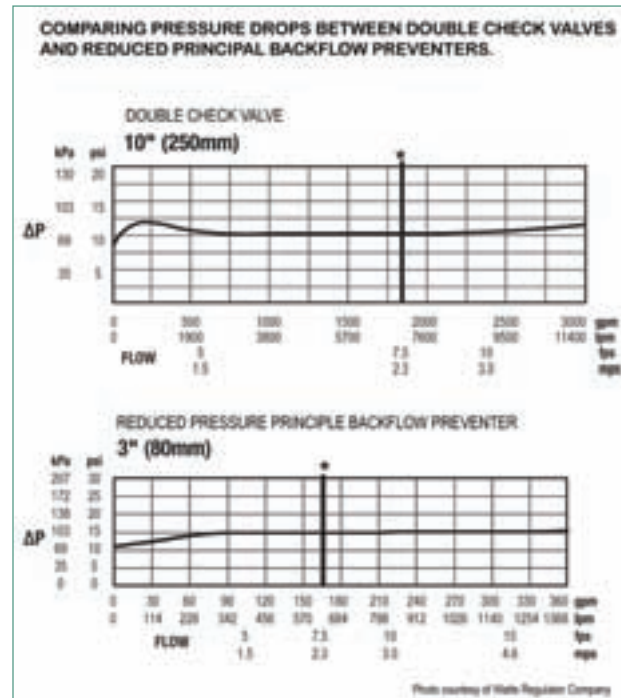
Double check valves are quite large. A typical assembly includes an elbow on the supply pipe, an OS&Y valve, two check valves, a second OS&Y valve and an elbow down to the distribution pipe. A good rule of thumb for determining length is 12:1. This means that a 3" double check valve is approximately 3 feet long from elbow to elbow. A 4" device is approximately 4 feet long and an 8" device is approximately 8 feet long.

## Reduced pressure principle backflow preventers

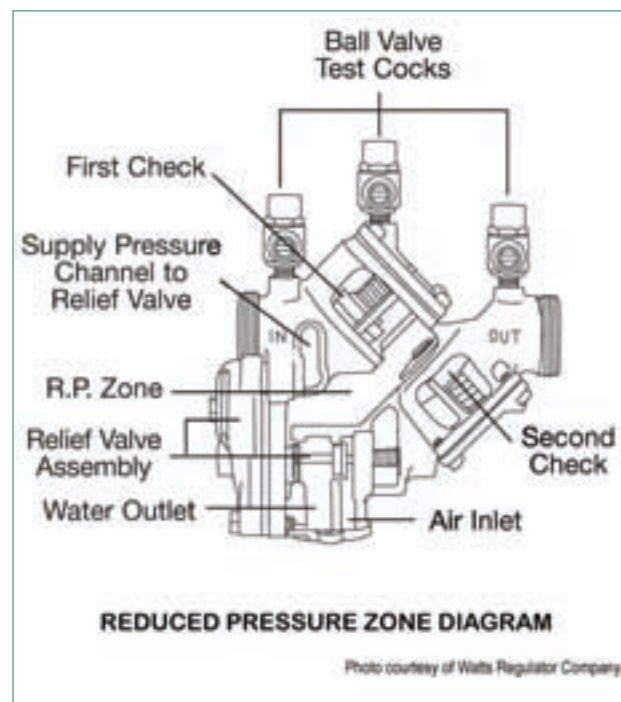
A reduced pressure principle backflow device (ASSE 1013) protects against high and low hazards in back pres-

sure and back siphonage conditions. There are many names and even more acronyms for these devices. RPPBFP, RPBFD, RPBP, RP and RPZ have all been used on plans. RPZ (reduced pressure zone) refers to a region

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Double check valves protect against back siphonage and back pressure and are available with a "detector" meter to assist utility providers in monitoring water use.



This diagram depicts a reduced pressure zone, which protects against high and low hazards in back pressure and back siphonage conditions.





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# Backflow

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of low pressure within the device. Essentially, a reduced pressure principle backflow preventer is a double check valve with an atmospheric vent between the two check valves. This vent keeps the middle region 2 psi lower than the supply pressure at all times and provides protection even when both check valves are fouled.

Since the middle zone is vented, this device will discharge water. This makes installation in a vault prohibi-

tive and installation in freezing climates a little more difficult. Installation requirements vary by jurisdiction but, generally speaking, the valve is installed at least 30" above grade with at least 12" clear below the assembly. There should be a clear, level platform for testing at least 30" deep on one side of the device. When installed indoors, a drain pan or manufacturer's drain kit should be installed and piped indi-

rectly to the sanitary sewer or to the outdoors where allowed.

Lengths are similar to double check valves. To reduce the space requirements, manufacturers have designed many configurations of these devices and double check valves. These include vertical installations, u-shaped devices and z-shaped devices. Stainless steel models provide compact sizes, lighter weights and, often, lower pressure drops. Many of these devices are also listed for compliance with lead-free laws.

With the reliability of reduced pressure principle devices, it's no wonder that administrative authorities are requesting them everywhere. They are the silver bullets of backflow prevention. Some jurisdictions have begun requiring them in fire protection systems. Because these devices can have a pressure drop up to 10 psi greater than a similarly sized double check valve, retrofit into existing systems is quite difficult without significant redesign. Doing so often necessitates the installation of a fire pump, making the fire protection system less reliable.

Using reduced pressure principle devices has also become commonplace for equipment inside a building. An ASSE 1022 device, internal to many carbonators, meets backflow requirements without the need to install a separate device on the water connection. Misuse of vacuum breakers has also built a lack of trust in their effectiveness. Proper specification and clear installation details will improve their reliability. Nevertheless, many authorities still require reduced pressure principle devices everywhere. Often, this is simply due to a lack of understanding. Building one's library with all referenced standards for backflow prevention can help reduce confusion while still protecting our valuable water supplies. ■

*Peter A. Kraut, P.E., is a licensed mechanical engineer in 22 states. He founded South Coast Engineering Group, near Los Angeles, Calif. in 2001. He can be reached at 818/224-2700 or at [pkraut@socoeng.com](mailto:pkraut@socoeng.com).*

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# The Water Reclamation Imperative

By Kevin Yoder

There are many reasons which one may consider recycling of greywater and rainwater harvesting. It is well known that we are a few short years away from having a water crisis in the United States. Many individual states are already rationing water and are considering or implementing mandatory rainwater harvesting. Many municipal sewer systems are tasked by the needs of the current populations and are being pressured by the federal government to update systems to keep wastewater from overflowing the treatment plants into waterways and polluting the water supplies. Many municipal freshwater suppliers cannot keep up with growth and struggle to meet the needs of industry and residential growth. The use for implementing greywater recycling and rainwater harvesting systems is very simple and relatively inexpensive.

Though more than 20% of the world's fresh water is in the five great lakes, fresh water is not always located where people live and the need for it is. It is said that the next "Great War" in the world will not be fought over oil or land, but for the rights to fresh water. One third of the world's population is already facing problems due to both water shortage and poor drinking water quality. The effects of it include massive outbreaks of disease, malnourishment and crop failure. The Colorado River that formed the Grand Canyon often never makes it to the ocean and Lake Meade is more than 60' low. These water supplies, and many like them, are depleted by human consumption and use, manufacturing, irrigation for farmlands and drought. Furthermore, excessive use of water has led to the degradation of the environment, costing the world billions of dollars.

Though water and water bills in many areas is relatively inexpensive, it is very common to see that your local sewer and water suppliers are in need of updating and enlarging or updating their failing infrastructures. What does this mean to you as a consumer? It means that the cost will go up. In commercial applications, the percentages will vary with the types of manufacturing and water used. But in the instances of tall buildings, recycled water can be used in the cooling towers to aid in air conditioning, as well as toilet flushing and irrigation. Many systems can be designed specifically for buildings and incorporate rainwater harvesting to partner with a greywater system, adding the ability to collect and conserve more water. When these systems are used the demands for fresh water are cut back and the outgoing sewer water is reduced saving money for you the consumer and the commercial costs for manufacturing are reduced allowing higher profitability, while being green at the same time.

The way greywater systems are designed is simple. They separate shower, baths, and laundry drains in residential homes and in commercial uses they can pull from

sinks, condensation lines from HVAC systems and rooftops. This water is filtered and chlorinated and stored in tanks. The tanks are monitored by sensors and pump systems and are calculated to meet the needs of the water supply. The systems are all calculated from the plans of your new building or can be retrofitted into existing buildings. From this we get the sum of the following information to consider: location of the building for average rainfall, and size of the roof structure that will be collecting rain; the number of people using the building and its purpose; and sources to collect greywater such as showers, bath, laundry units, A/C drains, and in many commercial cases water collection from manufacturing.



Commercial greywater systems can pull from sinks, condensation lines from HVAC systems and rooftops. This water is filtered and chlorinated and stored in tanks. Pictured above is a completed installation at a prison facility.

Everyone has a responsibility to save water so we can ensure that future generations can enjoy the same standard of living we enjoy today. There are economic benefits to being water efficient, but it requires us to reassess our relationship with water and learn to use it sparingly. We cannot increase our demands for fresh water without it having negative effects to the environment, society and the economy. ■

*Kevin Yoder is an associate with NuVale Products, Elkhart, Ind.*

Greywater recycling systems — such as **Brac Systems** ([www.bracsystems.com](http://www.bracsystems.com)) — can cut residential use of fresh water by 30 to 50 percent. Brac Systems and NuVale LLC ([nuvaleproducts.com](http://nuvaleproducts.com)) use a basic questionnaire that is filled out to calculate the areas that can be captured for recycling and specified to fill your needs.

# Smart, Efficient Near-boiler Piping

By Jim Erhardt

Modern hydronic heating systems have evolved in complexity over the last few decades, and — no doubt — we'll continue to refine and improve them. With this evolution, the need for proper piping design and technique has become more important. While simple systems, say a boiler and one or two baseboard zones, are pretty forgiving to piping error, systems that include radiant heat or fan coils aren't so tolerant.

A single piping error in a radiant system, for example, can lead to a system that refuses to deliver the expected comfort and efficiency, or simply just won't work at all.

It's little surprise to learn that most contractors who successfully install radiant heating systems have: a.) learned from a lot of expensive, time-consuming trial and error, or b.) have received the training to make sure the system goes in right and delivers the comfort and efficiency the customer expects. I know from personal experience: there's usually some of each in all of us.

As boiler technology has pushed operating efficiencies to new heights, the need for correct near-boiler piping has become more critical. "Near-boiler piping" generally refers to the piping and system components that are installed directly to the boiler and connect it to the distribution piping. These components typically include the system expansion tank, fill (pressure reducing) valve, air separator and in some cases depending on system design, a circulator and system purge.

The arrangement of these components in the near-boiler piping turns out to be a critical point of consideration when installing the system. Not only must these components be sized properly, but they must be installed in specific relation to one another to ensure proper system function and performance.

Working well is only one part of the picture, however. Future servicing of the system should be considered, too. A well-designed and installed hot water heating system will not only provide efficiency and comfort, but will also be highly serviceable.

Fortunately, most boiler manufacturers now offer their

preference for specific near-boiler piping in boiler installation manuals. These piping and component details are adopted from the Hydronics Institute; the recommended piping schematics help installers avoid myriad problems.

Most boiler manufacturers have adopted this piping arrangement, and it's no coincidence. The piping detail covers all of the concerns in a very efficient manner. Some of the key issues addressed are these:

Placement of the circulating pump with its suction port immediately downstream of the expansion tank. This ensures that the pump's developed head pressure is added to system fill pressure. This helps to control air problems.

The fill valve is piped to the system with the expansion tank. This safeguards the valve from fluctuating pressure caused by the pump. Without this step, unwanted fill water and excessive system pressure are sure to happen.

Optimal placement of the system air separator. There's no better place for this component than at the point of highest temperature and lowest pressure. This is where dissolved gasses are most likely to come out of solution and are most easily arrested and cast out of the system.

Inclusion of a system purge. After all, if a need arises, we want quick and efficient purging of an entire multi-zone system, including the boiler.

Taking this a bit further, some boiler manufacturers show an isolation valve between the system and the expansion tank. In a modern system with the pressure relief valve installed directly on the boiler, the 100-year-old engineering directive to not place a valve there — from the days when the relief valve was installed on the expansion tank — can now be ignored.

The benefit of this valve is to enable the easy servicing of a diaphragm-type expansion tank. A little-known fact about these tanks is that the air pre-charge must be checked annually. The only way to accurately do this is to isolate the tank from system fill pressure, meaning that the air charge can be accurately measured only when there's no system pressure on the wet side of the diaphragm.

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# Boiler Piping

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Just like a tire on that car or truck you drive each day, a diaphragm tank, over time, can (and most likely will) lose some of its pre-charge. Just like riding on a soft tire, under-inflation can lead to premature tank failure. With inclusion of an isolation valve, the critical service point of matching the air pre-charge to the system fill pressure becomes much easier to do.

In my years of attending and conducting contractor training seminars on hydronic design and installation, I've noticed that the old excuse of "this is the way I've always piped a boiler" is slowly giving way to the realization that there is indeed a "better way" to do this. After all, the near-boiler piping – like the arteries and valves nearest the heart – play an important role in seeing to it that the rest of the system gets what it needs. And, if not, you'll hear from your customers, all too often when it's late. And cold.



Jim Erhardt (left) and Dan Holohan discuss the Watts pre-assembled, pre-engineered Boiler Header Module package in relation to their shared passion for hydronic heating.

Dan Holohan's written some really good, really funny articles on this topic. And, hey, if our Yoda of the hydronics industry points to the wisdom of proper piping in the mechanical room, there's gotta' be something to it, Right?

A quick scan of boiler manufacturer piping diagrams reveals that a specific, smart, well-thought-out arrangement of components in the near-boiler piping will ensure highest operating efficiency and greatest ease of commissioning and service.

It's is our collective hope here at Watts that installation contractors will take these recommendations to heart. After all, you want your installed systems to perform as expected, and so your customers. If they're happy, you'll be happy, too. They sleep better. You do too.

And meanwhile, down in the mechanical room, that new mod-con is humming along beautifully, pumps, valves and other components are working in concert and warmth flows like hydronic heaven. ■

*Jim Erhardt is the national market manager, Watts Water Technologies.*

## It's Modular

While at this past AHR Expo, an editorial team from *Plumbing Engineer*, along with a TV crew and Dan Holohan, visited with Jim Erhardt on the show floor. Holohan and Erhardt have known each other for years, so they jumped right into an easy conversation about a topic they both know a thing or two about: near boiler piping.

As the big camera moved beyond the two of them, it includes a display at the very front of the Watts booth. The display shows a new near-boiler piping module that was the topic of Dan's and Jim's conversation and is sure to be of interest to hydronic heating professionals.

The preassembled, pre-engineered Boiler Header Module package consists of three Watts products; the PIPF flanged purge valve, the RBFF residential boiler fill fitting and the new AS-MB micro-bubble air separator in flanged configuration. These three products not only create technically perfect near-boiler piping, but also save the installation contractor considerable time doing this critical piping work by avoiding a bucket full of fittings to accomplish the same task.

The flanged micro-bubble air separator (AS-MB FL) features flanged connections — fixed on one side, swiveled on the other — that can accept the purge valve, a circulator or circulator flange. It uses a removable corrosion-proof coalescing media that resists temperatures to over 300°F. It also features the Watts DuoVent air vent assembly that can be easily removed for inspection or replacement. The micro-bubble air separator is also available in 3/4", 1" and 1 1/4" fpt connections.

The residential boiler fill fitting features a one-piece forged body and a three-way ball valve design that facilitates easy servicing of the system fill valve and expansion tank. It also includes a pressure gauge for convenient reference to system pressure when making adjustments to the fill valve, a component that, alone, replaces up to 18 individual fittings.

The flanged purge valve features a full port ball valve design, and integral purge port with tethered cap and a swivel flange connection. It is available in 3/4", 1" and 1-1/4" fpt sizes.

With this combination of products, boiler installations are faster, neater and more compact. The Watts module takes up far less room in the near boiler piping than it would if the pieces and fittings were assembled individually on site. The customer will no doubt appreciate the professional-looking installation as well as the improved efficiency and serviceability the Watts module offers.

All of the Watts components are available individually, collectively as the Boiler Header Module, or as components of other Watts hydronic packages. Learn more about them at [www.watts.com](http://www.watts.com). ■



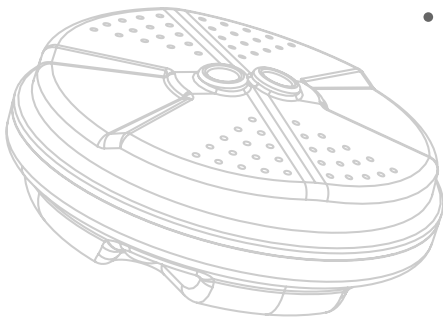


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# Product News

## Plumbing Engineer's Product of the Month



### Water management software

Updated software interface for Master-Trol Electronic Water Management Software controls valve usage and limits use of plumbing fixtures. The updated software features greater ease-of-use, providing real-time information about toilet, faucet, and shower activity and detailed reports on water consumption. **Acorn Engineering Company.**

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### Hand dryers

Aerix Series Hand Dryers dry hands in 10 to 15 seconds — about three times faster than most hand dryers — using a maximum 1,150 watts of power. Fan speed and run time can be adjusted to reduce noise and energy usage. An adjustable infrared sensor provides touch-free hand drying, while an automatic disconnection system



shuts the unit off after 60 seconds of continuous use. **Bradley Corp.**

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### Trench drains

Company offers a broad selection of trench drains for your job site requirements. The Smith/ACO Polymer Concrete and Fiberglass trench drain series and the Enviro-Flo® Polypropylene trench drain series can be utilized to improve drainage flow covering a variety of commercial applications. An assortment of grates and covers are available, which allows architects and designers to enhance the appearance of the projects. **Jay R. Smith Mfg. Co.**

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## HYDRO-CORE



### Forged brass manifold

A revolution in boiler installation and piping — Hydro-Core™ is a patent pending, fully fabricated forged brass manifold that combines precision crafted closely spaced tees with Webstone's Isolator® w/Rotating Flange & Drain™. Designed specifically for hydraulic separation, pump isolation, and purging the near boiler piping or secondary circuit loops. **Webstone.**

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### Cased air coil for geothermal

Company offers new Tranquility® (TAC) Cased Air Coil Series with sizes 026, 038, 049 and 064. Tranquility indoor coils are designed and matched for use with Tranquility indoor and



outdoor geothermal split systems. Using EarthPure® HFC-410A refrigerant, the TAC exceeds federal requirements for the 30% tax credit on installation costs when paired with a Tranquility split unit. Also, when paired with a split, the TAC exceeds ASHRAE 90.1 and Energy Star 3.0 efficiencies. **ClimateMaster.**

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### TempTAP™ thermostatic faucets

Commercial and institutional ASSE 1070 listed TempTAP™ thermostatic faucets feature a powerful paraffin actuator, which controls both temperature and pressure. With TempTAP™ specifying lavatory tempering is easy because there is no need for a separate thermostatic valve under the sink. The tempering is done inside the faucet just inches from the user where it is most effective. **Powers, a Watts Water Technologies Co.**

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### Dry-type sprinklers

The Series LFII Dry-Type Residential Sprinklers include the 4.9 K-factor Recessed Pendent, 4.9 K-factor domed concealed pendent, and 4.4 K-factor horizontal sidewall and recessed horizontal sidewall. The sprinklers are UL Listed and designed for use in residential occupancies per NFPA 13D, 13R, and 13. Each sprinkler has undergone special testing to meet UL1626 test criteria for dry pipe and preaction systems. **Tyco Fire Suppression & Building Products.**

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## Plumbing Engineer's Product of the Month

### The HydroVantage™ flush valve

Designed to create energy during each flush cycle. As water passes through the valve, the turbine spins creating electrical energy which is then stored in a rechargeable cell. This stored energy then powers the electrical needs of the flush valve for subsequent flushes. It eliminates the need for external electrical power or battery replacement for 10+ years under normal operating conditions. The HydroVantage™ flush valve provides optimal energy efficiency, low maintenance and ease of installation compared to other available generator products.

Environmental Trending™ along with 4.0 Sensor Technology™ continuously monitors ambient light levels and traffic patterns within the restroom eliminating false flushing while maximizing power savings. **Zurn Engineered Water Solutions.**

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### Structural sway brace attachment

Universal Sway Brace Attachment permits a secure, non-friction connection without drilling or welding to structural members. The



Fig. 828's unique patented design allows for attachment of seismic bracing to wide flange beams, including I-beam, open web, welded steel trusses and other structures up to 7/8-inch thick, with a maximum design load of 2,015 lbs. both along and across the beam. The one size, stable three-point attachment fits any beam width. TOLCO engineered break-off bolts allow for visual verification of proper installation torque. **TOLCO.**

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### SolPak solar water heating

Company has added two new environmentally-conscious solar water heating solutions to the company's line of SolPak active solar water heating systems: tankless gas products and Rheem Marathon™ storage tanks (pictured). With these additions, Rheem SolPak now provides contractors with an enhanced selection of energy-efficient solar options that can be tailored to any gas or electric job. **Rheem.**

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## Product Application

# Detailed cost study proves advantage of stand-alone over multipurpose fire sprinkler systems

By Eric Price

The home building industry continues to be divided when it comes to identifying the preferred residential fire sprinkler system design — stand-alone vs. multipurpose. Although most professionals agree that two independent systems offer superior integrity, proponents of multipurpose systems have long claimed a cost advantage in integrating the plumbing and fire sprinkler systems.

In theory, a multipurpose system appears to be the more economical choice under the premise that it requires less material and can be installed by a single contractor. However, a recent side-by-side comparative cost study has contradicted this premise.

A two-story, single-family, 2,200-square-foot (4,400 sq feet including finished basement) home in Madison, Wisconsin, was chosen as the test site. Blueprints were created to design the home's fire sprinkler system three different ways: a BlazeMaster® CPVC stand-alone system; a combination BlazeMaster/FlowGuard Gold® CPVC multipurpose system; and a full PEX multipurpose system using a tee and branch fire sprinkler design. Three local contractors were asked to bid on the various designs in order to provide prevailing market rates and ensure the most competitive bid.

In computing the total installed cost for the three options, it was confirmed that the BlazeMaster CPVC stand-alone system was the most cost-effective option. Although the cost differential of the BlazeMaster CPVC stand-alone system over the multipurpose alternatives was nominal, it does put to rest the perception that multipurpose systems offer a significant cost advantage. The actual cost comparisons are: (Pricing includes hot and cold water plumbing material & labor)

- BlazeMaster CPVC stand-alone system \$14,109;
- BlazeMaster/FlowGuard Gold® CPVC multipurpose system \$14,506;
- PEX multipurpose system (tee and branch design on the plumbing system) \$14,857; and
- PEX multipurpose system (manifold design on plumbing system) \$15,170.

Looking at the fire sprinkler side of the system only, the following comparisons were made:

### BlazeMaster CPVC stand-alone

- 480 ft of 1" BlazeMaster pipe with 43 heads;
- 70 hours of labor;
- Total installed cost of \$7,210 (\$1.66 per square foot);

### BlazeMaster/FlowGuard Gold CPVC multipurpose system

- 480 ft of 1" BlazeMaster pipe with 43 heads;
- 82 hours of labor; and
- Total installed cost of \$8,282 (\$1.91 per square foot).

### PEX looped multipurpose system

- 800 ft. of PEX tubing and fittings with 43 heads plus the added cost of a pump required to deliver enough water pressure through the PEX system (this was more cost effective than up-sizing the pipe and fittings. If the pump was not used, more fire sprinkler heads would have been necessary because of the smaller CTS pipe); and
- 77 hours of labor; and
- Total installed cost of \$10,017 (\$2.31 per square foot)

To understand how and why the CPVC stand-alone system fared so well economically, it's important to consider the expense of the additional tees and transition fittings needed to create the multipurpose systems. These items not only add to the total material costs but also, to a lesser extent, to the labor costs.

It's also important to note the impact of the colder climate at the Wisconsin test site. Had the project been located in a warmer climate where slab homes are more common, the cost savings of the CPVC stand-alone system over the multipurpose options would likely have been more dramatic. Since the Madison home has a basement, the fire sprinkler lines were run in the same area of the home as the cold water plumbing lines. Had there been no basement, the fire sprinkler pipes would have been run through the attic. This would have required additional feet of piping to connect with the plumbing pipe below the walls.

Although some building professionals may be surprised to see the cost results, those who have intimate knowledge of the mechanical properties of CPVC and PEX should understand why the BlazeMaster CPVC systems fared so well. If the two piping systems could be designed the same, the final costs might look different. The reality, however, is that PEX and CPVC systems do not lay out the same because PEX pipe has to be looped. In some homes, this practice of going up and looping back down may require twice as much PEX pipe to be used compared with a comparable CPVC design.

In addition, the internal diameter of a PEX pipe is significantly smaller than a similarly sized CPVC pipe. In fact, the

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internal diameter of a 1" PEX pipe is actually less than the internal diameter of a ¾" CPVC sprinkler pipe. That's because CPVC sprinkler pipe is manufactured to IPS (Iron Pipe Size) SDR 13.5 dimensions to allow for increased water flow. PEX pipe, on the other hand, is manufactured to CTS (Copper Tube Size) SDR 9 dimensions. As a result, more piping loops are typically required to deliver the same amount of water through a PEX system. Or, as in the case of the Madison test site, a pump was necessary to meet minimum flow requirements.

It's also important to note that the cost savings sometimes claimed by proponents of PEX piping results from the pipe's flexibility, which translates into a faster, easier and, thus, more economical installation. This is true for PEX pipe in ½" diameter. However, ½" PEX pipe is not used in multipurpose systems for the reason just mentioned — its smaller internal diameter. Generally, ¾" PEX pipe is the absolute minimum size that can be used. But in many cases, ¾" PEX doesn't work hydraulically, so 1" PEX pipe is needed to deliver sufficient water pressure. The reality is that, at 1" diameter, PEX pipe loses much of its flexibility and becomes more difficult to install, thus losing any labor cost savings it might have offered. PEX pipe in diameters greater than 1" is extremely rigid, bulky and comparatively expensive to purchase.

No backflow preventer was included because, contrary to popular belief, less than 20% of systems require them. If a backflow preventer was included, it would have added less than \$100. Another even less expensive option would have been to hook a nearby line to a toilet. This arrangement is known as a passive purge system.

With something as important as a life safety system, cost is not the only criteria when identifying the best piping material or system design. A safe, reliable performance is everyone's priority.

That's why some jurisdictions don't allow any type of multipurpose system. California, for example, a state that has required fire sprinkler systems in homes in various cities for many years, continues to favor stand-alone systems in its code. A major reason is the difficulty in hooking up an alarm bell with a multipurpose system since it's difficult to detect the difference between water flowing to help extinguish a fire versus a toilet flushing. In addition, any repairs or additions made to the plumbing line require the fire sprinkler system to be shut down in a multipurpose system. This presents a potentially risky situation.

Also relevant with regard to safety performance are the flame and smoke properties of the piping materials used in the various systems. CPVC, the only non-metallic piping material approved for both stand-alone and multipurpose systems, will not sustain burning. PEX, on the other hand, which is only approved for use in multipurpose systems, will continue to burn long after the flame has been removed.

That is not to say that a multipurpose system does not have its advantages. The purpose of this article, however, was to prove that cost savings is not one of those advantages. ■

*Eric Price, a 30+-year veteran of the fire sprinkler industry, is president of Engineered Fire Systems, Inc.—the company responsible for designing the various fire sprinkler systems at the Madison test site. Before starting his Grass Valley, California-based fire protection design company in 1984, he spent a number of years working directly with area fire departments and fire marshals to teach them about the mechanics of residential and commercial fire sprinkler systems. Engineered Fire Systems provides engineering, consulting and plan review services to developers, general contractors, building owners, and fire departments.*



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