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# Plumbing Engineer®

A TMB Publication

August 2009

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Peter Kraut, president of South Coast Engineering Group, Inc., conducts a field observation at the Regal Cinemas in Los Angeles.

## Also inside

- The PEX Quotient
- Website Spotlight

# Fact:

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# Fact:

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Plumbing Engineer
A TWB Publication

## FEATURES

### Engineering Spotlight: Peter Kraut

Continuing on the success of Plumbing Engineer's "Engineering Spotlight," PE recently spoke with Peter Kraut, PE, CPD, president of South Coast Engineering Group, Inc., Calabasas, Calif. **Read more on page 28**

### The PEX Quotient

The history of plumbing goes back thousands of years. Moses of Biblical fame struck a rock about 1,500 BC and became the first water utility. **Read more on page 34**

### A Model Plumbing Code, Part II

**Part II of Daniel Cole's "The Intent of Recommending a Model Code, Part II can be found online at *www.plumbingengineer.com*.**

## COLUMNS




***On the cover**: Peter Kraut, president of South Coast Engineering Group, Inc., conducts a field observation at the Regal Cinemas in LA.*



## INDUSTRY NEWS & OTHER DEPARTMENTS



**Online** | This month's Modern Hydronics column from Paul Rohrs can be found online at www.plumbingengineer.com.


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# From the desk of Tom Brown

## Don't count magazines out

On March 17, the Hearst Corporation printed the final copy of its Seattle Post-Intelligencer newspaper and confirmed plans to turn into an online-only newspaper, making it the largest U.S. daily newspaper to shift to an entirely digital news product. Preceding that was the Christian Science Monitor's announcement last year that it was scrapping its daily print issue to focus on running its Web site. And, in the phcp industry, recent news has surfaced regarding other magazines that are also going (or have already gone) the digital route.

Naturally, some people see this as the future of magazines and newspapers; however, while the "print is dead" meme has been hashed out countless times in the media world since the advent of the World Wide Web, few experts are willing to predict that print magazines will become dinosaurs anytime soon. In fact, the publishing industry is one that constantly reinvents itself to serve the evolving needs of its readers and advertisers, and we at TMB Publishing are no different. And while no one in the business will argue that ad dollars are moving online, it's extremely important to note that a lot of those dollars are still falling into the magazine industry bucket.

Of course, none of that really means anything if publishers operate on a faulty business platform — specifically one that seriously hinders efforts toward selling physical ad space in their printed magazines, which forces them to go digital on a permanent basis. Unfortunately, this is already happening in the PHCP industry, where one publisher has announced digital issues being offered in place of several printed issues throughout the year, and another publisher completely replacing its print magazines with digital offerings. In both of these cases, the move to digital is strictly advertising-based, meaning it's because of a lack of advertising and not one for the sake of being cutting edge or from a position of strength in the marketplace.

The advantages of printed media are many. For the advertiser, a printed magazine ensures them that their corporate message will be delivered to a select and definitive audience on a timely basis. Additionally, it means that their carefully crafted ad will be find a prominent fixture alongside quality editorial, rather than becoming lost within a sea of rotating banner ads, media rich videos and other online offerings all competing within the same digital space for visitor attention. Also, print ads provide for more accurate and detailed metrics, such as audited and qualified circulation, reader demographics, geographical breakouts and more — all plausible measurements of whether an ad in one magazine will have more impact than in another.

Speaking in terms of our readers, they read *Phc News*, *The Wholesaler* and *Plumbing Engineer* in print every month. They like the format of a printed magazine. They like the feel of it, the touch of the paper, slipping page after page through their fingers. They even like the surprise of finding a story in a section they wouldn't have sought out in an online search or browsing session. How do we know this? A recent survey conducted by *The Wholesaler*, revealed that 85% of wholesalers, contractors and engineers still view trade publications as a top viable choice for industry topics, news and product information.

Additionally, our magazines have one great strength that digital publications will never be able to match: They've not been commoditized. There are many online outlets that are reporting the same things. Magazines, such as those printed by TMB Publishing, have a specific voice that reaches a specific targeted audience, and in this era voice is values; our magazines create content with unique value, and because of that we don't plan on going completely digital any time soon. ■


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**Editorial, Advertising, Production, Accounting and Administrative Offices**

1838 Techny Ct.
Northbrook, IL 60062
(847) 564-1127 • Fax: (847) 564-1264
E-mail: *info@tmbpublishing.com*

**Owner**
Tom M. Brown

**Editorial & Production Staff**
John Mesenbrink, *Editorial Director*
Cate C. Brown, *Production Manager*
Mark Bruno, *Art Director/Prepress*

**Contributors**
Timothy Allinson, P.E., *Designer's Guide*
Richard Schulte, *Fire Protection*
Ron George, CIPE, CPD, *Code Update*
Bob "Hot Rod" Rohr, *Green Systems*
Paul Rohrs, *Modern Hydronics*
Bristol Stickney, *Solar Solutions*

**Sales Staff**
Brad Burnside, Publisher
*East*
1838 Techny Court, Northbrook, IL 60062 Phone: 847/564-1127
Cell: 224/659-3984
Fax: 847/564-1264
E-mail: brad@tmbpublishing.com

David Schulte
*Midwest, South and E. Canada*
1838 Techny Court, Northbrook, IL 60062
Phone: 847/564-1127
Cell: 847/420-4686
Fax: 847/564-1264
E-mail: dave@tmbpublishing.com

Diane Spangler
*West, Texas and W. Canada*
PO Box 9802, Fountain Valley, CA 92728 Phone: 714/839-6700
Fax: 714/839-6777
E-mail: diane@tmbpublishing.com

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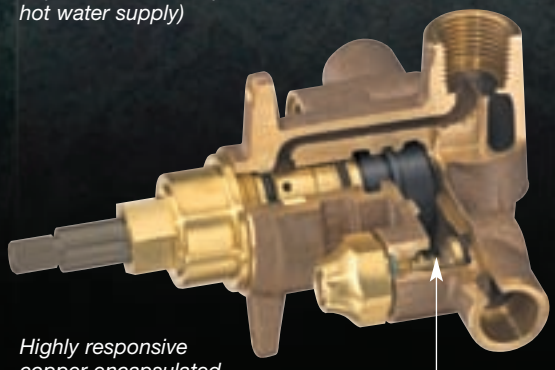

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# Industry News

## NFPA awards scholarships

THE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) Fire Safety Education Memorial Fund has made it a tradition to award students each year with scholarships to recognize their pursuit of careers in fire safety. This year four scholarship recipients have been selected based on their contributions to fire safety activities, as well as their academic achievements and leadership abilities.

**Justin Perry**, a junior in the Fire Protection Engineering program at the University of Maryland, was awarded the Arthur E. Cote Scholarship. Perry, who is currently working toward a combined bachelor's and master's degree, serves as one of the Clark School of Engineering ambassadors. He will be participating in fire protection analysis at Dominion Energy this summer and plans to become a professional engineer.

**Yaqiang Jiang**, a master's student at the University of Science and Technology of China, received the David B. Gratz Scholarship for his work in the college's State Key Laboratory of Fire Science program. Jiang has completed a research project involving smoke control in tunnel fires, and some of his results have been published in scientific journals. After receiving his master's, Jiang plans to study at the BRE Centre for Fire Safety Engineering at the University of Edinburgh for his Ph.D.

**Gregory Gorbett**, the recipient of the John L. Jablonsky Scholarship, has earned bachelor's degrees in both forensic science and fire science and has received a master's degree in executive fire service leadership. He is currently earning a master's degree in Fire Protection Engineering at Worcester Polytechnic Institute and has maintained a 4.0 GPA while volunteering as a firefighter. Gorbett plans to continue his career path as a professor and fire and explosive investigator.

**Beau Stevens**, a student at Oklahoma State University's Fire Protection and Safety Engineering Technology program, was awarded the George D. Miller Scholarship. Currently a training officer intern at Stillwater Fire Department in Oklahoma, Stevens has also been a consistent recipient of the Dean's and President's Honor Roll and has been an active student leader in on-campus fire protection and safety activities. In the future, he hopes to progress through a career as a firefighter, training officer and fire marshal.

## Lochinvar develops new Shield website, resources

LEBANON, TENN. — In addition to offering plumbing contractors commercial water heater solutions with the recently introduced SHIELD, Lochinvar has also created a new micro Web site — http://shield.lochinvar.com — that features a host of new tools and resources. Designed to help contractors conveniently access extensive information about the SHIELD and to fully understand its benefits, the new SHIELD Web site is now available to interested plumbing professionals.

## NIBCO® launches lead-free micro site

ELKHART, IND. — With a January 1, 2010, deadline for lead-free compliance in California and Vermont quickly approaching, NIBCO INC. launched a new website www.NIBCOleadfree.com, to help keep customers informed of important lead-free product updates. NIBCO's "Lead Free Resource Center" is a source for those in the plumbing industry who do business in California and/or Vermont. Both states will begin requiring all plumbing products that convey or deliver water for human consumption to be lead-free beginning January 1, 2010. Visitors can download NIBCO's Lead Free Reference Guide, glance through an ever-expanding list of FAQs and stay abreast of the latest product info.

## Quietside Corp. launches new website

CARLISLE, PA. — Quietside Corp., a master distributor of HVAC products in North America, has announced the launch of its new user friendly website — www.quietside.com.

The company recognized the need to redesign their current website not only to share key information with their current whole sale distributors and contractors that install their units daily, but also to inform home owners of the growing need to install energy efficient products in their homes.

## City of Santa Fe funds solar start-up

THE CITY OF SANTA FE is taking advantage of its long history in the solar industry by helping to launch a local, renewable energy company. SolarLogic, LLC, a new, solar hydronic technology and manufacturing company founded in Santa Fe in 2008, is leading the way in the creation of seamless, easy-to-install solar heating systems. As an investment in job creation and the local green economy, the City of Santa Fe's Economic Development Division has awarded SolarLogic a grant of $30,000.

SolarLogic's mission is to increase and speed the adoption of residential and commercial solar hydronic heating systems worldwide by manufacturing and selling a family of products that will spur the development of a large, new generation of system installers. The Company is developing and will manufacture and distribute two, flagship products: the SolarLogic Integrated Controller (SLIC) and SolarLogic Assisted Solar Heating Design (SLASH-D). Utilizing the SLASH-D web-delivered design service and the SLIC controller, an individual with an existing heating and/or plumbing business but no previous specific training in solar hydronic heating, will be able to specify, quote and install a custom, solar hydronic system.

SolarLogic was founded by the principals of Cedar Mountain Solar, one of Santa Fe's leading solar heating design and installation firms, along with a third individual from Santa Fe County. Along with significant new innova-

*More Industry News on page 10*

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# Industry News

*Continued from page 8*

tion, SolarLogic is successfully commercializing design concepts developed from the extensive knowledge and years of experience gained here in Santa Fe by the professionals at Cedar Mountain Solar.

Further information regarding SolarLogic can be viewed on the company website at www.solarlogicllc.com or email info@solarlogicllc.com.

## Sioux Chief hosts emerging plumbers

PECULIAR, MO. — Sioux Chief Mfg Co., Inc., recently hosted 84 plumbing students and their teachers to their facilities south of Kansas City, Missouri. The SkillsUSA participants were able to experience first hand, the manufacturing capabilities and innovative processes that produce many of the top-quality products they install.

The 45th annual National Leadership and Skills Conference (NLSC) was again held in downtown Kansas City, Mo. from June 21 through June 26. SkillsUSA is a national organization serving teachers and students from high school and college, who are preparing for careers in technical, skilled and service occupations, including plumbing occupations.

## NFPA 1600 available through iPhone app

THE NATIONAL FIRE PROTECTION ASSOCIATION (NFPA) announced the availability of an iPhone application for the latest edition of NFPA 1600, Standard on Disaster/Emergency Management and Business Continuity Programs, which has been adopted by the Department of Homeland Security.

Through the iPhone application, NFPA 1600 is fully searchable and is equipped with active links, as well as phone numbers for NFPA and other agencies involved with emergency management programs, risk mitigation and response. The 2007 edition includes major revisions to the listings of resources identified in the annexes. It also includes incorporating material on prevention as a new program element, as well as the latest rules for emergency management, mitigation, preparedness, response and recovery.

## Halsey Taylor drinking fountains selected for PlaNYC Initiative

OAK BROOK, ILL. — On June 12, 2009, Mayor Bloomberg attended a ribbon-cutting ceremony at PS 205K, one of many New York City public schoolyards that have recently been renovated as part of the PlaNYC 2030 Initiative, a comprehensive sustainability plan for the city's future. A collaboration between the New York City Department of Parks & Recreation, the Department of Education and the non-profit The Trust for Public Land, the PlaNYC Schoolyards to Playgrounds Program aims to increase the amount of open space in underserved neighborhoods throughout the five boroughs of New York City and ensure that all New Yorkers live within a 10-minute walk of a park or playground.

Along with the multitude of improvements and additions being made to the schoolyards, many will be updated with custom outdoor drinking fountains from Halsey Taylor. The PlaNYC team has chosen to install new Endura™ Steel Wall-mount Drinking Fountains (4705), customized with a specially designed "nyc water" logo and attractive blue color, in many of the newly created parks throughout the city.

## Top water heater brand named study

AMBLER, PA. — For the third year in a row Bradford White Water Heaters has been named the tank type water heater most purchased and recommended by contractors, according to an independent industry study conducted by Clear Seas Research. The annual report provides an in-depth analysis of the water heater industry including trends in product, installation, replacement and servicing, brand selection factors, brands most often purchased, product information resources and more. Bradford White was also the brand most chosen and recommended in the 2006 and 2007 research studies. ■


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# Designer's Guide

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

## School of hard knocks

Some people hate to admit their errors. This is usually because of insecurity or ego. On rare occasion I think it is the result of a unique form of intelligence — an unshakable belief that an error is not possible. I had an old boss who never made a mistake, because even when he did, he could convince an entire room full of very bright people that he had not — something or someone else was to blame. Unfortunately, I don't play that game very well. In fact, I never even try to play it. I tend to wear my mistakes proudly like war wounds or badges of honor. Call me stupid, but there it is.

Often when one has made a mistake designing a plumbing system, the symptom of the mistake shows up as noise. Water hammer, cavitation, pipe vibration — all of these produce the symptom of noise. Left uncorrected, that noise, which is usually produced by unfriendly pressure conditions, can lead to an even worse problem such as a pipe rupture and flood, pump failure, valve failure, etc. Where there's smoke there's fire, and in plumbing, where there's noise there's pressure problems.

I'm a big fan of pilot-operated pressure reducing valves (PRVs), such as those made by ClaVal, Watts and Wilkins. They are not cheap, but I find the fact that they maintain a constant downstream pressure regardless of inlet pressure and flow fluctuations invaluable and well worth the premium, especially where pressure is sensitive to the fall-off associated with direct-acting PRVs. One thing you do have to be careful about with these valves — as with any PRV — is cavitation. If you ask the valve to reduce pressure to an excessive degree you enter the cavitation zone — first the cavitation noise zone followed by the cavitation damage zone as pressure differential increases.

The other day I got a call from the foreman on one of our projects — a recently completed building that was already in operation. He was busy balancing the hot water return system when he heard an alarming sound coming from the PRV closet. He opened the closet and found that at least one of two PRVs on the cold water PRV station making a lot of noise. As soon as he told me this I knew it was cavitating but found it strange that it was only occurring on the cold water rig and not the hot water rig.

A check of the design drawings revealed my mistake. The hot water rig was reducing pressure down-fed from a rooftop PRV rig that delivered a steady 84 psi to the hot water PRVs. In contrast, the cold water PRV rig was being supplied by an unregulated pump discharge riser. At shut-off head, this floating riser could supply as much as 160 psi to the cold water rig. Outlet pressure for both rigs was set to about 37 psi. Immediately I realized that the CW rig was in the cavitation zone during low flow conditions as the pumps approached shut-off head. Oops.

The first thing I did was solicit the help of the manufacturer, in this case ClaVal, which is made locally here in Newport Beach. The engineer I spoke with immediately confirmed that the valves were cavitating, and just as quickly shocked me by saying, "You'll need an anti-cavitation kit for both valves." Anti-cavitation kit? I never knew such a thing existed. I feared the remedy was going to be much more complicated and expensive that an anti-cavitation kit for a few hundred dollars. Live and learn. I really dodged the bullet on that one.

In a nearby building — another recently completed project — one of the condo owners was complaining of plumbing noise and water flow fluctuations from his fixtures. This particular building had street pressure water supply to ground floor duplex condos with a pumping plant that sent water to the high-rise condominium units above. I suspected the source of the problem was associated with the main water supply, so the first place I looked was at the incoming water service.

This building had a very typical water supply configuration with a 6" backflow preventer (BFP) immediately inside the building, street-pressure take-off downstream of that, followed by the domestic water pumping plant. The pumps were operating normally, so I went to the homeowner's unit to witness the issue about which he was complaining.

The condo owner, a young lawyer with his own practice, turned out to be much nicer than I feared, and not at all threatening (from a litigious perspective). He was thrilled that I was concerned about his problem. He demonstrated the flow and pressure fluctuations at various fixtures. I called my project manager via cell phone who was positioned at the pumping plant. As he turned the pumps on and off, I witnessed the flow fluctuations and knocking noises that correlated with the pump operation. I soon realized that the knocking sound was the reduced pressure zone (RPZ) check valves opening and closing as the pumps cycled, and the flow and pressure fluctuations were the result of the BFP fall-off.

The easiest fix to this problem would be to take the street pressure zone off the water service ahead of the backflow preventer with a braided flex to dampen the BFP check valve noise. If the units were stand-alone two story structures this would not be an issue, so in theory the presence of the building above shouldn't matter, but this is yet to be confirmed with the City. The alternative is to repipe the street pressure supply to the pump discharge with a PRV rig. I will soon know the required solution.

Speaking of backflow preventers, another interesting problem came up on a project that is worth sharing. Another building recently occupied — a hospital — had its BFPs tested by a registered testing agent and he found them to be discharging to an unusual degree. He promptly informed the facility's personnel that "the building had major plumbing problems"! This, of course, created a panic and I was sent in to find the problem.

Since the BFPs supplied the domestic water pumps directly, this was the obvious place to start my forensics. After watching the pumps operate for a while, turning each

*Continued on page 14*

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of the three pumps on and off, I realized that when the lead pump shut off there was a sudden increase in suction-side pressure. This of course raised the pressure to the BFP outlet higher than the street pressure inlet, causing them to discharge substantially with each cycle of the lead pump.

The lead pump was piped to the pneumatic tank through a ¾" check valve. This check was intended to prevent the pumps and suction piping from being exposed to the elevated pressure in the tank after lead pump shut-off. Since the suction piping was clearly being subjected to tank pressure after pump shut-off, the obvious conclusion was that the ¾" check had failed. This proved to be the case, and a minor fix resolved the "major plumbing problems in the building."

One last note about the same building and backflow preventers: This building also had a ¾" BFP serving a steam gun. The pipe serving the BFP failed one evening causing a minor flood. After fixing the pipe we witnessed the operation of the steam gun and associated BFP. Whenever the steam gun was turned off (via a quick-closing valve) the BFP was subjected to water hammer. This water hammer sent the BFP into a harmonic oscillation with the check valves alternating frantically, spitting like crazy, and the supply pipe whipping around in the basement ceiling like a 100-foot long angry snake. This had been occurring unobserved over previous weeks, so it's no wonder the supply pipe eventually failed.

Investigation into the BFP literature revealed something I had never known before. The installation manual states (probably so for all BFP manufacturers) that for a dead-end installation serving equipment with periodic flow requirements, a check valve may be required ahead of the backflow preventer. Well, installation of a check valve ahead of the BFP did resolve the harmonic vibration so I recommend doing so whenever you have a small BFP serving a boiler, cooling tower, or any equipment with a quick closing valve. Note that a water hammer arrester after the BFP will not necessarily do the trick. ■

***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.*

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**Circle 11 on Reader Reply Form on page 37**

# Code Update

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

## What are safe hot water temperatures?

I am often asked, "What is a safe hot water temperature for domestic hot water?" If you read the model codes, it states the maximum hot water temperature for a shower or bathtub is 120 degrees Fahrenheit. If you read the warning labels on the side of most water heaters the maximum hot water temperature is 120 degrees Fahrenheit on some labels and 125 degrees Fahrenheit on other labels. The 125 degree limit probably allows for some temperature loss before the hot water gets to the fixtures. Most water heater literature and warning labels mention the availability of thermostatic mixing valves or automatic temperature compensating valves and they recommend their use. If you look at many of the industry standards for shower mixing valves, they state the valves must have limit stops that are adjustable to limit the maximum hot water temperature to 120 degrees Fahrenheit. The testing in the standards gives test criteria for testing the shower valves to these limits.

I have served on the working groups for several plumbing industry standards committees for temperature actuated mixing valves and shower valves and it is generally agreed that 120 degrees is the maximum, safe hot water temperature. I also have served on hot water system design standards committees where the participants had agreed that maximum domestic hot water temperature from plumbing fixtures used for bathing and washing purposes should be 120 degrees Fahrenheit. There were a few exceptions for bidets, sitz baths and whirlpool tubs that had temperatures lower than 120 degrees Fahrenheit for the recommended maximum temperatures to prevent scalding. It also should be noted that some other uses like commercial dishwashers and laundries may need temperatures higher than 120 degrees Fahrenheit. There were two temperatures discussed for each fixture during the design standard meetings. One was the "use temperature" and the other was "the maximum temperature" to prevent scalding.

It's generally agreed that 120 degrees Fahrenheit is the maximum safe hot water temperature that should be delivered from a fixture. Therefore hot water above 120 degrees Fahrenheit can be considered hazardous. Model codes address this in various code sections.

The 2009 edition of the International Plumbing Code has the following language:

*2009 IPC Section 102.2 — Existing installations. Plumbing systems lawfully in existence at the time of the adoption of this code shall be permitted to have their use and maintenance continued if the use, maintenance or repair is in accordance with the original design and no hazard to life, health or property is created by such plumbing system.*

*2009 IPC Section 102.4 — Additions, alterations or repairs. Additions, alterations, renovations or repairs to any plumbing system shall conform to that required for a new plumbing system without requiring the existing plumbing system to comply with all the requirements of this code. Additions, alterations or repairs shall not cause an existing system to become unsafe, insanitary or overloaded. Minor additions, alterations, renovations and repairs to existing plumbing systems shall meet the provisions for new construction, unless such work is done in the same manner and arrangement as was in the existing system, is not hazardous and is approved.*

*2009 IPC Section 424.3 — Individual shower valves. Individual shower and tub-shower combination valves shall be balanced-pressure, thermostatic or combination balanced-pressure/thermostatic valves that conform to the requirements of ASSE 1016 or ASME A112.18.1/CSA B125.1 and shall be installed at the point of use. Shower and tub-shower combination valves required by this section shall be equipped with a means to limit the maximum setting of the valve to 120°F (49°C), which shall be field adjusted in accordance with the manufacturer's instructions. In-line thermostatic valves shall not be utilized for compliance with this section.*

The last sentence that states "in-line devices shall not be used for compliance with this section" does not mean in-line devices should not be used, it means the in-line devices will not protect against thermal shock and an automatic temperature or pressure compensating type shower valve conforming to ASSE 1016 must still be used to protect against pressure imbalances between the hot and cold water system which can lead to thermal shock incidents. A properly designed system would have a water heater set at 140 degrees Fahrenheit followed by a master thermostatic mixing valve set at a maximum of 120 degrees Fahrenheit and compensating type shower valves conforming to ASSE 1016 or CSA B125.1 located at each shower. Each shower valve should have the maximum temperature limit stop set to a safe temperature below 120 degrees Fahrenheit.

*2009 IPC Section 424.5 — Bathtub and whirlpool bathtub valves. The hot water supplied to bathtubs and whirlpool bathtubs shall be limited to a maximum temperature of 120°F (49°C) by a water-temperature limiting device that conforms to ASSE 1070 or CSA B125.3, except where such protection is otherwise provided by a combination tub/shower valve in accordance with Section 424.3.*

*2009 IPC Section 424.7 — Temperature-actuated, flow reduction valves for individual fixture fittings. Temperature-actuated, flow reduction devices, where installed for individual fixture fittings, shall conform to ASSE 1062. Such valves shall not be used alone as a substitute for the balanced pressure, thermostatic or combination shower valves required in Section 424.3.*

The 2009 edition of the Uniform Plumbing Code Has the following Language:

*2009 UPC Section 101.4.1.2 — Maintenance. The plumbing and drainage system of any premises under the Authority Having Jurisdiction shall be maintained in a sanitary and safe operating condition by the owner or the owner's agent.*

*2009 UPC Section 101.4.1.3 — Existing Construction. No provision of this code shall be deemed to require a change in any portion of a plumbing or drainage system or any other work regulated by this code in or on an existing building or lot when such work was installed and is maintained in accordance with law in effect prior to the effective date of this code, except when any such plumbing or drainage system or other work regulated by this code is determined by the Authority Having Jurisdiction to be in fact dangerous, unsafe, insanitary, or a nuisance and a menace to life,*

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*health, or property.*

*414.5 Limitation of Hot Water in Bathtubs and Whirlpool Bathtubs. The maximum hot water temperature discharging from the bathtub and whirlpool bathtub filler shall be limited to 120ºF (49ºC) by a device that conforms to ASSE 1070 or CSA B125.3. The water heater thermostat shall not be considered a control for meeting this provision.*

*416.3 Limitation of Water Temperature in Bidets.*

*The maximum hot water temperature discharging from a bidet shall be limited to 110ºF (43ºC) by a device that conforms to ASSE 1070 or CSA B125.3. The water heater thermostat shall not be considered a control for meeting this provision.*

*418.0 Shower and Tub-Shower Combination Control Valves.*

*Showers and tub-shower combinations in buildings shall be provided with individual control valves of the pressure balance, thermostatic, or combination pressure balance/thermostatic mixing valve type that provide scald and thermal shock protection. These valves shall conform to ASSE 1016 or ASME A112.18.1/CSA B125.1. Gang showers, when supplied with a single temperature-controlled water supply pipe, shall be controlled by a mixing valve that conforms to ASSE 1069. Handle position stops shall be provided on such valves and shall be adjusted per the manufacturer's instructions to deliver a maximum mixed water setting of 120°F (49°C). The water heater thermostat shall not be considered a suitable control for meeting this provision.*

The codes generally agree if there is a hazardous condition or a condition that is unsafe or a nuisance to life, health and property it should be corrected. It is also generally agreed that water above 120 degrees Fahrenheit at fixtures for bathing and washing with a few exceptions for lower temperatures can be considered dangerous and proper precautions should be taken to prevent the hot water from being a scalding hazard by using the proper safety devices.

When I hear about people setting their water heater to 120 degrees Fahrenheit to prevent scalding, I know they have good intentions, but most people do not know you cannot accurately control the hot water temperature leaving a water heater with the thermostat dial. ■

***The remainder of Ron George's column can be found online at www.plumbingengineer.com.***

***Ron George*** *is President of Ron George Design & Consulting Services. He has served as Chairman of the International Residential Plumbing & Mechanical Code Committee. He is active in plumbing code and plumbing product standard development committees with ICC, IAPMO, ASSE, ASME, ISEA and ASTM. His company specializes in plumbing, piping, fire protection and HVAC system design and consulting services. He also provides plumbing and mechanical code consulting services and he provides investigations of mechanical system failures and litigation support. His company also provides 3D cad services and Building Information Modeling (BIM) services.*

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# FPE Corner

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

## Fire Sprinkler Design – Part 1

In last month's column, I discussed how to determine when fire sprinklers are required based on the International Building and Fire Codes. This article — and the next — will attempt to identify what the engineer must include in the design of a fire sprinkler system.

First a short disclaimer, what constitutes an adequate sprinkler design for purposes of obtaining a building permit or meeting requirements of individual state licensing boards varies and must be taken into account by the engineer.

This article will use — as a basis for establishing what constitutes a proper sprinkler design — a position statement that was jointly prepared and approved by the Society of Fire Protection Engineers (SFPE), the National Society of Professional Engineers (NSPE), and the National Institute for Certification In Engineering Technologies (NICET) entitled "The Engineer and the Engineering Technician — Designing Fire Protection Systems."

This document presents a model for the roles played by the engineer and the engineering technician in the development of a design for fire protection systems. A full text version of the statement can be found at http://www.sfpe.org/upload/nspe-sfpe-nicet_position_statement_-_designing_fire_protection_systems_-_july_28_2008_final_nicet-nspe-sfpe_approved_version.pdf.

With respect to fire sprinkler systems, the position statement indicates that the engineer is responsible for preparing a set of documents from which the sprinkler contractor's technician can prepare layout drawings (i.e., shop drawings or working plans). The engineer's documents also can be used to serve as bid documents. The requirements for layout drawings or shop drawings, which are prepared by the engineering (or sprinkler layout) technician, are well defined under the provisions for working plans in paragraph 22.1.3 of NFPA 13 Standard for the Installation of Sprinkler Systems, 2007 edition.

Not everyone in the industry agrees that the SFPE position paper represents the correct model. Some professional engineers and fire sprinkler contractors have differing views. There are professional engineers that feel that the preparation of layout drawings is "engineering" and therefore must be prepared by a professional engineer. In fact, some jurisdictions and state engineering boards may require these drawings to be prepared by or under direct supervision of a PE. On the other hand, there are some fire sprinkler contractors who believe that fire sprinkler work does not require the involvement of an engineer in the design process, and that engineers prepare unusable and often unbiddable design documents.

However, the National Council of Examiners for Engineering and Surveying (NCEES) agrees in principle with the SFPE Position Statement and have issued their own position statement PS 25 on Fire Protection which:

"… recommends that Member Boards actively pursue enforcement of state statutes and rules with local permitting authorities having jurisdiction (AHJ) regarding the engineering supervision over the specification, design, and calculation of fire protection systems." To implement NCEES recommends:

• Contract drawings should include a set of fire protection drawings that are sealed by a licensed professional engineer.

• Supervision by a licensed professional engineer is required in the review of fire protection installation shop drawings for compliance with the engineer's design and specifications.

• Oversight by a licensed professional engineer is required in the installation of an original permitted design."

In practice, the contract/design documents prepared by the engineer represent a performance-based design. The engineer's design documents for a fire sprinkler system should include a basis of design (or design analysis) and a set of contract documents. The contract documents normally include drawings and specifications.

The basis of design should document the objectives of the system and document key design decisions. It is also very important that the basis of design confirm the adequacy of the water supply. The engineer must document the available water supply either by conducting or witnessing a fire hydrant flow test. In some jurisdictions flow tests are not permitted and the engineer may have to rely on data provided by the water purveyor or by calculation. With the available water supply data the engineer then must perform a preliminary sprinkler hydraulic calculation to confirm that it is feasible for the fire sprinkler system to be designed within the available water supply. If water supply improvements are needed such as a larger underground feed main, booster fire pump system, or pump with tank, they need to be included in the bid documents. Leaving it up to the bidding contractor to do their own flow test to verify the water supply adequacy could, for example, result in a large change order for a booster fire pump during construction. Copies of the fire hydrant flow test report and the engineer's preliminary hydraulic calculations should be included in the basis of design.

The contract drawings for the performance-based design of fire sprinkler systems should address the following:

1. Identify the building and/or fire code of the ruling jurisdiction. Also, identify applicable installation standards, which can include:

• NFPA 13, Standard for Installation of Sprinkler Systems;

• NFPA 13R, Standard for the Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height; and

• NFPA 13D, Standard for the Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes

Other applicable codes and standards from NFPA could include:

• NFPA 14, Standard for the Installation of Standpipe and Hose Systems;

• NFPA 20, Standard for the Installation of Stationary Pumps for Fire Protection ;

• NFPA 25, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems; and

• NFPA 72, National Fire Alarm Code

2. Identify the type of fire sprinkler system being provided. Paragraph 3.4 of NFPA 13 defines these systems, which include wet pipe, deluge, dry pipe, preaction, and combination preaction-dry pipe systems.

3. Clearly indicate the areas to be protected by sprinklers. This would normally be the entire building. It is also important

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that the contract documents identify any combustible concealed spaces requiring sprinkler protection. It would also be helpful to identify other areas requiring sprinklers that may not be apparent to contractors such as elevator machine rooms and shafts, mezzanines, combustible overhangs, etc.

4. Identify sprinkler system design criteria, specifically:

a. Occupancy Hazard Classifications. Identify areas of the building as either Light Hazard, Ordinary Hazard Group 1 or Group 2, or Extra Hazard Group 1 or Group 2. Identify storage or special occupancies, which have special sprinkler requirements. Refer to Chapter 21 of NFPA 13 for more information on special occupancy sprinkler requirements.

b. Discharge Criteria. This normally involves indicating required design densities, design areas, and hose stream demand for each occupancy classification involved in the project. If storage occupancies are present discharge criteria for control-mode sprinklers, large drop sprinklers, Specific Application Control Mode Sprinklers, ESFR sprinklers, or in-rack sprinklers must be presented.

5. Identify the available water supply data. At a minimum the contract drawings must include the location of the test fire hydrant, static pressure, residual pressure and flow at residual pressure. If the engineer is not absolutely sure the flow test data represents the worst-case available water supply, the contractor should be required to provide a safety factor or "cushion" (a 10% pressure cushion is often used).

6. Show a detailed design of all piping between the point of connection to the water supply and the sprinkler riser. This may be under the purview of the civil engineer since it involves work beyond the "5-foot line." The design should include any required backflow devices, valves, meters, thrust blocks and other pipe restraint. If backflow devices are required the means of forward flow testing of the device must be indicated.

7. Locate the fire sprinkler riser. In multistory buildings show the location of the riser on each floor. Show locations of zone or section control valves and floor control valves.

8. Provide a fire sprinkler riser diagram with connections to all sprinkler zones or floor control valves.

9. Locate water flow alarm devices, tamper switches and other alarm and supervisory devices. Identify connection to fire alarm system and/or off-site monitoring provisions. In the case of preaction or deluge systems the design must include the detection and control subsystems.

10. Identify the location of fire department connections.

11. Identify requirements for seismic protection.

12. Identify requirements, if any, to counter the effect of microbiologically influenced corrosion or other unusual corrosive conditions in the water supply.

We have discussed the important elements of fire sprinkler design to be included in the engineer's basis of design and contract drawings. In the next article, I will describe the key elements needed to develop a well-written fire sprinkler specification. ■

***Samuel S. Dannaway**, PE, is a registered fire protection engineer and mechanical engineer with bachelors and masters degrees from the University of Maryland Department of Fire Protection Engineering. He is past president and a Fellow of the Society of Fire Protection Engineers. He is president of S. S. Dannaway Associates, Inc., a 15-person fire protection engineering consulting firm with offices in Honolulu, Hawaii and Guam.*

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# Solar Solutions

By Bob "hot rod" Rohr

## Solar storage: Banking the BTUs

One thing becomes quite obvious when you start designing and installing solar thermal systems: you rarely get exactly the amount of solar energy you need, exactly when you need it.

The easiest and most practical use for solar thermal is DHW, or SDHW (solar domestic hot water). These systems are more often than not a pre-heat system designed to offset a percentage of the total DHW load. The installer or designer determines a solar fraction to what to design and assemble. The solar fraction (SF) is the percentage of DHW load that the solar can be expected to deliver. Basically, it is the amount of energy required to cover the DHW load divided by the energy the solar can contribute to the load. Determining the DHW load is easier said than done. The industry has some rules of thumb, such as 20 gallons per person per day. I think that may be a tad high. Others prefer 20 gallons per day for the first two and 15 gallons for additional family members.

One common sense method is to look at the hot water supply they have and ask if that is sufficient. If they have a 50-gallon 37,000 BTU/hr input tank, there is the number.

Another method would be to put a water meter on the cold supply to their water heater and get a real-time figure. No need to grossly oversize the supply, but then again I have never had a customer complain of too much hot water supply. But I have under-estimated more than one job and have had to correct it on my nickel. Determine to the best of your knowledge, and maybe document what you intend to provide, or supplement with solar.

Back to the supply vs. demand challenge. Generally, these days, the DHW load in a typical residence is required in the morning and evening hours. It may change a bit on weekends when schedules change and clothes washing goes full blast. So really, a residential SDHW system calculates out nicely. Your solar window is open the widest between 10:00-2:00. In a perfect scenario, you want to present the coldest possible tank to the solar array as the sun rises. This drives the efficiency to the best percentage.

When all the calcs are said and done, a solar fraction of 45 - 60% is well within reach pretty much anywhere in the United States. We calculate that over a 12-month period, of course. It is quite possible to get 80 - 100% in the summer months and drop back to 30% or less in the colder, less sunny months. Using actual data and software simulations, I feel confident in those projections.

So in a nutshell, a 60-120-gallon storage, with an appropriately sized collector array will provide the solar fraction. It also presents a reasonable payback for a SDHW system.

But all this gets a bit foggier when you start looking at covering heating loads with solar thermal. Right out the gate you realize you get the best, and most, solar when you need it least. You can warm a lot of water all summer long. But what are you going to heat with it?

So the dilemma becomes how, and how much, do you try to store. This is the challenge solar installers have always faced. It hasn't changed in the 30-plus years I have been involved with active solar thermal systems. In a perfect thermodynamic world you could exactly match the solar input, or harvest, to the ever-hanging heating load. I have read about projects in Europe that have DHW and heating fractions right up to 100%. Examine the numbers carefully to see what type of storage capacity is required to accomplish. Snoop around www.jenni.ch to see some of the 90 - 100% SF systems they have built and installed. On one apartment installation, an 8-unit complex required 205,000 liters of storage to get that SF. If my math, is correct that is around 54,000 gallons of solar storage. Could you spec that sized insulated tank to your customers?

But there is some encouraging news for those interested in chasing down the solar storage challenges. Water, being the medium we all work in, becomes the best shot at storage. It's cheap, easily stored and shuffled and a fairly good conductor of heat.

Here are a couple examples of how to put it to use: Cedar Mountain Solar owner Bristol Stickney writes a monthly column for *Plumbing Engineer*. In his writings, Bristol has described a developed means to store excess solar energy in the mass of the building. Typical jobs he installs has a radiant heat component. They use a series of controls and zoning to store the energy in various zones of the radiant slabs. Care must be taken to prevent overheating the space and allowing uncomfortable temperatures in those zones, of course.

Bob Ramlow of Wisconsin loads up a large sand bed under the slab as a parking space for solar gained during the summer months. This can take him deep into the heating season, depending on the building loads and storage capacity available.

Still the most common thermal storage remains insulated tanks containing plain old tap water. Tanks are readily available in all sorts of sizes, shapes and configurations. Tanks with coils inside for heat exchange have been popular over the years. We now see tanks available with multiple coils inside for various temperature outputs and loads. With the solar thermal industry ramping up again, we are seeing high tech approaches to tank design. Stratification chambers, lances or fiber materials are being used to encourage the tank temperatures to stratify. Several manufacturers offer tanks with a wax-like product on the top for some latent heat storage. Tank-in-tank designs are another approach. Several manufacturers install small capacity stainless steel flash tanks inside the solar storage tank. The concept is to store small quantities at elevated temperature to address Legionella concerns. Some wild stratification tanks are being built these days. Yet other brands use small ECM circs to "stack" the tank in layers. Clever concepts.

Tanks with external heat exchangers are another ideal

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way to look at thermal storage; this allows you to purchase less expensive storage only tanks. Now you have more options for capacity and this also allows you to size the external heat exchanger exactly to the load and conditions. If or when the tank springs a leak, a new insulated tank can be installed at a much lower cost. This is especially true when you start looking at tanks in excess of 120-gallon capacity. Still, other contractors limit tank size to 120 gallons to take advantage of common off-the-shelf products. They then manifold together multiple tanks to configure the exact capacity to match the design. Clever piping and 3-way motorized valves can allow you to "load" these tanks at different temperatures or to match the daily gain, providing sufficient temperatures to meet that load. Large quantities of lukewarm water doesn't help much for covering you heating loads. Certainly, designing your heating distribution temperatures as low as possible will help maximize the solar contribution.

So at the end of the day, and the end of the article, there really isn't a "one size," or one method that fits all approaches to solar storage.

Research and educate yourself on the options for tanks, heat exchangers and controls. Talk to the old solar dogs with years of experience.

Jump at any chance to attend the Frankfurt ISH show. InterSolar in Munich is another great show to see wild and unique solar storage products. These shows and others have U.S. versions now. Most of the big players in the industry — both foreign and domestic — bring product to the plumbing and solar trade shows across the States.

Domestic tanks suited for solar have been around for many years and new players are entering the market with high-tech solutions. Rheem has built the external coil Solaraide for many years. Vaughn stone-lined tanks are another old name in the industry. Heat Transfer Products has some clever hybrid solar tanks, some with high efficiency back-up burners built in. Lochinvar has a clever approach called the LockTemp, available in sizes from 78 - 2,500 gallons. Bradford White offers 10 or more solar specific tanks. Heat-Flo builds dual coil, stainless steel and solar storage solar tanks. Many solar storage tanks will have a provision for a back-up electrical element. This provides a nice, simple dual-fuel option. ■

***Bob "hot rod" Rohr*** *has been a plumbing, radiant heat and solar contractor and installer for 30 years. Rohr has been a long-time RPA member, and has since joined Caleffi North America as manager of training and education.*

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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EXCELLENCE BY DESIGN

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# South Coast Engineering


*Peter Kraut visits a job site at the Nokia Theater in LA. Most of the plumbing for the entire downtown entertainment district was designed by South Coast Engineering Group.*

# Preserving beauty, facilitating function

*Conducted by John Mesenbrink*

Continuing on the success of its "Engineering Spotlight," *Plumbing Engineer* recently spoke with Peter Kraut, PE, CPD, president of South Coast Engineering Group, Inc., Calabasas, Calif.

Founded in 2001 on the idea that the focus of any successful consulting engineering firm should be the creation of accurate, understandable and viable construction documents, South Coast Engineering Group has raised the standard of design. With HVAC, plumbing, fire protection, siphonic roof drainage and electrical engineering services, South Coast Engineering focuses on a broad spectrum of markets such as schools, hospitals, retail centers, theaters, restaurants, office buildings, convention centers, hotels, condominiums, apartments, athletic facilities and high rise buildings. Over time, South Coast has developed a few specialties, including sound stages and amusement park rides.

*Plumbing Engineer* was fortunate enough to conduct the following Q&A with Peter Kraut.

***PE: Please provide a brief history of the company.***

**Kraut:** In the 1990s, I worked for a large engineering firm in Los Angeles. A job came in from The Sports Club/LA, but it was relatively small and did not include HVAC or electrical so it did not get much attention from the principals or senior management. Through attention to that client's needs and detailed involvement in the plumbing design, I turned it into a sizable account that included clubs in Boston, Washington D.C., San Francisco, New York, Miami and Houston. In 2001, that client — and many of the architects, engineers and contractors from those projects — asked me to start my own business. Each of those successful projects turned into a few more contacts and a few more jobs. Today, 75 percent of all of our contacts can be traced back to that one, small, plumbing-only job.

***PE: How did you get involved in the industry?***

**Kraut:** As a graduate in Architectural Engineering Technology from Wentworth Institute of Technology in Boston Massachusetts, I had completed internships with a civil engineer and an architectural model builder. I moved to Southern California where I immediately began looking for work in architecture. With over 500 resumes in circulation, I expanded my job search into construction and finally landed a job as a project manager/estimator with a general contractor. When they closed their doors, I went back to school to brush up on AutoCAD and then found a job with what I thought was an architect; however, it was a mechanical engineer. Although I knew nothing about plumbing, I was hired as a plumbing designer and learned on the job by reading code books and mimicking the works of others. After a few years, I moved to a large firm in Los Angeles where I worked on larger projects including universities, hotels and convention centers. There I joined trade organizations, got involved in committees and was exposed to a whole new world of plumbing engineering.

***PE: What are your initiatives for the company?***

**Kraut:** I believe that building information modeling, or BIM, will surpass green building as the buzz word of design by 2010. We began drawing in 3D as beta testers for Autodesk's Building Systems in 2001. For this, South Coast

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# Spotlight — SoCo

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Engineering Group was the first success story on Autodesk's website. We have evolved into using many platforms, including AutoCAD, Navisworks and Revit. As leaders in siphonic roof drainage, our 3D modeling has been the key to ensuring that the pipes fit where they are drawn and the system can be installed exactly as drawn.

***PE: What makes South Coast unique from others?***

**Kraut:** We avoid canned approaches to engineering. I believe that our job is to educate architects and owners and let them make the decisions. To do this, we need to explain complex engineering systems with features and benefits that a layman can understand. We identify the initial costs, utility costs, maintenance issues and other pros and cons. Then, we can design a system around their specific needs.

*Walter De La Cruz models plumbing in 3D using Revit while Bill Siler overlooks the program.*

We work for owners, architects, developers and design build contractors. We prepare schematic designs, construction documents and even shop drawings. Our three-dimensional detailing work for contractors has made us smarter engineers. We can tell architects with authority how much space we need in a wall or around a piece of equipment. This means that everything fits with no wasted space.

What we have found is that an engineer can apply his knowledge and experience to any industry as long as he makes a concerted effort to understand his client. Sound stages, for example, are all about acoustics and include a unique feature — WAGS (water, air, gas and sewer) provided in the sound stage. These are used by set builders to the fullest extent of their imagination. In order to quantify those utilities, you must understand the business.

***PE: What are the biggest obstacles when spec'ing a job?***

**Kraut:** It would be convenient to specify only old-school, top-shelf, gold-plated products that are oversized and redundant, thus reducing our liability. Our clients, however, have budgets and space constraints. Our job is to specify products that meet their needs. There are many great products on the market. Some have been around for a while and some are relatively new. New technology has a place in design, but may not be a good fit for every project. Some clients may not be comfortable with the risk inherent to new products, but we owe it to our clients to keep them informed

***PE: Can you name a project of which you are most proud?***

**Kraut:** We have designed the plumbing for a few amusement park rides. For a 500 seat theater, we designed the 40-horsepower, 2,000-gallon compressed air system that moves the seats in sync with the 3D projected show; the calculation

had to be extrapolated from the movements in animation. We also designed the purified water system that sprays in the face of the audience when a character on screen sneezes. After my 7-year-old son went there on a field trip, I told him that I designed the water purification system. He looked at me with such admiration and said, "You made the spit? … cool!"

***PE: Is your firm involved in sustainable design or "green" practices?***

**Kraut:** Green building is here to stay; those who have not embraced it yet should do so now. Long before South Coast Engineering Group was formed, I was involved in the design of several green buildings, including one of the country's first Platinum buildings. Those experiences have created forward thinking that South Coast Engineering Group has always practiced. The green building movement has opened our clients' eyes, and now we are more likely to convince them to focus on energy and resource usage over first cost. The LEED rating system has become the standard by which green buildings are judged, but some creative designers have found ways to get around the intent and just get the points. ASHRAE's new standard for High Performance Buildings may change that. It addresses many of the conflicts such as the water used in the irrigation demand on a green roof.

***PE: How has the economy affected your business? How are you dealing with it?***

**Kraut:** Like many firms, we have had to cut back some of our staff and expenses. We are still getting most of our work from repeat clients, but we find ourselves bidding more than ever in an overly competitive environment. These things are outside of our control so we are focusing on managing the things we can. We are steering away from high risk, like condominiums, indemnification clauses and pay-when-paid contracts. These practices have led to developers gambling with other peoples' money and have left many engineers with invoices on which they will never collect.

***PE: How can South Coast Engineering Group better assist builders in today's economic climate?***

**Kraut:** Builders are looking for ballpark information early to determine if a project is feasible or not. Any engineer can calculate utilities by the end of the construction document phase, but we bring the experience that helps in the planning

*Bill Siler inspects a hot water heater installation at a high rise condominium.*

before engineering begins. Estimating water supplies, planning equipment spaces, identifying code issues and even reviewing lease documents are a routine part of our practice.

***PE: Speaking of climate: How does geography play a part in your work and how does it differ from, say, the***

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***Northeast? (temperatures, sunlight, humidity, pollution control, etc.)***

**Kraut:** Climate and geography play a major part in design. In Southern California, we have it easy — seldom freezing, rarely humid and only an occasional tremor. Of course, we have become experts in air conditioning, air purification and water treatment. Our work in other parts of the country has rounded out our experience with frost protection, heating and humidity control. We also have consulted in even greater climate extremes outside of the country including Kiev and Dubai.

***PE: It seems to me that California is on the cutting edge of technology, codes and standards. Would you agree? How does this affect your business? For the best?***

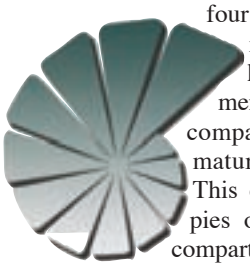
**Kraut:** Codes and standards are constantly changing, usually for the better. Our own City of Calabasas, nationally known for banning smoking in public, passed a law that required commercial buildings over 5,000 square feet to meet LEED Silver requirements. I was a member of the recent General Plan Advisory Committee that upheld that ordinance. Now, the Los Angeles Department of Water and Power is leading the nation in green building ordinances to protect our natural resources. I am proud to be a small part of this effort as well. Staying on top of these changes allows us to pass that information on during design instead of reacting to it during construction.

***PE: According to SOCO's company profile, Innovation, Coordination and Presentation are three fundamental concepts by which the company abides. Can you expound those benchmark principles?***

**Kraut:** First, as innovators, we are always looking for a better way to do things. Second, new ideas often require more effort to work with other building elements, but this coordination is essential to their success. Third, if these systems are not detailed clearly in the construction documents, there is little chance that the systems will be installed completely and correctly. The best example of these benchmark principles can be found in our siphonic roof drain design. We were the second engineering firm in the country to design these systems and today we are the leader in this innovation. Our coordinated three-dimensional model and fully-dimensioned drawings are essential the ultimate performance of these systems.

***PE: I love this statement: "South Coast Engineering Group strives to create flexible, dependable mechanical systems within structures while preserving the beauty of the form in which they function." Can you explain the Nautilus logo concept?***

**Kraut:** Unchanged for 500 million years, the Chambered Nautilus embodies the principles of South Coast Engineering Group. Always a plan for future expansion, there are typically four compartments in a newly hatched specimen and over 30 compartments in a mature Nautilus. This creature occupies only the outer compartment and each time a new one is built, the old one is sealed off. Not only a shelter for protection, but a mechanical device, the shell's inner compartments are filled with gas to maintain a neutral buoyancy at depths of 1,500 feet or more. The Nautilus can then freely move about by jet propulsion and by displacing or injecting fluid into the outer cavities. In this way, South Coast Engineering Group strives to create flexible, dependable mechanical systems within structures, while preserving the beauty of the form in which they function. ■



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# The PEX Quotient

*PEX has become an increasingly popular piping product. Several miles of Watts Radiant's oxygen barrier RadiantPEX tubing, for example, was installed in the concrete slab floor at Zylstra Harley-Davidson, St. Charles, Ill.*

By Bill Allen, PE

The history of plumbing goes back thousands of years. Moses of Biblical fame struck a rock about 1,500 BC and became the first water utility. The Roman aqueducts delivered water to Rome from 300 BC to 200 AD. Indoor plumbing is only about 100 years old. The Uniform Plumbing Code was first published in 1946.

The first pipes were clay, wood and lead. After World War II, most indoor water piping was galvanized steel. As the economy boomed, piping systems with better corrosion resistance and ease of installation were introduced. In the 1960s and 1970s, plastic piping systems challenged the metallic materials in use. Some like PVC and CPVC were successes; Polybutylene piping for residential use was a failure. Also during the 1970s we saw PEX introduced.

PEX tubing has proven to be a good system for radiant floor heating, ice melting and residential water piping. There are several processing methods to provide the cross-linking of the polyethylene material. Make sure you verify which performs best in your situation.

Caution: When used properly, every piping material or system can provide good service. Placing galvanized material in corrosive soil will cause it the turn into a sprinkler system. Place copper in contact with concrete or directly connected to steel and it will turn green and disappear. Plastic pipes, if not properly treated, will deteriorate when exposed to direct sunlight. Some plastics can handle high temperatures. Some plastics are approved for use in drinking water and domestic water systems. Some should not be exposed to chlorine. **Read the instructions!**

There have been fitting failures of some PEX systems in the past when the metal alloys reacted with the water chemistry and failed. When invited to analyze a home, which the night before, had 18 inches of water covering the first floor, it was discovered that the incoming water line had failed at a fitting resulting in a ¾" diameter tube, pouring hundreds of gallons of water into the home. I must report that the builder did a great job on the seals for the doors as they contained the water in the home. Further inspections uncovered leaking fittings that were caused by inexperienced operators not crimping the fitting to specs or using the wrong ring material.

Every product goes through growing pains after they are

*Continued on page 36*

| 1.5 GPM Flow – Similar to Lavatory | | | | | | |
|---|---|---|---|---|---|---|
| Size | PEX Velocity | ΔP PSI/CFT | Type L Cu Velocity | ΔP PSI/CFT | Schedule 40 Steel | ΔP PSI/CFT |
| 3/8" – 0.350" dia. | 5.00 | 15.61 | 3.30 | 6.57 | 2.52 | 4.22 |
| ½ – 0.475" dia. | 2.72 | 3.62 | 2.06 | 2.14 | 1.59 | 1.35 |
| 2.5 GPM Flow – Similar to Shower or Kitchen Faucet | | | | | | |
| 3/8" | 8.34 | 39.0 | 5.50 | 16.04 | 4.20 | 10.24 |
| ½ | 4.53 | 9.02 | 3.44 | 5.19 | 2.64 | 3.22 |
| For flow noise control - 8 FPS is the maximum recommended velocity | | | | | | |

*The PEX info from The Plastics Pipe Institute and Plastic Pipe and Fittings Association Design Guide is a valuable addition to any designer's library.*

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- Meets CISPI 301 Requirements

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|---|---|---|---|---|
| 117-3K | Retention Strap Kit. (2) Galvanized steel straps with (5) stainless steel band clamps. 90° bend support strap & diagonal inside strap. | 2" - 3" | 6 | Specification Data Available Upon Request |
| 117-4K | | 4" | 6 | |
| 117-6K | | 6" | 6 | |
| 117-8K | | 8" | 6 | |

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# The PEX Quotient

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released. As Pogo, the comic character, stated, "There are no problems, only unsurmounted opportunities."

When I started in this business back in the Dark Ages, water hammer was a problem. We had faucets that were not stingy with the flow and had valves that could be closed rapidly. The fast velocity of the large flow combined with the sudden stop resulted in noisy piping systems. On more than one occasion I have seen pipes peeled open like a banana from those forces. With the improvements in valve design, water-saving design and the application of water hammer arrestors, this has generally become a thing of the past.

Have you compared the inside diameter of the various piping products available? PEX has a smaller inside diameter than the other materials of the same trade size. This affects the velocity and pressure drop.

In some areas of the country plumbers have used 3/8" diameter PEX to reduce costs and to deliver hot water to the faucet faster. Care must be taken to avoid a low-flow condition due to low pressure and water hammer from the increased flow velocity.

During the last 20 years, I have had requests to inspect and correct PEX systems because the newly installed systems were having water hammer problems and other difficulties. The PEX design manual points out that the flexibility of the PEX allows it to absorb the forces of the pressure surge. This is true, but if the installer does not properly secure the tubing to the structure, the tubes will slap the wall surfaces and create a loud pop.

PEX cannot be stretched tight when secured to the structure. PEX can extend as much as 0.01 inch per foot for a 10°F rise (manufacturer's published specification). A hot water pipe can easily see variations from 60° F to 120° F. In an 8-foot high wall, the pipe can move ¾". This creates an installation problem as to how to provide expansion and contraction while preventing water hammer noise. The design guide shows examples of ways to solve this and prevent the offensive water hammer. To secure the tubing as it passes through the drywall use a prefabricated pipe support bracket that spans the studs to limit movement.

*A nail stop prevents a trim nail from penetrating a PEX tube passing through a stud.*

As the PEX is routed through the structure, the tubing must be located in the center of the stud. If located too close to the drywall an errant trim nail or drywall screw can penetrate it. Use metal plates where nails or screws may penetrate the tube — especially at the top and base plates of wood construction. A homeowner purchased some new solid oak flooring to dress up their new home. The installer removed the baseboard to install the wood and replaced it using 2-inch wire brads fired from a pneumatic gun. Need I say more? They had an interesting contoured flooring system. A small piece of metal where the tube came out of the floor for a water closet would have saved $25,000.

My personal residence has PEX and it gives great service — now that a couple extra clamps have been added. ■

***William Allen, P.E.**, is the mechanical engineering manager, Geo-Marine Inc., Knoxville, Tenn. He has held titles such as facility and environmental engineer with General Motors; corporate energy manager with Litton Industries; and an engineering consultant with several engineering firms. He attended college at General Motors Institute and received a bachelor's degree in Plant Engineering in 1971. In 1973, he received a master's degree in Environmental Engineering from USC.*

# Advertiser Index

# Website Spotlight

## ATS creates buzz in design community with website

How much time does it usually take for an engineer or architect to put together a complete plumbing specification package for a 100,000-sq.-ft. high school? The answers range from a few days to a week. However, engineers and architects are now


*On atsspec.net, users can make selections by plumbing fixtures/fittings, green products, project type, luxury products and ATS Specification Manual.*

accomplishing this task in less than an hour, complete with written specifications, drawings, fixture schedules, AutoCAD blocks, BIM families and budget pricing. Allied Technical Services (ATS), Toronto, Canada, is making this possible for designers across North America with its accurate and efficient online plumbing specification system.

Lou Petro launched Allied Technical Services in 1969 with one overriding goal in mind: provide the design community with the most compressive specification service on the market, and do this at no cost, through the sponsorship of industry manufacturers. "By working at mechanical engineering firms, I knew the time it took to create an accurate specification and I wanted to improve that process," said Lou Petro, president of ATS.

Over the years, the company has continued to improve the quality and diversity of their services. Forty years later, ATS is still on the cutting edge of providing no cost specification services to the design community. "Our goal is to continually improve our website and programming capabilities based on the needs of the engineering community," said Bill Petro, vice president.

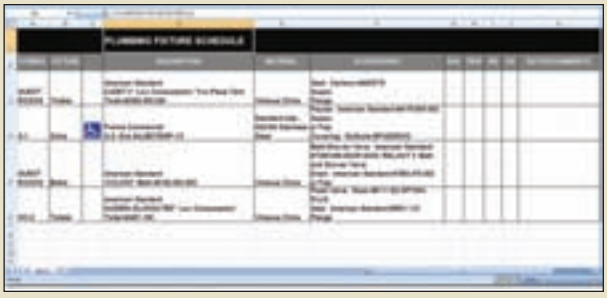
ATS launched its online service — atsspec.net — to rave reviews from the design community. The website provides information on which to build a complete plumbing specification, and this eliminates the need to search through catalogs to compile the information needed for an accurate specification. The site allows engineers and architects to create a specification for most projects in less than an hour, saving a design firm both time and money.

The company's unique one-stop shop, "Online Plumbing Specification System," offers a variety of helpful tools including a Green Product (LEED) area, Luxury Product options, a CAD/BIM library and an advanced product search feature for finding specific products. In addition, the website provides designers the option of uploading their own office masters — or using ATS Suggested Projects templates — for their projects. The online service also automatically notifies you of product changes such as updated manufacturer model numbers, product changes and prices and building code requirements.

The website provides designers a variety of options for their spec format, including Microsoft Word and Excel and PDF. In addition, the newly released fixture schedule format allows designers to compile a complete fixture schedule in under an hour.

Engineers have found the website easy and convenient to use for creating specs. "I have used ATS and it is awesome. I was able to spec out a sink with all the requirements in about five minutes. This would have taken me hours," said Alexander Hochhausl, senior mechanical engineer at Stantec Hauppauge, New York.

With no plans of slowing down, ATS is at the forefront of plumbing design and continues to introduce new tools and innovative specification services for its engineering and architectural users; the ATS Spec online system remains the most advanced plumbing specification tool available in the marketplace.



*Users can save and print their project as a plumbing fixture schedule in Excel format or choose from 10 other available download formats.*

To access the ATS website at no cost or obligation, log onto www.atsspec.net, and sign up for a user account and see what thousands of engineering firms have already discovered. "I am really, really impressed with ATS. I've shown it to everyone in the office," said Hochhausl.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