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FROM THE PUBLISHER

STANLEY M. WOLFSOn

Addressing the Competition

As a publisher of any publication, but especially a magazine, you sometimes wonder how you rate among the competition or how the competition rates you compared to themselves. Every once in a while comes an editorial or publisher’s column that provides insight into how your magazine is regarded by the competition. Sometimes, you even get great insight into how other publications work, in the public eye and behind the scenes.

One such recent article in one of our competitors is very instructive for both the way it is written and the way it presents data. It reminded me of one of the more interesting statistics classes I took at college. The instructor was trying to get us to understand the difference between casual and causal relationships; in fact, the whole section was devoted to using statistics to muddle the truth.

The article in question is from the “Industry News” section of Plumbing Engineer magazine and examines the BPA circulation statements of its magazine compared to PS&D and PM Engineer. Without going into the nuts and bolts of the numbers, which really are only of interest to advertisers and marketers, suffice to say that the numbers they claim come from the PS&D statement misrepresent and obfuscate the actual numbers and facts.

The article says: “At the worst, they perhaps show an attempt to mislead the Society’s members and other professional decision makers within our industry.” Perhaps it is the other way around—perhaps the publication making the assertion is having difficulties in the marketplace such that it must resort to a misrepresentation of facts.

Thinking positively, my guess is that whoever wrote the Plumbing Engineer article doesn’t know how to read a BPA statement and/or just made a mistake. (I rather assume that than any nefarious reasons. Of course, if that is the case, any upstanding and respectable publication would issue a correction and/or apology.)

This same article also says: “In a recent issue of Plumbing Systems & Design, it was stated by the publisher that circulation renewals are a source of revenue for ‘other’ magazines. We at Plumbing Engineer take an exception to this erroneous statement for the simple fact that every magazine works on the same basis—they all generate revenue solely through advertising dollars. In fact, investing in renewals is our third highest cost.”

This statement clearly misses the whole concept and idea of Plumbing Systems & Design magazine. Despite what is alleged in the above quote, I stand by what I said and reiterate here: PS&D, unlike its competitors in the marketplace, is not published in accordance with an advertising-driven business plan. This is a magazine published by the society for professional plumbing engineers and designers—the American Society of Plumbing Engineers. The magazine purposely does not trade on industry news and other “gossip.” It only presents the finest technical material of interest to the plumbing industry professional for educational and professional development purposes.

But don’t just take my word for it. Listen to what our readers, your peers, say:

Regarding Don Wise’s article “A 12-Step Program for Avoiding Liability for Hot Water System Injuries,” Alex Weiss, PE, says, “Articles like this one make this magazine the best in the industry.” Mark Banas tells “Plumbing Technology of the Future” columnist Winston Huff, “I very much enjoy your articles from both the style of your writing and information you provide…Keep up the good writing.” Herbert Argintar, PE, says, “PS&D advocates [ASPE members’] professionalism by showing how professional they are becoming, and aiding and abetting that pursuit.”

Owing to the fact that our columnists are experts in the field of plumbing engineering technology, our readers continually e-mail questions about systems on which they currently are working, sparked by topics featured in the magazine. After reading the March/April 2007 issue, readers wanted to know more about an approved method for condensate drain sizing, check valve requirements in the International Plumbing Code, and using butterfly valves as shutoff valves for steam.

While the Society was created by and exists for its members, it is those members who are dedicated to the advancement of the profession and industry. For this reason and, while it would be nice to make a profit on the advertising (and we have every intention of doing just that), despite not making a profit since its inception, the magazine continues to be published and offered on a complimentary subscription basis to everyone interested in the technical and educational side of the profession and industry—not just the membership of ASPE. With PS&D’s built-in ASPE membership base and its credibility in the profession and industry, subscriber retention and attraction for PS&D is nowhere near our third largest expense. After publication (printing and mailing) costs and salary and administrative costs, our third largest expense is for providing high-quality technical material and editorial content—we believe that is how it should be.

This is what a professional society does and is all about. This is what distinguishes ASPE and its premier publication, Plumbing Systems & Design, from those who would be competitors. Competitors for advertising dollars—yes, we have those. Competitors for educational and professional development material, information for the professional and the industry, and a magazine and society that represent the profession and industry—no, there are no competitors. Imitation is indeed the sincerest form of flattery, and we appreciate it.

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IN SUPPORT OF CPD

The ASPE board of directors recently decided to disband the Certified in Plumbing Engineering (CIPE) designation to concentrate the Society’s efforts and resources on the Certified in Plumbing Design (CPD) designation (see this issue’s “From the President’s Pen” in the ASPE Report section for more information). While those who hold the CIPE designation have been invited to become CPDs without taking the certification exam, many are concerned about the CPD’s more stringent recertification requirements. A reader explains why the effort is worth it.

Having seen this issue rear its ugly head in 1999, I was happy to see it resolved by the time the Philadelphia Symposium was over. In 1996, I took the CIPE exam and passed. Just like [all] CIPE certificates, mine has no expiration date on it. When the board of directors at that time created the CPD designation, I recognized it as an opportunity to improve my education and standing in the engineering community. Maintaining my CPD designation has not been easy or free. It has required me to attend four symposiums, take time off of work, and spend time away from my family. In travel, lodging, food, and registration fees, it has cost me and my family over $8,000, not to mention the $35 every two years to recertify. During this time, all [CIPEs] had to do is spend $25 every two years to re-register. Others have not even bothered to do that and still keep their CIPE designation. I know of several others that have recertified their CPD one or two times and have let it lapse. They currently are still using their CPD designation even though they are not supposed to. Since there seems to be no enforcement, what’s stopping them from doing it? Certainly not their conscience.

If I had known back in 1999 that this was all going to get pushed to 2007 and all I had to do was re-register my CIPE status every two years, I would have had a very hard time convincing my wife that spending eight days of vacation, 16 days away from my family, and draining $8,000 from our bank account is justified to have a CPD designation. On the other hand, I have had the privilege of traveling to Philadelphia, St. Louis, San Antonio, and Chicago, have made new friends, and have run into several old friends. Also, I have attended many classes taught by some great instructors and really have improved my education and standing in the engineering community.

[CIPEs] have missed a lot in the last eight years, and now are being handed an opportunity to get on board with the rest of us. I strongly encourage you to do it.

Leif Lindahl, CPD
Senior Plumbing Designer
Knott Benson Engineering

BACKWATER VALVES IN THE IPC

I am writing with a question regarding the “Backwater Valves” article that appeared on page 48 of your January/February 2007 Plumbing Systems & Design publication. My question is: how long has the requirement for check valves on building drains been in Section 715.1 of the International Plumbing Code?

Brian C. Curtis, PE

Backwater valves have been in the BOCA plumbing code as far back as 1970. The language of the code has varied through the years and has gotten more stringent and more specific in the past few years.

The 1990 BOCA National Plumbing Code Section P-1003.2 only states: “A backwater valve shall be installed where plumbing fixtures are subject to backflow from the public sewer.”

In 1995, the BOCA National Plumbing Code was renamed the International Plumbing Code, and the requirements significantly changed. The revised code states: “A backwater valve shall be installed where the overflow rim of the lowest plumbing fixture is below the overflow rim of the next upstream manhole in the public sewer.”

Jim Stenqvist, CPD, LEED AP

PRAISE FOR NEW COLUMNIST AND PS&D

Regarding Donald Wise, I am pleased that he will be writing for PS&D. I know him well; his article in the January/February issue was very well done, as was his “Forensic Engineering” column in the March/April issue.

As a forensic engineer, I found the last two issues to be most informative. I wish you published every month.

Leonard Weiss, PE
New York City

Leonard, your wish is coming true! Starting with the September 2007 issue, PS&D will be published 10 times per year. Look forward to single-month issues in September, October, November, and December 2007, and again in March, April, May, and June of 2008. January/February and July/August will remain, for the time being, combined issues.
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Over the past few years, my company has been involved in more and more design/build projects. Due to these experiences, I decided to take a step back and look at both the design/build approach as well as the more traditional design-bid-build approach. Some things surprised me, and some didn’t. I would like to present some thoughts regarding the differences in the two processes that I find interesting, and maybe we all can use the information to rethink how we typically design buildings.

With any project that we are working on, we are concerned about budget. We somehow never have enough of a budget to design the building exactly as we believe it should be built. Beyond the usual discussion between using cast iron versus polyvinyl chloride piping, some interesting ideas come out of many discussions about the budget. An idea brought up in a recent discussion that I find particularly interesting is the notion of not insulating domestic hot water piping runouts to the fixtures that are located in either a wall or a chase.

Of course, my first concern was that such an installation would not comply with the energy code and, therefore, would not be permitted. However, in this case, the energy code is not quite clear on the matter and leaves some room for interpretation. The only argument that I found was the fact that the energy code uses the term “entire” when referencing the domestic hot water recirculation system. What does the word “entire” mean in this context? My interpretation was more inclusive than that of the rest of the project team and included all piping up to the fixture supply stops. The other interpretation was that “entire” referred only to the recirculated portion of the system and did not necessarily apply to the unrecirculated branch piping off the recirculated piping. How do you argue with that? I found the argument compelling and almost agreed with it. However, I always have tried to err on the side of conservation, and losing heat to a plumbing chase for the sake of saving some money on pipe insulation was not in anyone’s best interest.

One of the concerns was about the cold water. If we did not insulate the hot water piping in the chase, the condensate that certainly would form on the piping could create a problem with moisture in the chase. Of course, if you are not insulating the hot water piping, the additional heat loss to the chase would help evaporate the condensate developed from the cold water piping. I do not know if any installations were actually reviewed to see if not insulating the hot and cold water piping in chases caused problems. I know of many piping installations without insulation in chases that don’t have many problems, but that does not alleviate my concerns about not insulating the piping.

What I found to be the most interesting part of the discussion was when I voiced my opinion that the lack of pipe insulation on the hot water piping did not comply with the energy code. The response was very simple: “We talked to the code authority, and they do not check for compliance with the energy code.” So, the issue is not what the code says or does not say, but rather whether or not the code authority enforces what the code says. I guess that begs the question, when are code requirements enforceable? I understand what the code authority is saying, but that somehow should not relieve the due diligence of the design professional to do the right thing. I believe it is our responsibility to follow what the code says, regardless of whether we agree with the code language or not. We had a lengthy discussion on this issue, with points being made on both sides. The conclusion of the discussion is really not the relative point in this column, but rather that the discussion occurred at all.

This discussion has caused me to stop and think about what I design and why I design it. When thinking about certain decisions regarding the systems we design, we always should put the public’s well-being in the forefront and try our best to do the right thing. This is not always as clear or easy as we would like, and sometimes we need to review various issues to make sure we understand intent. Unfortunately, there can be a fine line between the intent of the code being a minimum standard and the code too often being considered the maximum that is required.

I hope this causes some discussions in your office about your interpretations of the items listed above. I think you might be surprised.
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Installing air-admittance valves at individual fixtures or on the top of stacks is one of the methods for venting a drainage system listed in the International Plumbing Code (IPC). The Uniform Plumbing Code (UPC) does not allow or acknowledge the use of air-admittance valves for venting drainage systems. Many jurisdictions throughout the United States have adopted the UPC as their local code. Of these jurisdictions, many have amended the local code to recognize the use of air-admittance valves in venting drainage systems.

I have talked to many building officials and plan reviewers in jurisdictions that do not allow the use of air-admittance valves, and they all seem to have the same reason for not recognizing air-admittance valves in their codes. The reason is that an air-admittance valve is a mechanical device that can fail, and they do not want to allow a mechanical device in drain, waste, and vent systems.

The dictionary defines a mechanical device as a “mechanism consisting of a device that works on mechanical principles.” The dictionary also states that a mechanism is “an assembly of moving parts performing a complete functional motion, often being part of a large machine.” By these definitions, an air-admittance valve is not a mechanical device; however, it does have a moving part functioning via gravity that prevents sewer gases from escaping from the drainage system.

Mechanical devices, including sump pumps, sewage ejectors, check valves, backflow preventers, pressure-reducing valves, circulating pumps, and pressure and temperature relief valves, are used and are necessary in plumbing systems. Those who exclude air-admittance valves from venting drainage systems because they are mechanical devices also would have to exclude all backflow preventers, pumps, and pressure-reducing valves from plumbing systems because they are mechanical devices as well.

Air-admittance valves must be installed in accordance with the requirements of the IPC where this code is in effect and with the installation standards of the specific manufacturer.

The installer must adhere to the requirements of the IPC when installing air-admittance valves. The installer must also adhere to the installation standards of the specific manufacturer. The requirements of the major manufacturers are very similar to the requirements of the IPC. Following are the general requirements for installing an air-admittance valve:

1. Individual or branch-type air-admittance valves may be used for venting individual fixtures, branch fixtures, and circuited fixtures. By this requirement, air-admittance valves are not permitted for venting combination drain and vent systems and wet-vented systems. Air-admittance valves are not permitted to vent these systems because of the possibility of positive pressure in combination drain and vent systems and wet-vented systems.
2. Stack vents and vent stacks shall be permitted to terminate to stack-type air-admittance valves.
3. Individual and branch-type air-admittance valves shall only vent fixtures that are on the same floor level. These fixtures shall connect to a horizontal branch drain.
4. Air-admittance valves shall only vent stacks and systems that are a maximum of four branch intervals from the top of the stack.
5. Drainage systems and stacks that are four branch intervals from the top of the stack shall be provided with a relief vent. This relief vent shall extend to the venting system that extends to the outdoors.
6. Stack-type air-admittance valves shall not serve as the vent terminal for drainage systems that exceed six branch intervals.
7. Individual and branch-type air-admittance valves shall be located a minimum of 4 inches above the fixture drain.
8. Stack-type air-admittance valves shall be located at least 6 inches above the flood level rim of the highest fixture.
9. The valve shall be located within a ventilated space.
10. A minimum of one vent shall extend to the outdoors.

In a recent plan review for one of the projects that I designed in a neighboring state—in which the local jurisdiction had adopted the IPC—one of the plan review comments stated, “Relief vents are required for each air-admittance valve.” This particular building was a single-story grocery store where an air-admittance valve was specified for an island in a floral area. It is apparent that the plan reviewer does not understand the requirements for installing air-admittance valves. The inexperienced plan reviewer saw Section 917.3.2, Relief Vent of the IPC that requires relief vents, but he did not completely read the requirements. As the previously mentioned requirement number five states, relief vents are required only on drainage systems that are more than four stories high.

It is imperative that all those involved in the design, review, installation, and inspection of plumbing systems be familiar with all aspects of the locally adopted plumbing code. As plumbing designers and plumbing engineers, we need to work with local building officials to help them understand correct plumbing principles.
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Material Selection for Commercial Underground Drainage Applications

By William Morris

Cast iron or PVC DWV? That’s the crucial question when designing piping systems for commercial underground drainage applications in North America. Plumbing designers frequently face a choice between PVC DWV and cast iron for these applications due to budgetary considerations, contractor preference, and other factors. As you would expect, the decision becomes more complex when choices are introduced, such as whether to use service weight, no-hub, or extra-heavy cast iron or whether to approve cellular core PVC when solid wall has been specified.

The short answer is that the perfect drainage material for all applications does not exist. The selection of the correct material for an application is as unique a decision as the requirements for any specific project. The objective of this article is to provide plumbing engineers and designers with general information on the performance properties of PVC and cast iron soil pipe drainage systems with an emphasis on underground applications, to review the applicable standards, and to identify aids for material selection.

WHAT ARE THE PERFORMANCE DIFFERENCES?

Over the years, PVC DWV and cast iron soil pipe have had proven track records of excellent service for the life of a building. However, there are distinct performance differences between these piping systems, including working temperature, combustibility, initial cost, life expectancy, and structural strength.

Cast Iron Soil Pipe. The term “soil pipe” goes back to the origins of plumbing. The name, which predates the term “sanitary waste,” refers to a piping system designed to carry “night soil.” Cast iron soil pipe (CISP) is manufactured to ASTM A 74 for service and extra-heavy pipe and fittings and CISPI 301 and ASTM A 888 for no-hub pipe and fittings. Extra-heavy and service soil pipe and fittings are commonly joined with compression gaskets conforming to ASTM C 564 but also may be joined with lead and oakum. No-hub pipe and fittings are joined with shielded couplings conforming to CISPI 310, ASTM C 1277, or ASTM C 1540 and a thermostet gasket conforming to ASTM C 564. Frequently overlooked in project specifications, ASTM C 1540 is a relatively new standard for heavy-duty no-hub couplings. (See Summary of Standards sidebar.)

CISP is most commonly manufactured from gray cast iron. The graphite content provides cast iron with natural corrosion resistance to sanitary effluents. Products produced by members of the Cast Iron Soil Pipe Institute (CISPI) are manufactured from 100 percent post-consumer recycled content, which is becoming increasingly important for Leadership in Energy and Environmental Design (LEED) certification under the U.S. Green Building Council. Additionally, cast iron can be readily recycled at the end of its service life.

The most current versions of ASTM A 888, ASTM A 74, and CISPI 301 all require the raw material to be 100 percent screened for radioactive material (yes, this has happened with other cast products). The standards also require the iron to be subjected to spectrographic analysis to ensure that it meets specified metallurgical content. Tensile strength testing also is required; test bars must meet or exceed 21,000 pounds per square inch (psi). Finally, CISP pipe is required to be date-coded so that records for a lot of pipe can be matched to quality control (QC) records. According to the standard, QC records must be maintained for a period of seven years and must be made available upon request.

A rigid piping system, CISP offers great structural strength, which significantly reduces hanger requirements and provides consistent fall. CISP has a maximum working temperature of 212°F with ASTM C 564 gaskets (higher for lead and oakum joints) and good corrosion resistance to sanitary effluent. ASTM E 136 classifies cast iron as a non-combustible material, making it acceptable for use in plenum spaces.

PVC DWV. PVC has a high strength-to-weight ratio, broad chemical resistance, and the unique ability to be solvent welded, which forms a permanent cross-molecular bond between pipe and fittings. These performance characteristics, combined with its relatively low cost, make PVC the most widely used piping material in the world. PVC DWV is manufactured to ASTM D 2665, which is a system standard addressing solid wall PVC pipe, fittings, and solvent cement. Solid wall PVC also is commonly manufactured and listed to ASTM D 1785 for pressure-rated pipe and is thus dual marked. Cellular, or foam, core pipe is manufactured and listed to ASTM F 891 and is suitable for non-pressure applications only. Cellular core PVC pipe is designed to be used with ASTM D 2665 fittings. Solvent cements shall conform to ASTM D 2564. Primer is required to join PVC properly and shall conform to ASTM F 656.

Pipe and fittings manufactured to ASTM D 2665 or ASTM F 891 are listed to National Sanitation Foundation (NSF) Standard 14, which establishes minimum physical and performance properties, testing frequencies, and health effect requirements for plastic piping systems and is the basis for third-party conformity assessment programs required in most model plumbing codes.

ASTM D 2665 and ASTM F 891 require pipe and fittings to be produced from virgin material. At the end of its service life, PVC can readily be recycled into other products. Life-cycle assessment (LCA) likely will become a requirement of LEED 3.0 to assist in material selection and point qualification. The Plastic
Pipe and Fittings Association (PPFA) is currently developing a life-cycle inventory for several piping materials. Initial indications are that PVC products have relatively low energy requirements and carbon dioxide emission impacts.

PVC is classified as a combustible material; however, it has a low heat contribution of approximately 5,000 British thermal units per pound (Btu/lb), and, due to a high limiting oxygen index of 40, it cannot support combustion in the Earth’s atmosphere. However, PVC will not pass an ASTM E 84 or ULC S102.2 test with index values of less than 25 flame spread and 50 smoke developed; therefore, it will not meet the requirements for inclusion in plenum areas found in mechanical codes. Listed firestop devices or collars conforming to ASTM E 814 must be used when penetrating a fire-rated assembly.

PVC DWV has a low initial cost, excellent resistance to chemical and sanitary effluents, and a maximum working temperature of 140°F. However, as a flexible piping system, it requires greater support and care in underground applications than a rigid piping system. Additionally, PVC will expand approximately 3.6 inches per 100 feet of pipe with a 100°F temperature change. Compensation for thermal expansion should be designed into systems and generally can be accomplished through the use of offsets or expansion couplings.

**UNDERGROUND APPLICATIONS**

The most significant difference between PVC DWV and CISP in underground applications is in the way they support external loads. CISPI and the Uni-Bell PVC Pipe Association provide helpful tools to assist designers in the selection of materials for underground applications.

**Flexible Versus Rigid Piping Systems.** In underground applications, the primary difference between flexible and rigid piping systems is in their failure mode. When rigid piping systems like concrete, clay, and cast iron fail under an earth or live load, they crush. For this reason, rigid piping systems can be evaluated with a ring crush test, and the derived values can be used to verify that the pipe will withstand the required external load. Flexible piping systems like PVC, ABS, and steel are considered to be in a failed condition when earth or live loads have caused the pipe to deflect beyond a certain point. Therefore, different approaches are required to evaluate cast iron soil pipe and PVC DWV for underground drainage applications.

**CISP in Underground Applications.** Evaluating CISP for required earth or live loads is relatively straightforward. CISPI publishes maximum crush load data on no-hub, service, and extra-heavy cast iron soil pipe in the *Cast Iron Soil Pipe and Fittings Handbook*, copies of which are available from CISPI and its member companies. Excerpted data from the *Handbook’s Maximum Crushing Load table* is shown in Table 1. The table also demonstrates that extra-heavy soil pipe can withstand up to 58 percent greater crush load than service weight, which is useful to designers working with applications subject to demanding live loads or sheer forces.

The *Handbook* provides tables containing earth load and live load values for varying trench widths and depths. This data can be used in combination with maximum crush load tables to evaluate soil pipe for a specific application. Additionally, the *Handbook* publishes tables for maximum allowable trench depth, which indicate the maximum burial depths for soil pipe. Excerpted data from the *Handbook’s *Deep Burial* table* is shown in Table 2.

To install CISP underground, the trench can be dug to a minimum width to accommodate the size of the pipe. The trench bottom should provide uniform support; no special bedding is required unless the pipe is being installed on rock. Backfill requires no special procedures, except that it is free of large rocks. CISPI 310 no-hub couplings may be used for aboveground or belowground installations. However, service and extra-heavy hub pipe systems offer greater resistance to sheer forces and may be easier to install in underground applications. A common practice is to specify no-hub aboveground and service or extra heavy belowground.

**PVC DWV in Underground Applications.** A commonly asked question is “what is the crush strength of PVC pipe?” The questioner often wants a simple answer in tabular format and is sometimes frustrated with the complexity of the answer. As a flexible system, PVC pipe works with the surrounding soil to support an earth or live load, termed the “soil-pipe mechanism.” For that reason, the crush strength of a section of PVC pipe in a press without the support provided by the surrounding soil is not relevant. The Iowa Formula, attributed to Merlin Spangler, is commonly used for this purpose. The Uni-Bell PVC Pipe Association publishes a very helpful calculator based on the Iowa Formula that is available as a free download from its website (www.uni-bell.org). Uni-Bell’s *Handbook of PVC Pipe* is an excellent and inexpensive reference that aids in use of the calculator. The Uni-Bell calculator allows a designer to input variables specific to the application, including

### Table 1  Maximum crushing load data

<table>
<thead>
<tr>
<th>Pipe Size (in.)</th>
<th>No-hub</th>
<th>Service Weight</th>
<th>Extra Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>6,617</td>
<td>7,680</td>
<td>9,331</td>
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<tr>
<td>3</td>
<td>4,542</td>
<td>5,226</td>
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<tr>
<td>4</td>
<td>4,877</td>
<td>4,451</td>
<td>8,324</td>
</tr>
<tr>
<td>5</td>
<td>3,999</td>
<td>3,582</td>
<td>6,739</td>
</tr>
<tr>
<td>6</td>
<td>3,344</td>
<td>2,997</td>
<td>5,660</td>
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<tr>
<td>8</td>
<td>3,674</td>
<td>3,674</td>
<td>6,546</td>
</tr>
<tr>
<td>10</td>
<td>4,317</td>
<td>4,317</td>
<td>7,465</td>
</tr>
<tr>
<td>12</td>
<td>3,632</td>
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</tr>
<tr>
<td>15</td>
<td>4,742</td>
<td>4,727</td>
<td>7,097</td>
</tr>
</tbody>
</table>

**Source:** *Cast Iron Soil Pipe and Fittings Handbook*

### Table 2  Deep burial data

<table>
<thead>
<tr>
<th>Pipe Size (in.)</th>
<th>Maximum Trench Depth (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No-hub</td>
</tr>
<tr>
<td>2</td>
<td>189</td>
</tr>
<tr>
<td>3</td>
<td>89</td>
</tr>
<tr>
<td>4</td>
<td>73</td>
</tr>
<tr>
<td>5</td>
<td>49</td>
</tr>
<tr>
<td>6</td>
<td>34</td>
</tr>
<tr>
<td>8</td>
<td>35</td>
</tr>
<tr>
<td>10</td>
<td>42</td>
</tr>
<tr>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>15</td>
<td>31</td>
</tr>
</tbody>
</table>

**Source:** *Cast Iron Soil Pipe and Fittings Handbook*
FEATURE: PVC OR CISP?

maximum allowable deflection, soil modulus, load parameters, additional live loads, pipe diameter, and pipe stiffness. Pipe stiffness values for these equations can be taken from the applicable ASTM standards and are available from pipe manufacturers. It's worth noting that stiffness is constant for each pipe diameter for pipe manufactured to a dimensional ratio but varies by pipe diameter for ASA B36.10 Schedule 40 and 80 PVC systems.

Figure 1 shows the output from the Uni-Bell calculator for 6-inch (6.625 outside diameter) ASTM D2665 PVC DWV pipe with a pipe stiffness of 150 lb/in./in. using variables selected for this example. The first graphic shows the external load that the pipe is subjected to in pounds per feet to a burial depth of 30 feet. The second table shows the impact of the external load on the pipe as a percentage of deflection. For many piping systems, 5 percent to 7.5 percent deflection is commonly used to define the point of failure. For the purposes of this discussion, we will use the more conservative 5 percent deflection. In this example, the data presented shows that 6-inch ASTM D 2665 PVC DWV pipe is suitable for burial to a depth of 28 feet with an earth load of 1,855 lb/ft.

Flexible piping systems like PVC are dependant on proper compaction and backfill for their ability to withstand an external load. Naturally, if these systems are not installed correctly, they will not be able to withstand the loads they were designed to carry. ASTM D 2321 is an excellent standard for the installation of PVC in underground applications. This standard, which contains details on bedding and backfill for varying soil conditions and required trench widths, is an excellent resource for specifiers who wish to provide direction for the installation of PVC systems in their projects.

Table 3 provides a high-level comparison of the underground installation requirements for CISP and PVC DWV.

WHAT ABOUT CELLULAR CORE?

Cellular, or foam, core PVC pipe was introduced in the United States in the 1980s. It is extruded with a layer of foam sandwiched between an inner and outer layer of solid PVC. The advantages of cellular core PVC (or ABS) include reduced weight, reduced cost (approximately 25 percent), and quicker cutting. Figure 2 shows the inner and outer PVC layers with the cellular core stained orange for identification.

Because cellular core pipe can be used only for drainage applications and solid wall PVC is dual marked for both pressure and
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Viega Brass PEX Crimp Fittings
A high quality, proven dependable connection system, perfect for residential applications.

Viega PolyAlloy PEX Crimp Fittings
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drainage applications, some specifiers believe that solid wall is a more robust product better suited to commercial applications. Table 4 shows that 2-inch solid wall PVC pipe has twice the stiffness of cellular core pipe. However, as the pipe diameter increases, the performance gap is reduced until the values merge at 8 inches.

Using the Uni-Bell calculator and the pipe stiffness data in Table 4, with variables selected for this example, we can calculate deflection of 3 inches (3.500 OD), 4 inches (4.500 OD), 6 inches (6.625 OD), and 8 inches (8.625 OD) for solid wall and cellular core pipe. The results, compiled in Table 5, indicate that both the solid and cellular core pipe can withstand earth loads to a depth of 22 feet before deflection exceeds 5 percent. Thus, when properly installed, both solid wall and cellular core PVC pipe are suitable for commercial underground applications. As always, the final determination belongs to the designer and is dependent on the application.

Because of the countless variables involved in designing commercial underground drainage applications, it is crucial that design engineers have the tools and resources necessary to make decisions on the best material to use. The most experienced plumbing designer or engineer may find the differences in the performance properties of PVC and cast iron soil pipe drainage systems complex. By using the available industry resources to weigh the requirements of an application against cost and ease of installation considerations, design engineers can make the best determination about which material to use.

**RESOURCES**


### Table 4 Pipe stiffness data

<table>
<thead>
<tr>
<th>Pipe Diameter (in.)</th>
<th>Pipe Stiffness (lb/in./in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F 891 Foam Core</td>
</tr>
<tr>
<td>2</td>
<td>300</td>
</tr>
<tr>
<td>3</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
</tr>
<tr>
<td>6</td>
<td>120</td>
</tr>
<tr>
<td>8</td>
<td>100</td>
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Source: ASTM F 891 and ASTM D 2665

### Table 5 Pipe deflection percentage

<table>
<thead>
<tr>
<th>Depth (ft)</th>
<th>3.500 Foam Core (P.S. 300)</th>
<th>4.500 Solid Wall (P.S. 510)</th>
<th>4.500 Foam Core (P.S. 200)</th>
<th>6.625 Solid Wall (P.S. 310)</th>
<th>6.625 Foam Core (P.S. 120)</th>
<th>8.625 Solid Wall (P.S. 150)</th>
<th>8.625 Foam Core (P.S. 100)</th>
<th>8.625 Solid Wall (P.S. 100)</th>
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</thead>
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<tr>
<td>2.00</td>
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<td>0.17%</td>
<td>0.31%</td>
<td>0.24%</td>
<td>0.39%</td>
<td>3.60%</td>
<td>0.42%</td>
<td></td>
</tr>
<tr>
<td>4.00</td>
<td>0.48%</td>
<td>0.33%</td>
<td>0.62%</td>
<td>0.47%</td>
<td>0.79%</td>
<td>0.71%</td>
<td>0.85%</td>
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</tr>
<tr>
<td>6.00</td>
<td>0.72%</td>
<td>0.50%</td>
<td>0.92%</td>
<td>0.71%</td>
<td>1.18%</td>
<td>1.07%</td>
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<tr>
<td>8.00</td>
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<td>0.66%</td>
<td>1.23%</td>
<td>0.94%</td>
<td>1.58%</td>
<td>1.43%</td>
<td>1.70%</td>
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<tr>
<td>10.00</td>
<td>1.21%</td>
<td>0.83%</td>
<td>1.54%</td>
<td>1.18%</td>
<td>1.97%</td>
<td>1.78%</td>
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<tr>
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<td>2.50%</td>
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<td>16.00</td>
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<td>2.46%</td>
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<tr>
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<td>3.92%</td>
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</tr>
<tr>
<td>24.00</td>
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<td>5.52%</td>
<td>4.99%</td>
<td>5.94%</td>
<td></td>
</tr>
<tr>
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<td>2.49%</td>
<td>4.61%</td>
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<td>5.91%</td>
<td>5.35%</td>
<td>6.36%</td>
<td></td>
</tr>
</tbody>
</table>

Maximum deflection: 5%, Soil modulus: 400 psi, Proctor density: 85–95%, Load: Prism

**BILL MORRIS** is Vice President of Technical Services for Charlotte Pipe and Foundry. Bill has more than 20 years of experience in the plumbing industry and is active in a number of codes and standards bodies, including ASTM A-04 Committee on Iron Castings, the National Sanitation Foundation (NSF) Industry Forum on Standard 14, and the Cast Iron Soil Pipe Institute (CISPI) Technical Committee. For more information or to comment on this article, e-mail articles@psdmagazine.org.
### SUMMARY OF STANDARDS

<table>
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<tr>
<th>Standard</th>
<th>Title</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CISPI 310–04</td>
<td>Specification for Coupling For Use In Connection With Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications</td>
<td></td>
</tr>
<tr>
<td>ASTM D 2665</td>
<td>Standard Specification for PVC Drain, Waste, and Vent Pipe and Fittings</td>
<td>The scope of ASTM D 2665 covers both solid wall PVC pipe and PVC DWV fittings. Solid wall PVC pipe is frequently manufactured to comply with both ASTM D 2665 and ASTM D 1785 so that the resulting pipe is dual marked for both pressure and drainage applications.</td>
</tr>
</tbody>
</table>

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Continuous Circulation — Too Hot?

I received an e-mail from a reader who expressed concern that continuously circulating water when using a master mixing valve (ASSE 1017) leads to steadily increasing temperatures, until the domestic hot water reaches the temperature of the water heater or boiler water. He suggested that using a thermostatically activated circulation pump that shuts off at night may be an appropriate solution. However, using a pump that shuts off at night promotes growth of the Legionella bacteria and creates an environment in which someone could be scalded.

LEGIONELLA BACTERIA CONTROL REQUIRES CONTINUOUS WATER MOVEMENT

No system is so well designed that it is immune from Legionella bacteria or conditions that favor its growth. Some portion of domestic water system piping consists of dead legs, has scale deposited on it, or has hidden pockets where bacteria hide. Maintaining circulating water at temperatures of 122–127°F is required to minimize the potential for bacteria colony migration and amplification. Shutting off the hot water circulation pump at night creates the ideal habitat for Legionella bacteria growth: temperatures significantly less than 122°F and stagnant water. Continuous recirculation of hot water flushes the piping, captures migrating bacteria, and transports the bacteria to the heater, where they are exposed to deadly temperatures (significantly above 130°F). Stagnant water allows bacteria to migrate and colonize previously uninhabited areas.

PROPER MIXING VALVE OPERATION

Recirculated hot water return piping must have its flow split, so that part of the flow can be piped to the heater’s domestic water coil, and part can be piped to the mixing valve’s cold water connection when a thermostatic mixing valve is used for temperature control (see Figure 1). This configuration is mandated by International Plumbing Code Section 607.2.3, which states, “Where a thermostatic mixing valve is used in a system with a hot water recirculating pump, the hot water or tempered water return line shall be routed to the cold water inlet pipe of the water heater and the cold water inlet pipe or hot water return connection of the thermostatic mixing valve.”

Proper mixing valve operation adjusts the proportion of hot and cold water admitted to the mixing valve to obtain the desired set-point temperature downstream of the valve. A diverter is perhaps the best description of the return water piping configuration. The water flow is directed to the valve or to the valve via the heater depending on return water temperature. During periods when no water is drawn from the system (no-draw periods), the quantity of water that recirculates remains constant. Even so, a small amount of hot water from the heater coil must be added to compensate for the cooling that occurs as water circulates in the piping loop to maintain a constant temperature.

CAUSES OF OVERHEATING

During no-draw periods, the water system resembles a closed-loop hot water heating system in which the distribution piping serves as a radiator. If the excess heat added by the mixing valve is not dissipated by the time the water completes one pass of the circular distribution piping, the temperature will increase with each additional pass. Either the cycle time needs to be increased by slowing flow—allowing for a longer heat dissipation period—or the heat content of the added water needs to be decreased to maintain equilibrium.

A mixing valve must be selected that will establish and maintain equilibrium throughout the range of operation. The point of highest loading frequently occurs when the maximum hot water demand coincides with the period of lowest cold (makeup) water temperature, and the period of least demand occurs during no-draw periods.

Predicting hot water system operation during no-draw periods is often complicated by poor valve performance at the lower extremes of their operating range. Mixing valves do not shut off flow when the flow drops below the rated range. As long as there is a pressure differential, water will flow, but heat transfer characteristics can be somewhat unpredictable below the normal operating range. Fine-tuning operation of temperature control systems in this range often requires trial and error probing after system startup. Commissioning hot water systems prior to placing them in operation is essential.

Proper selection of the pump, piping, insulation, and mixing valve are interrelated and required to prevent temperature creep. However, compensating for common design and installation errors is possible in many circumstances. Following, I list some of the common mistakes and indicate how improper

**Figure 1** Hot water heater piping with thermostatic mixing valve bypass
The plumbing people prefer.

PEX pipe can give you fits with flow rates—and budgets. Let’s compare two systems: one with 1/2” copper tube (which uses external fittings) and the other, 1/2” PEX pipe (which uses internal fittings). The copper tube system can achieve a flow rate of 5 gallons per minute at a given velocity. But at the same velocity in a PEX system, its restrictive internal fittings reduce flow rate by 60%. To achieve the flow rate of the copper system, you’d have to move up to a 3/4” or larger PEX pipe. And larger pipe costs more and is harder to install, offsetting any savings you hoped PEX would provide.

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Which fitting isn’t fitting?

You’d have to upgrade to a 3/4” PEX pipe to match the flow rate of a 1/2” copper tube at the same velocity.
selection of one component affects the others. When a system operates outside of the design envelop because of an improperly selected component or unusually wide operating range, a thermostatic mixing valve bypass can be installed to prevent temperature creep.

PROBLEM #1: OVERSIZED CIRCULATION PUMPS OR TOO MUCH INSULATION

Circulation pumps should not be oversized. Incorrectly assuming high piping thermal losses or high resistance to flow leads to designing a hot water system that is vulnerable to water temperature creep. Piping loops that don’t cool as quickly as calculations indicate (i.e., they are over-insulated) or that don’t have a sufficient residence time (i.e., pumps are oversized and cause high flow rates) cause water to be returned to the heating plant at temperatures that are too high. Pumps should be selected so that at their no-draw operating point, they circulate the water at a rate necessary to allow a five-degree water temperature drop as the water travels through the loop.

SOLUTION A balancing valve can be installed on the return water piping so that the flow rate can be precisely controlled. Removing insulation may be required in some situations, especially on small systems, to obtain an adequate temperature drop.

PROBLEM #2: AN OVERSIZED MIXING VALVE

Oversizing a mixing valve ensures poor thermal control by causing the valve to operate below its optimal temperature range for a longer period than would be required by a properly selected valve. The heat added to the water by a mixing valve must be matched to the rate of cooling of the water as it completes one pass of the piping loop. When a valve is oversized, it is often difficult to obtain consistent performance even when it appears that the operating parameters are identical. It can be difficult or impossible to achieve adequate control of temperature.

SOLUTION Replace the mixing valve.

PROBLEM #3: UNDERSIZED PIPING

This is similar to problem #1 in that it results in a residence time that is too low; that is, the water flow rate is too high. Piping selection must be matched with pump selection to transport the design volume of water at the design flow rate (for the cooling rate). Undersized piping has a higher surface area per unit volume of water flowing in the pipe than properly sized piping and may perform adequately in regards to heat loss. This can be compromised by the addition of either natural or man-made insulation.

SOLUTION Systems with undersized piping can frequently be salvaged provided the piping is large enough to distribute the maximum instantaneous demand for water. Since the quantity of water in such a system is small due to the small pipe volume and resistance to flow is high, these systems may not be suitable if the rapid fluctuations occur in the operational parameters such as instantaneous demand (see “The Flush Experience” in my article “A 12-Step Program to Eliminate Liability for Hot Water System Injuries” in the January/February 2007 issue of PS&D).

If the demand side of water delivery does not impose instantaneous demands that the system cannot accommodate, adding a balancing valve or flow restrictor may slow the flow sufficiently to allow required heat transfer to occur. However, such a modification must be tested thoroughly, because it will increase resistance to flow and may create locations that do not receive adequate demand of water flow.

Undersizing piping may seem to be a rather obvious design blunder, but it occurs frequently when demands on a properly sized system increase after it is placed in operation. Caution must be exercised in determining if the installed system can be salvaged or if a new one is required.

Perhaps the best solution for systems with undersized piping is to break them up into networks of smaller systems each with its own supply and return piping. In a campus setting, this may require providing supply and return piping for each building rather than feeding them from a common loop. Another option is to increase the temperature of the main distribution piping and install heat exchangers with an isolated local system for each building that receives heat from the main loop.

TUNING THE HOT WATER MIXING VALVE

In buildings where temperature creep is a problem and it is not possible to implement one of the previously mentioned solutions, a manual bypass can be installed around the mixing valve. Most temperature creep problems are solved by obtaining the proper return water pump and heater water loop flow rates. However, occasionally an installed system with incorrectly sized components or a system that requires unusually wide flow rates can benefit from installing a bypass.

A bypass should be installed only after other efforts to balance the heater loop have been exhausted because, once installed, extraordinary diligence is required to maintain the system in a balanced state. An automated bypass valve can be installed, which would bypass water once the return water reaches a preset temperature. Some manufacturers of packaged high-low mixing valves incorporate similar bypasses in their products.

For those who are working with an existing system or who wish to install the piping themselves, the bypass piping should be at least a pipe size smaller than the distribution piping and should contain a check valve and a balancing valve. Automatic valves should respond to a temperature sensor located near the return water pump intake. Initial adjustments can be made during a period of low or no use by opening the bypass balancing valve slowly and monitoring the system until the water temperature stabilizes.

Temperature should be checked frequently after installing a bypass to ensure that the conditions under which the temperature may drift are understood and checked. Environmental conditions change throughout the year. Even if you opt for an automatic bypass, it may require adjusting at least seasonally and perhaps more often depending on variations in user and system parameters.

...continued on page 49
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What Plumbing Designers Need to Know About Valves, Part 2

Part 1 of this series in the March/April 2007 issue covered the functions of the basic manually operated valves—gate, globe, angle, ball, butterfly, and check—which are used to start and stop the flow in a system, regulate flow, and prevent backflow. Part 2 will cover valve materials, components, connections, working pressures, and where to use what type of valve.

Manufacturers must follow codes and standards when constructing valves. They are as follows:

- **AWWA C500**: Metal-Seated Gate Valves for Water Supply Service for gate valves for water and sewage systems
- **AWWA C504**: Rubber-Sealed Butterfly Valves for rubber-seated ball valves
- **MSS SP-67**: Butterfly Valves for butterfly valves
- **MSS SP-80**: Bronze Gate, Globe, Angle, and Check Valves for bronze gate, globe, angle, and check valves

**Valve Materials**

A valve may be constructed of several types of materials, both metallic and nonmetallic. Metallic materials include brass, bronze, cast iron, malleable iron, ductile iron, steel, and stainless steel, and nonmetallic materials are typically thermoplastics.

Bronze and brass valves usually are limited to sizes 2 inches and smaller and are used for water services. Brass valves should not be used for operating temperatures above 450°F (232.2°C), and bronze valves should be limited to uses below 550°F (287.8°C). Cast iron valves commonly are used for water and steam up to 450°F (232.2°C). A higher tensile strength iron can be used in larger sizes. Malleable iron valves are stronger, stiffer, and more durable than cast iron body valves and hold much tighter pressure. This material can withstand tough stresses and shocks. Valves made of ductile iron have a higher tensile strength and good corrosion resistance. Steel valves are recommended for temperatures as high as 450°F (232.2°C) because of the wide variety of alloys in steel. They also are used in high-pressure applications and conditions that may be too severe for iron or bronze bodies. Stainless steel valves are available in a wide variety of alloys and often are used for pure water and other services requiring noncorrosive materials. Seating surfaces, stems, and discs constructed of stainless steel are suitable where foreign materials in the fluids handled could have adverse effects.

Valves constructed of thermoplastics are used widely to carry corrosive fluids where conventional valves are not suitable or other alloy metals are very expensive. It is suggested that thermoplastic valves can be used in 85–90 percent of all utility services.

Many different types of thermoplastic materials are used in the construction of valves, and all standard valve types are available. Generally, plastic valves are limited to a maximum temperature of 250°F (121.1°C) and a maximum pressure of 150 pounds per square inch gauge (1,035 kilopascals). Available valve types and their sizes are given in Table 1.

**Valve Ratings**

Manufacturers rate their valves in terms of saturated steam pressure or pressure of non-shock cold water, oil, or gas (WOG), or both. The rating appears on the body of the valve. A valve with the markings “125” and “200 WOG” will operate safely at a saturated steam pressure of 125 psi (861.3 kPa) or 200 psi (1,378 kPa) cold water, oil, or gas.

The plumbing designer should become familiar with these markings on valves and keep them in mind during a construction inspection. If a valve ruptures, it can cause serious damage and/or injury.

### Table 1 Thermoplastic materials and valve types

<table>
<thead>
<tr>
<th>Valve Design</th>
<th>Materials</th>
<th>Size Range, in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ball, union design</td>
<td>PVC, CPVC, CPVF, PVDF</td>
<td>¾–4</td>
</tr>
<tr>
<td>Ball, compact design</td>
<td>PVC, CPVC</td>
<td>½–3</td>
</tr>
<tr>
<td>Ball, multiport</td>
<td>PVC, CPVC, CPVF, PVDF</td>
<td>½–3</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>PVC, CPVC, CPVF, PVDF</td>
<td>½–10</td>
</tr>
<tr>
<td>Butterfly</td>
<td>PVC, CPVC, CPVF, PVDF</td>
<td>½–24</td>
</tr>
<tr>
<td>Globe</td>
<td>PVC, CPVC, PP</td>
<td>½–4</td>
</tr>
<tr>
<td>Gate</td>
<td>PVC</td>
<td>1½–14</td>
</tr>
<tr>
<td>Ball check</td>
<td>PVC, CPVC, CPVF, PVDF</td>
<td>1–4</td>
</tr>
<tr>
<td>Swing check</td>
<td>PVC, CPVF, PVDF</td>
<td>¾–8</td>
</tr>
<tr>
<td>Labcock</td>
<td>PVC</td>
<td>¾</td>
</tr>
<tr>
<td>Foot</td>
<td>PVC, CPVC, CPVF, PVDF</td>
<td>½–4</td>
</tr>
<tr>
<td>Pressure relief</td>
<td>PVC, CPVC, PP</td>
<td>½–4</td>
</tr>
<tr>
<td>Solenoid</td>
<td>PVC, CPVC, PP</td>
<td>½–1</td>
</tr>
</tbody>
</table>

Source: Facility Piping Systems Handbook
VALVE COMPONENTS

Figure 1 identifies every component of a valve. The stem and bonnet are two very important components to the valve because they are the only moving parts. The stem design is manufactured in four basic categories: rising stem with outside screw and yoke, rising stem with inside screw, non-rising stem with inside screw, and sliding stem.

Stem Construction. The rising stem with outside screw (Figure 2a) and the rising stem with outside screw and yoke (Figure 2d) keep stem threads outside of the valve, away from possible corrosives, high temperatures, and solids in the line that might damage the stem threads. The rising stem with outside screw is ideal where the possibility of sticking is a hazard, such as in fire protection systems. When the hand wheel (which is non-rising) is turned, the stem rises as the yoke bushing engages the stem threads.

The threads are easy to lubricate; however, care must be taken to not damage the exposed stem threads. When using a rising stem valve, the plumbing designer should make sure that sufficient clearance is available to allow a full opening of the valve.

The rising stem with inside screw (Figure 2b) is the most common stem design in bronze gate valves. When this valve is opened, both the hand wheel and stem rise, so the plumbing designer must take caution to ensure enough clearance for this valve to be fully opened.

A non-rising stem with inside screw (Figure 2c) is the valve to use when a requirement for minimum headroom for operation exists. With this type of valve, the stem does not rise, thus reducing packing wear. Because the threads are inside the valve, heat, corrosion, erosion, and solids can damage the stem threads and cause excessive wear. Also, because the stem does not rise when the hand wheel is turned, it is difficult to determine the disk position.

With the sliding stem (Figure 2e), the operation of the stem is linear, straight up and down. There is a lever instead of a hand wheel, and no threads are on the stem. The sliding stem is available on gate and globe valves and is useful where quick closing or opening of a valve is desired.

Bonnet Construction. When choosing a valve, the bonnet should not be overlooked. The bonnet provides a leak-proof closure for the body of the valve. The basic types of bonnet construction include screwed union ring, screwed-in, bolted, and welded designs (see Figure 3). The screwed union ring bonnet is used where valves require frequent inspection or cleaning. While ideal for smaller valves, the screwed union ring bonnet is not practical for large-size valves. The screwed-in bonnet is the simplest and least expensive and usually is used on bronze gate, globe, and angle valves. It also is recommended where frequent dismantling is not required. The bolted bonnet joint is practical and commonly used for large-size valves and for high-pressure applications. If the plumbing designer requires a leak-free body-to-bonnet joint, he should specify a welded construction. The disadvantage of the welded bonnet is that access to the trim parts is not available if repairs are needed.
END CONNECTIONS

Valves come with several different end connections. They are screwed, welded, brazed, soldered, flared, and flanged ends.

Screwed end connections are by far the most widely used. This type of connection is found in brass, iron, steel, and alloy piping materials. It is suitable for all pressures but usually is confined to small pipe sizes.

The welded-end connection is available only in steel valves and is used mainly for high-pressure and high-temperature services. The plumbing designer should specify welded-end connections only on systems that do not require frequent dismantling. There are two types of welded-end materials: butt and socket welding. Butt-welding valves and fittings come in all sizes; socket-welding ends usually are limited to sizes 2 inches and smaller.

Brazed-end connections are available on brass materials. The ends of such materials are designed for use with brazing alloys to make the joint. While brazing is similar to solder joints, a brazed joint can withstand higher temperatures.

Soldered joints are used with copper tubing for plumbing and heating lines. The joint is soldered by applying heat. The solder flows into the joint between the tubing and the socket of the fitting or valve by capillary action. Solder has a low melting point, so soldered joints have limited use in high-temperature applications.

The flared end is commonly used on valves and fittings for metal and plastic tubing up to 2 inches (50.8 millimeters) in diameter. The end of the tubing is flared, and a ring nut is used to make a union-type joint.

Flanged-end connections generally are used where screwed-end connections are impractical because of cost, size, and strength of joint. Large-diameter piping usually requires a flanged-end connection. Flanged ends also make assembly and dismantling easier. When using flanged ends, it is important to match the facings. When bolting iron valves to forged steel flanges, the facing should be of the flat-face design on both surfaces.

See Table 2 for a general list of valves by service type, and the sidebar for a breakdown of valve working pressure ratings by service. Valves are very important to a plumbing system, and care should be taken when selecting the right valve for the application. Always verify the valve’s working pressure to ensure it can handle the system pressure and material; make sure that the fluid being carried through the system will not corrode the valve; and ensure that the valve material won’t have an effect on the fluid.

RESOURCES


<table>
<thead>
<tr>
<th>Service</th>
<th>Gate Valve</th>
<th>Ball Valve</th>
<th>Globe Valve</th>
<th>Butterfly Valve</th>
<th>Check Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot and cold water</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>Compressed air</td>
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<tr>
<td>Vacuum</td>
<td>•</td>
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<tr>
<td>Medical gas</td>
<td>•</td>
<td></td>
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<tr>
<td>Low-pressure steam</td>
<td>•</td>
<td>•</td>
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<td>•</td>
<td>•</td>
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<tr>
<td>Medium-pressure steam</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
<td>•</td>
</tr>
<tr>
<td>High-pressure steam</td>
<td>•</td>
<td></td>
<td>•</td>
<td>•</td>
<td>•</td>
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<tr>
<td>Fire protection</td>
<td>•</td>
<td></td>
<td>•</td>
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<td>•</td>
</tr>
</tbody>
</table>

WORKING PRESSURE RATINGS BY SERVICE

Hot and Cold Water Service

Gate Valves:
- 2 in. and smaller: Class 125, rated 125 psi SWP (steam working pressure), 200 psi non-shock CWP (cold working pressure)
- 2½ in. and larger: Class 125, rated 100 psi SWP, 150 psi non-shock CWP

Ball Valves:
- 2 in. and smaller: Rated 150 psi SWP, 600 psi non-shock CWP

Globe Valves:
- 2 in. and smaller: Class 125, rated 125 psi SWP, 200 psi non-shock CWP
- 2½ in. and larger: Class 125, rated 125 psi SWP, 200 psi non-shock CWP

Butterfly Valves:
- 2½ in. and larger: Rated 200 psi non-shock CWP

Check Valves:
- 2 in. and smaller: Class 125, rated 125 psi SWP, 200 psi non-shock CWP
- 2½ in. and larger: Class 125, rated 125 psi SWP, 200 psi non-shock CWP

Compressed-Air Service

Ball Valves:
- 2 in. and smaller: Mainline valves shall be rated 150 psi SWP, 600 psi non-shock CWP

Butterfly Valves:
- 2½ in. and larger: Rated 200 psi non-shock CWP

Check Valves:
- 2 in. and smaller: Class 125, rated 125 psi SWP, 200 psi non-shock CWP
- 2½ in. and larger: Class 125, rated 200 psi non-shock CWP

Vacuum Service

Ball Valves:
- 2 in. and smaller: Rated 150 psi SWP, 600 psi non-shock CWP

Butterfly Valves:
- 2½ in. and larger: Rated 200 psi non-shock CWP

Medical Gas Service

Ball Valves:
- 2 in. and smaller: Rated 150 psi SWP, 600 psi non-shock CWP
- 2½ in. and larger: Rated 600 psi non-shock CWP

Low-pressure Steam (including service up to 125-psi saturated steam to 353°F [178°C])

Gate Valves:
- 2 in. and smaller: Class 125, rated 125 psi SWP, 200 psi non-shock CWP
- 2½ in. and larger: Class 125, rated 100 psi SWP, 150 psi non-shock CWP
Ball Valves:
- 2 in. and smaller: Rated 150 psi SWP, 600 psi non-shock CWP

Globe Valves:
- 2 in. and smaller: Class 125, rated 125 psi SWP,
  200 psi non-shock CWP
- 2½ in. and larger: Class 125, rated 125 psi SWP,
  200 psi non-shock CWP

Check Valves:
- 2 in. and smaller: Class 125, rated 125 psi SWP,
  200 psi non-shock CWP

Gate Valves:
- 2 in. and smaller: Class 200, rated 200 psi SWP,
  400 psi non-shock CWP
- 2½ in. and larger: Class 250, rated 250 psi SWP,
  500 psi non-shock CWP

Globe Valves:
- 2 in. and smaller: Class 200, rated 200 psi SWP,
  400 psi non-shock CWP
- 2½ in. and larger: Class 250, rated 250 psi SWP,
  500 psi non-shock CWP

Check Valves:
- 2 in. and smaller: Class 200, rated 200 psi SWP,
  400 psi non-shock CWP
- 2½ in. and larger: Class 250, rated 250 psi SWP,
  500 psi non-shock CWP

High-pressure Steam Service (including up to 300-psi saturated steam to 421°F (216°C))

Globe Valves:
- 2 in. and smaller: Class 300, rated 300 psi SWP
- 2½ in. and larger: Class 300, rated 300 psi SWP

Check Valves:
- 2 in. and smaller: Class 300, rated 300 psi SWP
- 2½ in. and larger: Class 300, rated 300 psi SWP

Fire Protection Systems
Globe Valves:
- 2 in. and smaller: Class 175 psi WWP (water working pressure)
- 2½ in. and larger: Class 175 psi WWP

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The reemergence of our core cities as more active and vibrant communities brings pressure and challenges to those who design buildings and their systems. The density of buildings, traffic, the scarcity of land, and a competitive spirit among developers are all factors that work together to push modern buildings higher.

Sometimes, we envision high-rise buildings as towering skyscrapers. While this is the romantic and not always incorrect vision, a “high” rise can be as short as eight to 10 floor levels. The National Fire Protection Association (NFPA) defines a high-rise building as a building with an occupied floor that is 75 feet above the level where the firefighting apparatus would stage firefighting operations. That low threshold requires several specific features to be designed into buildings to promote life safety and allow for emergency responders to safely and quickly access the higher levels of the building, thereby saving lives and considerable invested resources. With that fairly simple definition, all high-rise design challenges should be the same, right? Perhaps some additional discussion is warranted before we make that determination!

PRESSURE PROBLEMS

High-rise design and construction present more than a few special challenges, especially regarding the design of plumbing systems. Some of the biggest challenges to high-rise plumbing design relate to controlling pressure. Pressure is both friend and foe in plumbing systems. Plumbing engineers learn early that as you lift water above a datum, you lose 1 pound per square inch for every 2.3 feet of elevation. While this may seem a reasonable incremental loss, it can be a significant penalty when the water is raised 75 feet; then, a requirement is added to maintain a high minimum pressure at the top of the column. Many designers answer this challenge daily.

For instance, a common condition in a water riser serving a toilet group in an office building supplied with flush valve fixtures requires 25 psi at the most remote fixture. You add a pressure boost system to meet that demand on the top floor. A common complication begins when you stack floors. The combined head pressure may cause the total pressure at the bottom to exceed the allowable safe level as limited by code and materials. This too is a fairly routine condition that often is solved by either placing pressure-reducing valves on each level where pressure exceeds the code maximum or branching from the higher pressure riser to make a pressure zone. This pressure zone uses a central pressure-reducing valve and sub-riser to meet the minimum pressure required at the highest level and the maximum pressure allowed at the lowest level. This particular method has been used successfully in many high-rise building designs.

Supplying adequate water pressure at all levels of the building is critical for building occupants, although economics, basic building functions, and overall heights have significant impact on methods of water supply distribution. Numerous intermediate-height and even very tall high-rise buildings use various pumping schemes. One early method used elevated storage tanks at the top of the building with fill pumps at the bottom of the building, a classic gravity downfeed arrangement. This method evolved into direct pumping systems using multiple pump packages with constant-speed, constant-pressure controls. Both of these methods proved to be reliable...
and affordable through the years, and many such designs are still active today or still are used in current design practices. Continuing improvements and development of variable-frequency electric drives and an ever-increasing emphasis on reducing energy consumption and costs make the variable-speed, direct-pumped package a modern workhorse of the industry.

The critical need to provide adequate flow and pressure gives the high-rise plumbing engineer ample opportunity to practice their craft. A thorough understanding of pumping basics is critical to start with, and one of the most widely recognized sources is the Fluid Handling Training and Education Department of ITT Industries, better known as Bell and Gossett’s Little Red Schoolhouse. From this fundamental training, more advanced texts could include the Pumps and Pumping Systems Handbook, published by ASPE, as well as training brochures published by all reputable pump manufacturers and system packagers. Even the seasoned professional can benefit from occasional review of these texts to refresh some of the basics and rediscover some of the subtleties of pressure booster systems.

**DRAINAGE**

Pressure control on the drainage side presents other challenges. True, water is essentially the same in either system; however, drainage theory holds that considerable air travels downward with the water flow. This theory asserts that water flowing in a vertical pipe tends to adhere to the pipe’s walls, acting very much like a sleeve of water with a hollow core of air, all sliding down the pipe’s walls until it reaches a ratio of approximately 6/24 full of the pipe cross-sectional area. This watery sleeve travels at almost 15 feet per second (fps), propelled by gravity but restricted by friction. When the piping remains vertical, the entrained air is relatively simple to control, but when piping offsets from the vertical, the fluid flow velocity drops considerably, filling the entire pipe diameter. Horizontal, sloped drainage piping should flow in the 4–8 fps range, so it is easy to see that a large slug of water can quickly develop. This can lead to compressing air in the path of the fluid and/or lowering air pressure on the leaving side of the fluid flow. The impact of these fluid and air fluctuations can be controlled by effective use of yoke vents, relief vents, and vent connections at the bases of stacks. Here again, the solutions are largely not unique and have been used successfully on many intermediate-height and even extremely tall high-rise buildings. (For those who are just beginning in this type of plumbing design, a recommended reference is High-rise Plumbing Design, by Dr. Alfred Steele.)

A related concern is the impact of the hydraulic jump on the piping itself. The mass of water and the rapid change of velocity from vertical to horizontal cause this jump. While the pressure associated with this jump is significant, it does not destroy the fitting at the base of the stack. Rather, the movement of the pipe stresses the frictional forces that hold the joint to the pipe, leading to eventual coupling failure. Good design must compensate for the strong thrust that occurs at this change of direction. Successful methods include increasing the horizontal drain size and/or slope, using thrust blocks, or using restraining joints with threaded rod or similar arrangements that mechanically anchor the fitting to the entering and leaving piping.

**VENTING**

Once the water is raised and used, it is discharged to a drainage system that includes an attendant venting system, which is responsible for the flow of air in the drainage piping network. Air is critical to the drainage process because drainage flow is caused by sloping pipes, and the motive force is gravity. Absent air, the drainage would range from erratic to nonexistent. When the water in a pipe flows to a lower area, air must be added to replace the water, or a negative pressure zone will occur. If this zone is near a fixture, air will be drawn into the drainage system through the fixture trap with an easily identified gulping sound and very slow drain performance. This condition leads to poor performance throughout the drainage system and trap seal loss due to siphoning or blowout.

The remedy for this condition is venting. At the individual fixture level, this consists of a fixture vent. As the number of fixtures increases, venting needs do as well, and a venting system evolves, with branch, circuit, and loop vents at the appropriate locations. When dealing with high-rise drainage stacks, a vent stack should be attendant, allowing for pressure equalization and relief along the height and breadth of the system. Aside from relieving pressure in the drainage system, the vent system allows air to circulate in both directions in response to the fluctuating flow in the drainage system. In many high-rise vent designs, where stacks need to offset horizontally on a given floor, a relief vent is required. Although not often highlighted, the building venting system also serves to supplement the vent for the municipal sewer, relieving
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Ammonium Benzoate  Barium Carbonate  Calcium Hypochlorite  Cuprous Chloride
Ammonium Bifluoride  Barium Chloride  Calcium Nitrate  Dextrin
Ammonium Carbonate  Barium Hydroxide  Calcium Oxide  Dextrose
Ammonium Chloride  Barium Nitrate  Calcium Sulfate  Disodium Phosphate
Ammonium Citrate  Barium Sulfate  Can Sugar Liquors  Distilled Water
Ammonium Dichromate  Barium Sulfide  Carbon Dioxide  EDTA, Tetrasodium
Ammonium Fluoride  Barium Acetate  Carbon Monoxide  Ethanol, up to 5%
Ammonium Nitrate  Barium Perchlorate  Carborundum  Ethylene Glycol, up to 50%
Ammonium Sulfate  Barium Perchlorate  Carbonic Acid  Ferric Chloride

Acetic Acid, up to 10%  Arsenic Acid  Calcium Hydrosulfite  Ferric Hydroxide
Acetone, up to 5%  Barium Carbonate  Calcium Sulfite  Ferric Nitrate
Adipic Acid, sat’d in water  Barium Chloride  Can Sugar Liquors  Ferric Sulfate
Alum, all varieties  Barium Hydroxide  Carbon Dioxide  Ferrous Chloride
Aluminum Acetate  Barium Nitrate  Carbon Monoxide  Ferrous Hydroxide
Aluminum Chloride  Barium Sulfate  Carborundum  Ferrous Sulfate
Aluminum Fluoride  Barium Sulfide  Carbonic Acid  Fluosilicic Acid, 30%
Aluminum Hydroxide  Barium Acetate  Calcium Acetate  Formic Acid, up to 25%
Aluminum Nitrate  Barium Perchlorate  Calcium Carbonate  Fructose
Aluminum Sulfate  Barium Chloride  Calcium Carbonate  Glucose

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noxious or even hazardous gases and allowing the sewer to drain without pressure limitation.

**VERTICAL PIPING**

Plumbing engineers must consider the impact of plumbing systems on general construction practices. Most experienced engineers and contractors agree that vertical piping systems are generally more effective than horizontal piping systems in multilevel projects. Vertical piping uses fewer supports, hang- ers, and inserts and requires less horizontal space in ceiling ple-

Altogether, vertical piping is a pretty good bargain; however, it is not without penalty. The penalty of vertical piping is multiple penetrations through structural slabs. Each of these penetrations must be sealed or protected to prevent vertical migration of fire and smoke (i.e., turning the tall building into a tall chimney). Not only is the sealing of penetrations an issue, but the sheer number of penetrations also can be equally difficult. The location of these multiple penetrations is critical to the integrity of the structure and the function of the fixtures even more than the aesthetics of the built environment. Tall buildings require more robust structures, further limiting the allowable space for penetrations. Other structural practices, such as post-tensioned beams and slabs, which serve to lighten the overall building structure, can limit even further the available locations for slab penetrations.

**FIRE PROTECTION**

One area that should not be overlooked in any high-rise design is the fire protection systems. As a minimum, all high-rise buildings should have sprinkler systems on each floor and standpipe systems in each stairwell. These systems have proven themselves throughout the years to significantly save both life and property. The specific type, coverage density, and outlet placement all vary based on the building type, height, and location and local fire authorities. All high-rise buildings containing fire protection systems have large, dedicated fire pumps to provide the flows and pressures required for the individual system.

**MATERIALS**

For most high-rise designs, piping systems can be specified and installed using very standard piping and fittings. Sanitary and vent piping and storm water piping within these buildings are mostly hubless cast iron, selected primarily for availability and quiet operation. Underground sanitary and rainwater piping is hub and spigot cast iron with gasket joints. In some instances, particularly horizontal, large-diameter drainage piping below grade, the piping is ductile iron with mechanical-type joints. This type of piping system is used widely because of its suitability to flow and pressure, availability, and quiet operation, and because it is typically made of post-consumer product, so it is very “green” in application.

Water systems for high-rise buildings are typically Type L copper. Tubing sizes 2 inches and smaller are typically assembled using 95-5 solder; for larger diameter tubing, we usually leave the contractor the choice to braze or use mechanical joints with roll groove fittings. Medical gas distribution is typically Type L copper with brazed joints as outlined by NFPA. Except for extremely tall buildings, these materials generally give good service over a wide pressure range and are within maximum pressure limits by significant amounts. As buildings get taller, many water systems can exert pressures that exceed the safe working pressure of copper tubing. In some areas, stainless steel light wall pipe (Schedule 10) or standard pipe (Schedule 40) is a reasonable alternative to increase safe working pressures. Both of these materials can be joined using roll groove mechanical joints.
COMPLEX HIGH-RISE STRUCTURES

Moving from the very general discussion about basic concepts of design and system coordination, one must consider pressure piping in the water supply and distribution system, as well as general drainage and venting approaches. Finally, plumbing engineers must recognize the impact of plumbing installation on the building structure. All of these discussions apply, in various degrees, to any type of high-rise building: office, condominium, or hotel. These challenges multiply when plumbing engineers design buildings that are more complex because of function, such as hospitals. Typically, hospitals have a higher density of plumbing fixtures than most other types of buildings, leading to more penetrations to serve them.

Hospitals offer a challenge because they require so many more systems. Aside from the routine rainwater, sanitary drain and vent, and cold water systems, hospitals often have other special piping needs, such as laboratory waste, medical gases, or multiple water temperatures to serve patient care or cleaning and sanitizing purposes.

Many hospitals have laboratories, and some other types of institutional buildings may have drainage systems to serve chemical- or acid-using fixtures or equipment. Where this occurs, it is important to define acceptable piping materials, in both suitability to the medium being piped as well as acceptability to the local authority. High silicon iron, borosilicate glass, polypropylene, and PVDF are all commonly used. Different materials have different strengths and weaknesses. Iron and glass piping are almost universally suitable for use with most acids, bases, and similar chemicals. Both are heavy and require more space for installation, but they are not easily attacked by flame or generate heavy fumes and smoke. Simple penetration protection is adequate in most locations. On the other hand, plastic products can be somewhat troublesome for both chemical drainage systems in general and high-rise buildings in particular. They have a narrower list of chemicals that they resist well, and they are more fragile as well as susceptible to failure by flame exposure. Plastics also may cause smoke-generation issues that must be addressed to protect life safety. Resolution of these installations may vary by location and authority having jurisdiction. Regardless of the material and approval received, chemical, acid, and laboratory drainage and vent systems must be separate from the domestic drain and vent systems used throughout the building.

In one recently completed high-rise laboratory building, biological research labs were on the upper four floor levels. Each of these lab spaces was served by an acid- and chemical-resistant drain and vent system, separate from the domestic drain and vent systems, that extended to connect to a monitoring station at the junction with the building sewer. In this case, glass piping was selected, offering the benefits and longevity of that material. On the highest level, a biosafety containment facility was added for critical research in a fully secure environment. Even though this floor used products and materials identical to the adjacent lower floors, the piping circuits were segregated and protected from potential discharge to the environment until passing through a sterilization facility. Even the vents were filtered to prevent uncontrolled discharge to the environment. This containment facility also housed a small population of research animals, which were appropriately safeguarded and cared for, including cage-washing and autoclave equipment to protect against infection. Drainage from this equipment is a high-temperature waste, which often causes difficulty with leakage when using one of the available plastic products.

Multiple water temperatures required for different operations lead to another increase in piping and penetrations. This is not only for the supply side, such as cold water distribution, but also for the circulating hot water piping. Usually each water temperature must circulate independently, but occasionally multiple risers or multiple-temperature circulating piping can be combined to return to the heater or mixing valve. Finally, there are the medical gases. Code requires distribution for patient uses to be horizontal, on each floor, with zone valve boxes and area alarm panels. These distribution systems must be fed from sources that are usually remote, thus requiring another set of supply risers.

AN EXAMPLE

A particular new hospital has a number of additional plumbing design opportunities beyond those associated with high-rise construction. First, this project is an infill project, constructed between two wings of an existing high-rise hospital, one of which is also involved in a vertical expansion and facility upgrade to the ICU floors. A second interesting task was the relocation of several active drainage systems serving the hospital and exiting through this project’s site, which include primary and secondary storm drainage, sanitary drainage, relocation of the grease waste drainage from a significant food preparation area, installation of a new passive-type interceptor, relocation of acid-resistant drainage from a major laboratory function, and installation of a new acid neutralization basin. The new interceptor and neutralization basin and outfalls are located in the private perimeter roadway that surrounds the building.

Another area of coordination with the underground systems is the addition of a new branch from the central utilities on campus, designed and installed as a separate contract by
a separate engineering and contracting team. This included high-pressure steam and condensate, chilled water supply and return, emergency power duct bank, primary high-voltage power supply, telephone, and fiber optic. All of these modifications were required to be completed before the first-floor slab was poured.

Even after the underground adventures were covered, the building continued to present creative opportunities to the design team. The slab spacings were determined to copy those in the existing hospital, which were very short intervals. This led to an approach that is commonly used for hotel-type construction, using multiple vertical risers placed in the toilet chases to serve multiple floors. Of course, this approach was required to be modified because of the irregular stacking of like fixture groups from floor to floor and the relatively large floor plates (varying between 22,000 and 24,000 square feet per floor). Additional complexity was provided by the modern HVAC requirements for medical facilities and the impact of ceiling plenums, high-density communication and data systems, and high ceiling elevations for more spacious aesthetics on typical patient care floors. Interspersed throughout the building are specialty areas, such as isolation rooms, patient preparation, patient step-down recovery, and ADA-accessible patient rooms.

The ultimate solution for the project was a combined system using large, centrally spaced main waste and main vent stacks that allowed each smaller fixture riser to extend to the main stacks individually or as a building drain. The riser diagram that resulted has a distinctive fan- or brush-shaped outline where all piping funnels together into the main stack. In the final configuration, this building ended with three main soil, waste, and vent stacks, two main rainwater stacks, one main water supply riser, and one main medical gas riser.

**IT’S ALL THE SAME, RIGHT?**

As this discussion illustrates, modern high-rise design is often a series of design concepts that must be tested through analysis and coordination and then adjusted during the coordination period to maximize flexibility and constructability. This exercise is critical for all building trades but especially so for plumbing systems, for which piping must be accurately placed or accounted for in the early construction phases, while the fixture mounting and finishing connections are made much later after the piping systems are concealed. It also highlights the need for designers and engineers to be familiar with the work of their peers in other trades. This allows for a certain amount of anticipation between trades, which should be beneficial to the overall project.

In summary, I have quickly reviewed the process of high-rise plumbing design, particularly focusing on pressure control and the impact of piping systems on the general construction of the building. You can see that although many solutions are routine and similar in application, each approach has trade-offs that must be identified, evaluated, and committed to on each unique project. This understanding supports the notion that good engineering is thoughtful and proactive and that good engineers are open to frank discussion and understanding pertaining to their own trade work, as well as that of other trades that are involved in the building.

In design and construction, all high-rise buildings are significant undertakings for everyone involved. All buildings are unique in form and specific design solutions. It takes a collaborative effort and a determined outlook to achieve success in high-rise design and construction. Good high-rise plumbing design makes even the tallest of structures more comfortable and safer for all building occupants, and good engineering and design practices and experiences turn the most daunting high-rise design into a matter of scale.

In the final analysis, I believe the answer to the question is “yes.” It is all the same—all high-rise buildings are such complex organisms that they require close scrutiny and evaluation to maximize the project’s potential for the owner and to create a design that is robust enough to serve the needs of the building for years to come and still provide for affordable construction.

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Photo by David Ropinski
We understand our customers would rather focus on their business, not their wastewater. Environmental regulations for wastewater are getting tougher and more businesses need treatment systems to remove oil, grease and solids from their wastewater. Without proper treatment, a business puts its time, money and reputation at risk.

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Waterless? Are We Sure About This?

My first reaction when I heard about the waterless urinal was that it was a bad idea. No water? Yuk!

Don’t get me wrong—as a plumbing designer, I’m all about water conservation and finding ways to control the nation’s collective water consumption. As a plumber, I’m also concerned about what I consider job one, which is protecting the health of the nation. As I’ve researched the plumbing industry’s new fascination with the waterless urinal, I’ve become somewhat enamored with this new darling of the water conservation crowd. At first blush, the waterless urinal seems to be an excellent way to save mass quantities of our precious water supply. Given the numbers put forth by waterless urinal manufacturers, it seems to be an easy decision to specify and promote the use of waterless technology. Going waterless is also a quick way to garner a few LEED points now and then.

For some years now, waterless urinals have been making their way into plumbing systems across the country. Unlike 1992, when the 1.6-gallon-per-flush water closet was mandated by law and the plumbing industry was forced to comply, now the waterless urinal remains the subject of debate. I am not aware of any jurisdiction or building authority that is prepared to mandate the waterless urinal. The plumbing codes have yet to address the subject. Not surprisingly, plumbers have been less than enthusiastic about the prospect of installing a urinal that has no way to rinse itself after each use. The waterless urinal has its proponents and detractors, and I’d like to explore this issue from both sides.

IN THIS CORNER…

In the green corner (the pure theory corner), we have the proponents. Proponents include plumbing engineers and designers, water authority officials, facility managers, and anyone else interested in water savings, as well as the manufacturers of waterless urinals. They, too, have a vested interest in the waterless urinal, for obvious reasons.

Over in the blue corner (the applied theory corner), we have the detractors. Detractors include plumbers in the field, plumbing unions, and plumbing contractors. I include plumbing contractors in the blue corner because they field the phone calls from customers who have complaints about plumbing fixtures. The maintenance staff also are in the blue corner because they are tasked with the care of the waterless urinal.

I’ll begin with the green corner. The figure most commonly bandied about is 40,000 gallons a year. That’s right: replacing an existing urinal with a waterless fixture can save 40,000 gallons a year. Proponents of waterless fixtures all seem to agree that 40,000 gallons is the number. Now that is impressive!

Recently I’ve been reading all I can on this subject because one of the projects I’m working on requires waterless urinals, a first for me. I came across an article in Wired News dated March 3, 2006. In it was an interview with Randy Goble, director of marketing communications for Falcon WaterFree Technologies in Grand Rapids, Michigan. In the article, he estimates that 50 million flush urinals are ripe for replacement. The article quotes Randy Goble directly as saying, “If we could convert just 10 percent of those to waterless, over 200 billion gallons of water would be saved each year.” Now that is even more impressive!

I’ve read accounts from facility managers and school officials who claim “no problems so far” with the installation of waterless urinals. Plumbing engineers can easily use the 40,000-gallons-per-year savings per urinal as a justifiable reason to specify waterless on all new construction, not to mention retrofits. Based on such figures, one would be silly not to consider replacing all existing flush urinals with the waterless version.

The other favorable aspect of water-free fixtures is that they are said to be more sanitary than flushing fixtures. The Wired News article also quotes a University of Arizona environmental microbiologist as saying, “Water provides an ample breeding ground for microorganisms.” Everyone I’ve asked says urine is sterile. Only when mixed with water does urine become a problem. Really?

With all this good news, one wonders why any flushing urinals remain anywhere. The question is why, more than a decade after they first appeared in men’s rooms, do waterless urinals continue to lack full-scale acceptance and blanket approval?

Well, pure theory is one thing. What about applied theory? That brings us to the blue corner. Some of the most vocal opponents of waterless urinals have been the plumbing unions. Supporters often dismiss the objections of unions, claiming the unions are worried only about losing work. That seems to be a logical conclusion, since waterless fixtures don’t have water pipes and flush valves. Personally, I think plumbers could only benefit if the switch to waterless fixtures was mandated. Plumbers would be responsible for replacing all the fixtures. They still must run the drainpipe and the vent pipe. Public rest rooms still require water closets and lavatories. Urinals only serve about half the population.

It could be that our local plumbing unions are genuinely concerned about public health. Maybe they are concerned about what goes on behind the wall. One waterless urinal manufacturer recommends de-scaling all existing drain piping before making the retrofit. Other requirements point out the need for brass drainage connections for the waterless urinal due to concentrated urine causing damage. Sterile urine causes damage?

The plumbing contractors I’ve spoken to tend to remain suspicious. They quickly are discovering that switching to waterless urinals requires more work than advertised. Far from a “set it and forget it” plumbing fixture, this thing comes with plenty of necessary appurtenances and operating instructions. A special and often-patented trap assem-
bly that requires a special lighter-than-urine liquid must be added to the regular bathroom maintenance schedule. The trap assembly and the trap liquid must be added to the list of consumables that need to be purchased and resupplied for the life of the fixture. Maintenance staff require training in the proper care and feeding of all waterless urinals. Once the plumbers are gone, it’s up to the building staff to maintain the fixtures. Yes, they still need daily cleaning and disinfecting, waterless or not. I’ve heard of several projects where the plumbing contractor has been instructed to install the water rough-in, capped and ready, along with the waterless urinals, just in case.

One of my colleagues asked me, “How do they know it’s 40,000 gallons?” I thought for a minute. In a Zurn brochure, I read that they base their number on 75 uses a day. The formula bases its savings on 1.5 gallons per flush. So, 75 uses times 365 days times 1.5 gallons equals 41,062.5 gallons.

Sorry, but that formula isn’t close to reality. Urinals are almost exclusively commercial fixtures. Adjustments must be applied to allow for weekends and holidays when urinal usage is near zero. Using 1.5 gallons per flush is also incorrect. One gallon or less per flush has been the standard for almost 15 years. In my opinion, a 40,000-gallons-per-year savings per urinal is rather optimistic. I don’t want to tell my customers that they can realize huge water savings if it simply isn’t true. Someone needs to show me a better formula that adds up to 40,000 gallons.

Lastly, but most importantly, the person who is tasked with maintaining the waterless urinal must be considered. I was reading an article in Maintenance Solutions entitled “Making Waterless Work” from January 2005. It chronicles the efforts of the administration of University of Southern Maine as it installed and studied waterless urinals on campus. For the most part, Mr. Waterless Urinal has been a success on campus. In the article is an interesting quote from John Rasmussen, building construction engineer with the University’s Facilities Management Department. “The cartridges have been the biggest sticking point,” he says. “People just do not like to change them. Sometimes supervisors end up doing it, but they shouldn’t have to.”

In the end, the success or failure of the waterless urinal will come down to maintenance. The engineers and installers can do their best as we all move toward sustainable water conservation. We’ll need to save a place on that bus for the maintenance staff—maybe a seat up front. PSD

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Case Study

Domestic Water System Design for High-rise Buildings
Vancouver, British Columbia, is a modern city of 2 million people sitting on the edge of the Strait of Georgia (connected to the Pacific Ocean) to the west, set against a backdrop of the Coast Range Mountains to the north, and bound by the United States border to the south. These geographical constraints, along with steady population growth, have resulted in the engineering and construction of literally hundreds of high-rise buildings, including office buildings, hotels, apartments, condominiums, and multiuse high rises.
I have designed several high-rise building projects over the past two decades and am the plumbing engineer of record for two current high-rise building projects located in Vancouver. Woodwards is a $250 million landmark multiuse redevelopment project on the edge of the city core that includes a 42-story residential condominium high-rise plus a 36-story residential condominium tower. The project also includes commercial retail spaces, government office levels, social housing, a food store, a university performing arts center, daycare facilities, and two levels of underground parking covering the entire city block. A second project, 1133 West Georgia Street in the heart of the downtown core, is a 58-story five-star hotel and condominium high-rise building. These prestigious projects, each with water and mountain views from the upper levels, will sell for well over $1 million per condominium unit.

Providing domestic cold and hot water to the upper floors is a fundamental requirement and provides the main challenge for the plumbing system engineer for a high-rise building project. Many parameters must be considered and many possible solutions exist. The engineer must consider building height, available municipal water pressure, pressure requirements not only at the upper floor but also throughout the building, flow demand, booster pump capacity and control, pipe and valve materials, riser locations, pressure zones, pressure-regulating stations, water heater storage capacity and recovery, water heater locations, domestic hot water circulation or pipe temperature maintenance, space requirements in the building, economics, energy efficiency, and acoustics.

The primary role of the project plumbing engineer is to determine the overall design solution that addresses the technical, physical, and economic aspects of the project, complies with the requirements of local codes, and meets or exceeds the client’s expectations.

Technical input regarding booster pumping equipment options and costs and domestic water heater equipment options and costs was obtained from local manufacturer’s reps. In addition, input on the construction costs associated with some of the various piping options was obtained during value engineering meetings with local trade contractors.

**DOMESTIC WATER PRESSURES**

Water pressures must be established for all points in the domestic cold and hot water systems. The first requirement is to obtain water pressure information from the local water utility company. Water pressure information is determined either by field measurement while flow testing at two fire hydrants in the vicinity of the project site or utilizing a dynamic computerized flow simulation program. Water pressure information should be provided to the project engineer as the winter, or maximum, static pressure, and the summer, or minimum, residual pressure at a designated flow rate. The maximum water pressure information is necessary, as it determines whether pressure-reducing valves are required for the lower levels of the project served directly by municipal pressure. Minimum water pressure information is necessary for sizing the domestic water booster pumps to serve the upper levels of the building.

Information generated by computer simulation can be advantageous, as it can be designed to account for future developments in the area, future upgrades to the municipal water system such as looped systems, and long-term deterioration of pipe capacity. The water pressures provided by the municipality for the hotel and condominium project are 120 pounds per square inch (825 kilopascals) winter static and 95 psi (650 kPa) at 1,000 gallons per minute flow (3,780 liters per minute flow) summer residual pressure. The engineer should consider reducing the minimum water supply pressure information by 10 psi (70 kPa) or 10 percent to account for other unknowns, future variations in the system, or changes to the piping configuration during installation. For this project, the minimum available municipal design pressure is 85 psi (585 kPa).

The second requirement is to account for pressure losses from the municipal water connection to the building’s water supply system booster pumps, including premise isolation backflow prevention devices, water meters, strainers, valves, and pipe losses. For this project, these losses are 10 psi (70 kPa), leaving 75 psi (515 kPa) available at the base of the system at the inlet to the pressure booster pumps.

The next requirement is to establish the residual water pressure required at the plumbing fixtures in the upper levels of the project. Plumbing codes and the ASPE *Data Book* generally state the minimum water pressure at a fixture other than flush valves to be 15 psi (105 kPa) or even less! However, the occupants for this project and many other high-rise condominiums will be people paying $1 million or more for a condominium who may be moving from a single-family home where the water pressure was 50 psi (345 kPa) or more. In hotels where upper-level suites with panoramic ocean and mountain views command several hundreds of dollars per night, the guests similarly will be expecting good water pressure. I recommend a minimum of 40 psi (275 kPa) at the upper levels for these projects.

Plumbing code restrictions and ASPE *Data Book* recommendations limit the maximum water pressure at a plumbing fixture to 80 psi (550 kPa). This pressure comes into effect when we look at pressure zones within the building as later discussed.

Next, the static pressure of the system must be determined. This is the largest pressure component in most high-rise project designs and is the water pressure that occurs based on the height of the piping system from the connection to the municipal water main to the highest plumbing fixture. There is a 0.433-psid (2.98-kPa) static pressure change for each foot of elevation change. For this 58-story project, the static pressure differential is 190 psi (1,310 kPa).

The last pressure that needs to be calculated is the friction loss that results from water flowing through the piping system, which is a function of pipe length, pipe diameter, velocity, volumetric flow in gpm (Lpm), pipe material roughness coefficient, and viscosity. (However, most pipe friction loss tables are based on potable water; therefore, viscosity does not need to be adjusted.) For this project, the friction head is 10 psi (70 kPa). Water velocities were restricted to 5 feet per second (1.5 meters per second) for cold water and 4 fps (1.2 m/s) for hot water and recirculation piping.
The pressure required to be generated by the domestic water booster pumps at the base of the plumbing system can be calculated:

\[
\text{Required pressure} = \text{Residual pressure at the highest fixture} + \text{Static pressure} + \text{Friction losses}.
\]

- Residual pressure at the highest fixture (40 psi [275 kPa])
- Static pressure (190 psi [1,310 kPa])
- Friction losses (10 psi [70 kPa] = Required pressure (240 psi [1,655 kPa])

Minimum available pressure (75 psi [515 kPa]) = Required pressure by booster pumps (165 psi [1,140 kPa])

**EQUIPMENT AND MATERIAL PRESSURE REQUIREMENTS**

The domestic water system must be designed to handle the high operating pressures at the base of the system. In this project, the required pressure at the discharge from the booster pumps is required to be 240 psi (1,655 kPa). Therefore, in addition to the booster pumps, the equipment, piping, valves, fittings, and pipe joints also must be designed, specified, and rated to accommodate the high water pressures at the base of the domestic water piping system. Components with a minimum 250-psi (1,725-kPa) rated operating pressure are required.

The rated internal operating pressure for copper tubing also must be considered in systems with high operating pressures, and the limitation is based on the type of alloy used for the joints. Lead as occurs in 50-50 tin-lead solder never should be used in making joints on potable water systems, regardless of the pressure. For example, tin-antimony 95-5 solder has a maximum operating pressure of only 180 psi (1,240 kPa) at 200°F (93°C) for a 6-inch (150-millimeter) pipe diameter joint. Brazing alloys and silver solder have significantly higher operating pressure limits and should be specified for small-diameter copper tubing, while grooved-end mechanical joint systems may be considered for 2-in. (50-mm) diameter and larger copper tubing.

Note that for taller buildings, water pressure requirements at the base of the system are increasingly higher, unless mechanical rooms are provided at intermediate levels within the building and pumping can be staged in series. At levels further up the building, the pressures are correspondingly lower, and equipment and materials can be designed to lower pressure ratings.

**DOMESTIC WATER PRESSURE BOOSTER PUMPS**

Several domestic water pressure booster pump arrangements were evaluated. The first consideration was to reduce the pumping energy generally associated with booster pump systems. Two factors can contribute significantly to wasted energy. First are systems that incorporate one pump to run continuously, even during low-flow or no-flow periods, and utilize a thermal bleed solenoid valve to dump water that is overheated in the pump casing due to the impeller operating below the demand flow rate. This wastes both energy and water. Second are systems that generate a single water pressure for the entire building that is high enough to satisfy the upper-level fixtures and then reduce that pressure through pressure-reducing valves to satisfy lower-level pressure zones in the building.

The initial design approach for the project was to provide separate booster pumps for each pressure zone in the building with each pump incorporating a variable-speed drive. This would eliminate both of the energy-wasting aspects described above. Each of the five pressure zone booster systems would consist of a simplex pump, with just one additional backup pump that would be interconnected with normally closed valves to all of the zone headers, thus providing backup for each of the zones when one of the simplex pumps was being serviced. The total connected pump horsepower for the project and the total energy consumption were lowest in this scenario. In addition, this arrangement did not require any pressure-reducing stations at the upper floors of the building, thereby increasing valuable floor area and reducing associated adjustments or maintenance work at the public floor levels. However, this scenario required additional risers, one cold water riser and one hot water riser, for each pressure zone in the building, running from the basement-level mechanical room up to the level of each zone. This scenario was presented as the primary system for costing.

The second scenario that was evaluated consisted of one triplex booster package for the cold water system and a separate triplex booster package for the hot water system, with pressure-reducing valve (PRV) stations for each pressure zone, located in valve closets at intermittent floor levels in the building. The domestic water heaters were located in the basement mechanical room on the upstream side of the hot water system pressure booster pumps with their cold water supply at city water pressure.

The third scenario consisted of one triplex booster pump package for the cold and hot water systems, with PRV stations located in valve closets at each pressure zone in the building. To minimize the size of the PRV station closets, the valve stations were staggered, with cold water PRVs on one level, hot water PRVs on a second level, hot water zone circulating pumps on a third level, and hot water zone electric reheat tanks on a fourth level. This pumping scenario required the primary domestic water heaters to be ASME rated for 250-psi (1,725-kPa) operation, as they were located in the basement mechanical room on the downstream side of the booster pumps. However, the lower number of booster pumps and associated interconnecting piping offset the premium cost for the higher pressure rating of the water heaters.

**ACOUSTICAL PROVISIONS**

Acoustic requirements must be considered when designing pressure booster pump systems. Minimizing noise at the source is by far the best practice. Pumps that operate at 1,750 revolutions per minute are generally quieter than pumps that operate at 3,500 rpm if the performance capacity can be achieved. Incorporating variable-speed drives into the pumping system generally reduces sound levels even further and specifically during periods of low-flow requirements, such as at night when sound issues may be most prevalent.

Vibration isolators should be provided on pump bases in all cases except for pumps mounted on slab on grade. The vibration isolators should include seismic restraint mounts in geographical areas with seismic zones, such as on the West Coasts of Canada and the United States. Flexible connectors should be provided on the inlet and outlet connections to the booster pumps or on the connections to the headers where package pump systems are utilized. Flexible connectors constructed of single- or double-spherical neoprene reinforced with Kevlar with built-in retention rings are recommended over braided stainless steel flexible connectors for two reasons. They permit axial movement as well as lateral movement, and in addition they provide attenuation of noise.
transmission in the fluid and piping due to the change in internal shape of the connector. Spring isolators should be considered on the domestic water pipe hangers and supports within the pump room to further mitigate pump noise from transmitting into the structure.

A prudent plumbing engineer should recommend that the client retain a project acoustical consultant to provide recommendations regarding the domestic water pressure booster pump and piping systems. It is far more expensive to remediate noise issues after the project is completed and occupied than to incorporate them into the original design.

DOMESTIC HOT WATER SYSTEM AND EQUIPMENT

The development permit for the project has very specific height restrictions, and constructing an additional level of million-dollar penthouse suites in lieu of a penthouse mechanical room forced the mechanical equipment, including the domestic water heaters, down to the basement-level water-entry mechanical room. Utilizing central-plant, natural gas-fired domestic water boilers at this low level in the building would have been prohibitive due to the high water pressure, routing, and termination requirements of the flues.

Individual electric water heaters located within a closet in each suite were considered and initially favorably priced by one of the plumbing trades; however, this option did not proceed based on the required floor space and loss of closet space within the units, lack of equipment diversity utilizing individual water heaters compared to a central plant system, maintenance and eventual replacement requirements within each suite, and the upsizing of electrical power requirements and distribution within the building.

Downtown Vancouver has a central steam distribution system operated by a private utility company, and steam service was incorporated into the project for HVAC systems as well as domestic hot water generation. Steam to high-temperature heating system heat exchangers were specified by the HVAC engineer, and heating system double-wall immersion heaters were specified for the domestic water heater tanks. Two systems were designed in parallel to provide part-load performance during maintenance periods.

Two system options were considered. Initially, it was anticipated that ASME hot water storage tanks rated for the high-pressure system requirements would be very expensive. Therefore, the first option considered using separate booster pumps for the cold water and hot water supply systems. A low-pressure municipal cold water line would supply cold water to low-pressure-rated water heaters, and downstream separate hot water booster pumps would distribute hot water throughout the building.

Pricing was obtained from a local pump supplier and a storage tank supplier; the costs were evaluated; and the final design solution incorporated one set of booster pumps, double-wall primary heating water to domestic hot water heat exchangers, and ASME high-pressure-rated domestic hot water storage tanks.

DOMESTIC WATER PIPE DISTRIBUTION SYSTEM RISERS AND MAINS

Several configurations of pipe distribution systems may be employed to distribute cold and hot potable water to the suites. Three configurations were considered for this project.

The first configuration consists of a triplex domestic water booster system located in the mechanical room at parking level P-1 supplying water to a main 8-in. (200-mm) diameter potable water riser. Pressure-reducing stations are provided in valve closets to develop pressure zones of approximately six stories per zone. The pressure-reducing stations consist of two PRVs in parallel, each sized for 50 percent demand with no manual bypass, as the pressure would be too high if the manual bypass valve was opened. This keeps the pressure within the zone between approximately 40 psi (275 kPa) at the suites at the top of each pressure zone and 70 psi (480 kPa) at the suites at the bottom of each pressure zone. Downstream of the pressure-reducing stations, subrisers then distribute water to each floor level within the pressure zone. At each story, a floor isolation valve is provided, and distribution mains are routed in the corridor ceiling to suite isolation valves and then into each suite. One advantage of this system compared to others is that all risers and horizontal piping are routed through common areas, and the only piping within a suite is the piping serving fixtures within that individual suite.

A second configuration consists of the same triplex booster pump system, main water riser, and PRV stations approximately every six stories as described. In this configuration, only one horizontal distribution main is routed in the corridor ceiling at the lowest level of each pressure zone, and in turn supplies subrisers located within each set of stacked suites. Isolation valves are provided at the base of each subriser and at the connection to each suite. The obvious disadvantages of this configuration are that common riser piping is routed through individually owned suites and that if the subriser needs to be shut down, all suites on that riser also are required to be shut down.

One negative aspect of most domestic water booster systems where more than one pressure zone is required is that most of the pumps’ energy is wasted. This is because the full volume of water for the building is boosted by the pumps to the pressure required at the highest story in the building, and then the pressure is reduced through PRV stations at all pressure zones except the highest zone. With increased emphasis on energy conservation and sustainable design, this led me to a third configuration that I had not heard of previously and do not know of being implemented in any projects to date, which excites me. The wasted energy consumed by PRV stations can be eliminated by designing dedicated booster pumps with variable-speed drives for each pressure zone. Therefore, only the pressure required at any given zone in the building is developed, and only the associated pump energy is consumed.

To reduce capital cost compared to providing duplex or triplex booster pump packages for each pressure zone, a single booster pump with a variable-speed drive is provided for each pressure zone, and one additional backup pump is provided for the entire building, sized for the upper pressure zone with manual interconnected piping and valves such that it could serve any zone in the building as required during servicing or replacement of any dedicated zone booster pump. The pump energy savings is approximately 50 percent, as the full volume of water for the building only is required to be boosted to the average pressure for the building. The capital cost of the pump...
equipment is reduced as total horsepower is reduced, as is the total connected electrical load, and pressure-reducing stations at intermittent valve closets throughout the building are not required.

The offsetting increase in capital cost is the increased number of risers and total length of riser piping and insulation, plus the interconnecting piping and valves to each of the pumps and the associated installation costs. On building projects where the client will be paying both the capital and long-term operating costs, the payback period may be worthwhile. Unfortunately, in the developer’s world where capital cost is king and operating costs are paid by a multitude of unknown owners in the future, payback periods are generally not marketable or sufficient to support these creative engineering solutions.

DOMESTIC WATER PIPE DISTRIBUTION WITHIN THE SUITES

Traditionally in Vancouver, water distribution piping has been Type L copper tube manufactured to ASTM B 88 standards, with wrought copper fittings and 95-5 soldered joints. Distribution piping has been routed within drop ceiling spaces and down within partition walls to the plumbing fixtures. The recent rise in the cost of copper materials and the labor cost of installation necessitated a trend to a different solution.

Over the past several years, cross-linked polyethylene (PEX) tubing has been used extensively. The material has several advantages, including lower material capital cost, lower installation cost, less joints and therefore less potential locations for leaks in concealed spaces, faster installation, and no potential for corrosion by aggressive local municipal water conditions, which has contributed to pinhole damage and expensive replacement of entire copper potable water systems in high-rise buildings. The common installation within a suite consists of brass isolation ball valves on the cold and hot water supplies generally located in a closet wall, short ¾-in. (19-mm) or 1-in. (25-mm) diameter headers with several ½-in. (12-mm) connections, and individual runs of PEX tubing from the headers to each plumbing fixture. The PEX tubing is routed within the structural floor slabs, and one major PEX tubing supplier has obtained a tested third-party listing for a two-hour fire separation rating. Quarter-turn mini ball valves are provided at each plumbing fixture, and water hammer arrestors are provided at dishwashers and clothes washers.

SUMMARY

Many variables must be considered during the engineering of domestic water systems for high-rise buildings, and many design solutions are available to the plumbing engineer. The water pressures vary at each level throughout the building and always must be considered in system layouts and when selecting equipment and pipe materials. Energy efficiency, space allocations, economics, and acoustics all play important roles in a successful project delivery to the client.
Water Efficiency Equals Energy Efficiency

PART 2: ENERGY USED FOR FACILITY WATER SYSTEMS

As reported in the last issue, “California's Water-Energy Relationship,” a report released in November 2005 by the California Energy Commission, illustrates the relationship between energy and water by stating that 19 percent of California's electricity and 30 percent of its natural gas support the state's water and sewer systems.

This brings a new importance to water-efficiency programs. Reducing the amount of water used in California, even in small amounts, will greatly reduce the amount of energy used by the state. Reducing water brings a double benefit to both the state's economy and natural water ecology.

The report shows that water uses energy in three ways. First, it takes energy to move raw water from the source through the treatment facility and to the point of use. Heating and treating water at the point of use is typically the second largest user of energy in a facility. Third, moving the wastewater away from the facility, treating it, and returning it to the source is another energy user. Reducing the amount of water at the point of use can save energy in all three areas.

This is the second of a series of articles that shows how water usage is linked to energy consumption. In the first article, I looked at the issues regarding how energy is used to transport and treat water and wastewater. This second article discusses the amount of energy consumed to transport water to the point of use. The last article will cover how simple water-efficient designs can save water and, as a result, energy.

TOP ENERGY-CONSUMING WATER SYSTEMS

Domestic water pumping systems used 11,953 gigawatt-hours (GWh) of electrical power in California in 2001. In the California Energy Commission report, domestic water pumping covers a wide range of pumping systems. For example, the study included water pumping for water treatment facilities, waste treatment facilities, and building pumping systems. Water used for crops, irrigation, and livestock was included in a separate line item. (See Figure 1.) According to the report, the following systems were the top energy consumers in California in 2001:

- Residential clothes drying used 5,769 GWh and 145 million therms of natural gas. While this activity is not directly related to plumbing engineers, it is important to know the amount of energy used in clothes drying.
- Residential water heating used 2,352 GWh and 1,079 million therms of natural gas. Residential water heating usage was broken into different categories. This line item did not include power used for clothes washing or dishwashing.
- Residential indirect hot water heating for clothes washing used 1,053 GWh and 486 million therms of natural gas. This energy usage is separate from general residential water heating usage.
- Residential washing machines used 726 GWh. This is the amount of energy used to operate the washing machine. It does not include the amount of energy to heat water for clothes washing. Similar to the clothes drying line item, this is not an item specified by the plumbing engineer.
- Residential indirect hot water heating for dishwashing used 686 GWh and 316 million therms of natural gas. While these systems use a great deal of energy, they do not use as much as residential systems state-wide.
- Residential dishwashing used 1,004 GWh. The energy used to heat the water was not included in this category.

These systems alone account for nearly 5 percent of the state's energy use. While not all of these systems are related to the systems that plumbing engineers directly specify, it is important for the plumbing engineer to know about them.

POWER GENERATION LOSSES

It is important to remember some significant factors about power generation as we look at energy conservation. The process to bring energy to a typical user involves many steps.

Consider coal, for example. Energy is used to mine and deliver coal to a coal-fired electrical power plant. Energy is used to remove the raw material from the earth with the use of earth-moving or mining equipment. More energy is used to pro-

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Figure 1 Top sectors of water consumers in California

<table>
<thead>
<tr>
<th>Sector</th>
<th>Description</th>
<th>2001 California Energy Consumption by End Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2001 California Energy Consumption by End Use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2001 California Energy Consumption by End Use</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adjusted Electricity (GWh)</td>
</tr>
<tr>
<td>AG &amp; WP</td>
<td>Domestic Water Pumping</td>
<td>11,953</td>
</tr>
<tr>
<td>AG &amp; WP</td>
<td>Crops</td>
<td>3,284</td>
</tr>
<tr>
<td>AG &amp; WP</td>
<td>Irrigation Water Pumping</td>
<td>2,269</td>
</tr>
<tr>
<td>AG &amp; WP</td>
<td>Livestock</td>
<td>1,216</td>
</tr>
<tr>
<td>RESIDENTIAL</td>
<td>Clothes Drying</td>
<td>5,769</td>
</tr>
<tr>
<td>RESIDENTIAL</td>
<td>Water Heating</td>
<td>2,352</td>
</tr>
<tr>
<td>RESIDENTIAL</td>
<td>Indirect Hot Water Heating for Clothes Washing</td>
<td>1,053</td>
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<tr>
<td>RESIDENTIAL</td>
<td>Washing Machine</td>
<td>726</td>
</tr>
<tr>
<td>RESIDENTIAL</td>
<td>Indirect Hot Water Heating for Dish Washing</td>
<td>686</td>
</tr>
<tr>
<td>COMMERCIAL</td>
<td>Water Heating</td>
<td>549</td>
</tr>
<tr>
<td>RESIDENTIAL</td>
<td>Evaporative Cooling</td>
<td>519</td>
</tr>
<tr>
<td>RESIDENTIAL</td>
<td>Solar Water Heating</td>
<td>18</td>
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<tr>
<td>COMMERCIAL</td>
<td>Cooling</td>
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<tr>
<td>MINING &amp; CON</td>
<td>Oil and Gas Extraction</td>
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<tr>
<td>INDUSTRY</td>
<td>Publishing and Broadcasting Industries</td>
<td>955</td>
</tr>
</tbody>
</table>

Source: “California's Water-Energy Relationship,” California Energy Commission
cess the raw material into fuel-grade coal. Finally, it takes energy to move the coal to the power generation plant.

This is not the end of the story for power production. The average coal used today has a heating capacity of roughly 18 million British thermal units (Btu) per ton. The Btu content varies in the different types of coal. When coal is burned at an electrical power generation plant, 100 percent of the potential energy of the coal is not generated into electrical power.

The power generating plant can lose 50 percent to 70 percent of the potential Btu power of coal in the actual kilowatts of energy produced as it leaves the plant. The U.S. Department of Energy “has a goal of developing a cost-competitive central power plant capable of 60 percent efficiency with near-zero emissions by 2020,” according to the National Energy Technology Laboratory. Another 10 percent can be lost in the generation lines, substations, and transformers before the power reaches the end user (see Figure 2). When the end user is a plumbing system or a system that handles water, more power is lost in moving and heating the water. Another loss of power in a plumbing system is due to friction when the water flows through the pipe.

(There is a move to require highly efficient motors that meet Table 12-10 of ANSI/NEMA MG-1, the standard for motors and generators, with motor efficiencies in the 85 percent to 95 percent range. In the real world, motors operating in the 75 percent range are not uncommon.)

As a result, a total of 90 percent of power can be lost to get the water to the final end user. This highlights the importance of reducing the amount of water used at the end point. Reducing 5 percent of the water used by the end user greatly reduces the amount of power consumed up the water line to the source and up the power line to the amount of coal that must be extracted from the earth.

POWER LOSSES IN WATER HEATING SYSTEMS

Plumbing engineers are familiar with power losses in domestic water systems. Eliminating these losses can help the building owner reap financial rewards.

Leaks. According to the American Water Works Association, the average house loses 10 gallons of water a day to water leaks. The old rule of thumb is that a drop of hot water a second can cost $1 a month in the homeowner’s electric bill.

Water Heaters. There are many types of water heaters. While electric water heaters are advertised as 100 percent efficient, such claims do not take into account the amount of energy lost with a storage-type water heater when it is not in use or the amount of energy that is lost to transport the power to the point of use.

Typical gas water heaters can be approximately 60 to 80 percent efficient during the heating cycle if perfect conditions exist (electric water heaters can be closer to 80 percent). However, in daily use, these perfect conditions rarely occur. If there is a storage system, heat will be lost when the hot water is not needed.

Instantaneous water heaters are available with higher heating efficiencies and only heat the water when hot water is needed in the system. However, there will be heat losses in the energy source to the water heater system when the system is not in use.

Pumps. Pumping systems in a facility use energy. A typical hot water recirculation pump uses energy to run the pump. If the pump is always on, it will cause the water heater to use more energy to maintain the system’s temperature as the heat dissipates throughout the hot water system.

Using a circulation pump that operates based on the thermal drop-off of the return water is a more efficient choice.

Domestic Water Booster Systems. Variable-speed systems and staged systems vary in the amount of energy they use. A pressure-reducing valve adds to the energy load on the system by reducing the pressure of the system.

Other systems that are not specified by the plumbing engineer such as clothes washers and dryers and dishwashers also consume water and energy.

CONCLUSION

It is important to realize that the cost of energy for a plumbing system is not always on the owner’s electric bill. The cost of energy is a new topic in today’s world and will continue to be an issue in the future of plumbing. There are new concerns about coal power plants and acid rain, air pollution, and carbon dioxide emissions. Nuclear power plants raise concerns about the waste from the plant and security issues when international countries develop nuclear programs. Natural gas, once thought to be in abundant supply, is becoming an expensive import to some governments.

As a result, water and energy conservation on site, along with technologies that can generate energy on site, will grow in importance. The market will encourage manufacturers to develop products to reduce water and energy consumption.

In the near future, the plumbing engineer will have to look beyond the water and electric meter when designing a building. He will have to look at how the energy usage is affecting the local community, state, and country. Once again, the plumbing engineer will have to look at the natural biosphere of a facility and design systems that respect and learn from the natural biosphere.

Next issue, I will look at ways to reduce the amount of total energy that is used in a facility, both the energy at the facility and the energy used to service the facility with clean water and to remove wastewater.

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Good Practice Issues to Consider

It seems that there are “good practice” issues on just about every project these days. Most of these issues can be quashed fairly easily if a specific code provision provides an answer in black and white, but others are more difficult to handle, especially when they pertain to a gray area in the code. Decisions that are left to someone’s interpretation of the code or relate to the correct way to install or apply a system component without specific instructions or defined limitations can be particularly problematic. Sometimes common sense is overlooked; in other cases, a blatant violation of the laws of physics occurs. In these instances, a failure of some sort or another likely will occur. This column discusses a few examples.

ISSUE #1: USE OF MAIN RELIEF VALVES WITH ELECTRIC-DRIVE FIRE PUMPS

This issue involves a fairly common scenario wherein an electric-drive fire pump is oversized for a specific application, and a pressure relief valve is added to limit the system pressure to 165 or 175 pounds per square inch. David Hague discussed the proper way to size a fire pump in the article “Stationary Pumps for Fire Protection” in the September/October 2004 edition of PS&D. In his article, he discussed the fact that sizing a fire pump sometimes can be confusing. I agree with this statement as well as his outlined approach, which I consider good practice. Fire pump sizing can be simplified into two rules. First, the pump must be of sufficient size to provide adequate water capacity and pressure to meet the system demand, with some margin of safety. Second, the pump churn condition (static pressure plus the maximum pressure output of the pump) should not pressurize the system beyond the maximum pressure rating of the system components.

In many cases, it is difficult to properly size a fire pump to meet a fire protection system’s demands without exceeding the rating of standard system components (usually 175 psi) during the churn condition. The best method for dealing with this scenario is to use higher pressure-rated components in the areas exposed to pressure beyond the maximum threshold for standard components. An alternate option is to use a pressure-reducing valve or valves to limit the system pressure under the churn condition. When using this approach, specific design criteria found in NFPA 13: Standard for the Installation of Sprinkler Systems and NFPA 14: Standard for the Installation of Standpipe, Private Hydrant, and Hose Systems must be followed. NFPA 20: Standard for the Installation of Stationary Pumps for Fire Protection does not permit the installation of a pressure-reducing valve prior to the pump discharge isolation valve. (Additional information can be found in the article “Pressure-Regulating Devices” in the September/October 2005 edition of PS&D.)

It seems that a common approach for dealing with this scenario involves the installation of a pressure relief valve between the pump and the pump discharge check valve. The relief valve often is configured to discharge back into the pump suction piping as shown in Figure 1. This is not considered good practice and should be avoided, since NFPA 20 does not permit these devices for this application. Main relief valves are to be used as safety devices with diesel engine-driven fire pumps, where the pumps may be turning faster than normal.

NFPA 20 (2007) Section 5.18.1.1 states, “Where a diesel engine-driven fire pump is installed and 121 percent of the net rated shutoff (churn) pressure plus the maximum static suction pressure, adjusted for elevation, exceeds the pressure for which the system components are rated, a relief valve shall be provided.”

NFPA 20 does not permit the use of a main relief valve to regulate pressure in systems using an electric-drive fire pump. In fact, further clarification is provided in NFPA 20 to emphasize this point. NFPA 20 Section 5.18.1.2 states, “Pressure relief valves shall be used only where specifically permitted by this standard.”

Many contractors and designers still incorrectly use relief valves to regulate the pressure in new fire protection systems or as corrective measures in existing systems with electric-drive fire pumps.

ISSUE #2: DESIGN AND INSTALLATION OF PIPE HANGER ASSEMBLIES

It is common practice for contract drawings to indicate “hangers shall be installed in accordance with NFPA 13,” but the drawings do not show the location of any hangers. This approach requires the contractor to provide the hanger locations and methods on the shop drawings. However, another trend in the industry is for contractors to develop shop drawings without hanger locations. Often, notes are added to the drawings indicating that hangers will be installed in accordance with NFPA 13.

NFPA 13 provisions for working drawings (shop drawings) have been included in the document for a very long time, and there always has been a requirement for hangers to be shown on...
the drawings (NFPA 13 Section 22.1.3). However, many contractors act surprised when comments are issued with a request for hangers to be shown on the drawings.

Contractors in many cases choose to begin installation of sprinkler systems before their shop drawings have been approved. In doing so, they are at their own risk. The addition of hangers on the shop drawings does require additional time and thinking, which apparently are of significant impact during the time crunch to get these documents finished. When hanger locations are not provided on the drawings, pipe fitters in the field are required to make judgments about where to locate the hangers. This may not be a problem with experienced pipe fitters, but it may be a problem with novice pipe fitters.

Relying on pipe fitters to determine the location and type of hangers is problematic for many reasons. In one case, the failure to properly locate hangers contributed to the failure of a 12-inch supply main, which caused significant building damage. In that particular case, hangers were omitted because a large duct crossed the location of the main as shown in Figure 2. Rather than add trapeze hangers to compensate for the duct above the sprinkler main as required by NFPA 13, the hangers were omitted. This resulted in a hanger spacing of approximately 19.5 feet. Fortunately, the failure occurred when the building was unoccupied, so no one was injured or killed.

Support methods also must be shown on drawings to avoid installation problems. For example, rods are meant to have tensile loading and sometimes are installed incorrectly when the loading is in compression. Figure 3 shows the improper use of all thread rods to support a sprinkler main. If the hanger arrangement had been shown on the drawing, this issue likely would have been discovered during a drawing review rather than in the field during installation.

Keep these issues in mind and try to use good practice in your designs and installations.

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**PEER TO PEER**

...continued from page 22

**HOT WATER SYSTEMS ARE ENGINEERED PRODUCTS**

Designing by rule of thumb won’t consistently result in properly operating recirculating hot water systems. Many systems are susceptible to temperature creep due to the improper sizing and selection of system components. Energy management initiatives, such as insulating portions of a system’s piping without calculating the effect on system operation, or aging components can cause temperature creep. Ongoing inspection and adjustment of hot water systems are necessary to maintain temperature control due to changes in domestic water demand and in the firing rate of the heater(s).

Water heaters should be inspected at least daily or per shift in larger buildings, as required by law in some locations. Temperature changes should be logged with an automatic recorder to verify that the system properly controls water temperature after system modifications. The domestic water system should be included as part of that inspection. If an experienced water heater operator is not part of the building’s operation staff, regular inspection by a capable service contractor should be obtained.

It is not uncommon to find hot water systems that deliver water in excess of 180°F to domestic water piping, even though temperature gauges clearly display the elevated temperature readings. I inspected one such building three times over a period of two years, and the elevated temperature reading was approximately the same each time, 180–190°F.

Obtaining proper hot water temperature control requires proper design, construction, ongoing supervision, and occasionally modification to hot water systems to provide proper control. Perhaps the best solution would be to install a combustion computer. These often have the capability to monitor and trend domestic hot water system operation automatically and alert the operator of temperature excursions.
In the last issue, I discussed some of the particular characteristics and some of the problems that set open-loop cooling tower systems apart from closed-loop systems, which generally are used for cooling or heating. But wait! You might have to solve even more problems before you get an open-loop system to operate satisfactorily.

In Figure 1, the condenser water pump is located above the suction source (the tower basin), meaning that a static suction lift exists. Static suction lift has no meaning in closed-loop systems, but it is vitally important in open loops. Sometimes people describe this situation simply as “the pump sucks water up from the source into the pump suction nozzle,” but that is not a very accurate way to think about it. It is better to recognize that the water is being pushed to the higher level by a pressure difference. The higher pressure of the atmosphere acting on the water surface compared to the lower pressure at the pump suction nozzle elevates the water against gravity and also overcomes friction loss in the suction piping. However, atmospheric pressure is 0 pounds per square inch, so the lower pressure at the pump must be a partial vacuum. That is another big difference between open- and closed-loop systems. Closed-loop systems always operate at positive pressures, unless the designer has incorrectly located the compression tank with respect to a high head pump. In this atmospheric, suction lift system, a partial vacuum must exist to elevate the water.

Compared to other kinds of pumps, centrifugal pumps are limited in their ability to produce a partial vacuum at the suction nozzle. If you are planning to use a centrifugal pump in a suction lift, you must evaluate carefully the friction loss in the suction piping and the static suction lift. A working rule of thumb is that the sum of suction lift plus friction head loss, called dynamic suction lift, should be less than 15 feet. If it looks like your system plan results in dynamic suction lift greater than 15 feet, you would be wise to lower the pump or raise the basin. Note that the limit on dynamic suction lift refers to the ability of the pump to move any water at all. The related issue of NPSHA and cavitation prevention has been covered previously in this column.

The check valve in Figure 1 must close when the pump is turned off to keep the pump and suction piping full of water. If there is no check valve or if the check valve leaks, then water drains down to the tower basin, and the pump has lost its prime.

The pump impeller is very efficient at moving water, but it does not move air very well at all. That is why pumps have to be primed, or kept full of water. In a closed-loop system, priming the pump is rarely a problem, since the entire system is full of pressurized water, including the pump. It is possible to install the closed-loop system pump at the top of the system, and a leak could cause the water level to drop below the level of the pump. The pump could lose its prime, but the system leak would have to be substantial, since the compression tank contains at least a little bit of water under pressure to make up for the leak. After the leak is fixed, you can add makeup water to reestablish the proper non-operating pressure in the system through the pressure-reducing valve, or PRV.

The PRV in Figure 2 is equipped with a fast-fill handle that is useful in filling and venting closed systems. In normal operation, the handle must be horizontal, as shown. The PRV that is used for makeup and to set the initial pressure in a closed-loop system also can be used to compensate for a leaking check valve in an open-loop system. My last column discussed a similar use of the PRV to keep the condenser and pump full of water. To solve the problem in Figure 1, determine the elevation difference from the PRV to the top of the piping system and divide that value in feet by 2.3 to get the minimum pressure required at the PRV. Then use the screwdriver adjustment at the top of the PRV to set the pressure. If the check valve is working, static pressure will hold the PRV closed, but if the check valves leak and the level of water above the PRV drops, the PRV will open to keep the pump and piping primed.

**Figure 1** A defective check valve will cause the pump to lose its prime

**Figure 2** Typical pressure-reducing valve

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March through September have been chosen by the ASPE Membership Committee as “member-get-a-member” months, the kickoff for a major chapter-by-chapter membership campaign. The Membership Committee is going all out to entice ASPE members to go out and find and sponsor new members to the Society. (Be sure to place your sponsor’s name and membership number on the ASPE membership application form.)

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Kenneth G. Wentink, PE, CPD, and Robert D. Jackson

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Note: In determining your answers to the CE questions, use only the material presented in the corresponding continuing education article. Using information from other materials may result in a wrong answer.

**CE Questions—“Private Sewage Disposal Systems” (PSD 139)**

1. **The retention period of sewage in a septic tank should be** ________.
   a. 12 hours, b. 24 hours, c. 36 hours, d. 48 hours

2. **The first step in the design of a subsurface soil absorption sewage disposal system is** ________.
   a. ascertain the code requirements
   b. determine the area required for the disposal field
   c. determine whether the soil is suitable for the absorption of the septic effluent
   d. calculate the fixture unit load to be served

3. **The recommended septic tank capacity for a five-bedroom home is** ________.
   a. 750, b. 900, c. 1,000, d. 1,250

4. **The minimum distance between a cesspool and a water supply line, as noted in Table 7, is** ________.
   a. 100 feet
   b. 20 feet
   c. 15 feet
   d. not recommended as a substitute for a septic tank

5. **What approximate percentage of new home construction employs a septic tank/soil absorption sewage disposal system?**
   a. 15 percent
   b. 20 percent
   c. 25 percent
   d. 30 percent

6. **Distribution boxes** ________.
   a. are required by many codes
   b. should be used only when specifically required by code
   c. offer practically no advantages
   d. all of the above

7. **The absorption area to be provided for an individual residence containing three bedrooms with a percolation rate of three minutes is recommended to be** ________.
   a. 100 square feet
   b. 200 square feet
   c. 300 square feet
   d. 600 square feet

8. **A covered pit with an open-jointed or perforated lining into which raw sewage is discharged is called a** ________.
   a. septic tank
   b. cesspool
   c. seepage pit
   d. none of the above

9. **The drain lines for distributing the effluent from the septic tank should be spaced no greater than** ________ apart.
   a. 3 feet, b. 6 feet, c. 9 feet, d. a and b

10. **The quantity of sewage flow from a single-family dwelling per person is** ________ gallons per day.
    a. 50
    b. 75
    c. 100
    d. 125

11. **The primary purpose of a septic tank is to** ________.
    a. distribute raw sewage to the leaching field
    b. chemically treat raw sewage
    c. vent odors to atmosphere
    d. act as a settling tank

12. **Sewage pit connecting piping** ________.
    a. should be laid at a minimum grade of 2 percent
    b. must be 6 inches in diameter minimum
    c. must be a least 5 feet deep
    d. none of the above
This form is valid up to one year from date of publication. The PS&D Continuing Education program is approved by ASPE for up to one contact hour (0.1 CEU) of credit per article. Participants who earn a passing score (90 percent) on the CE questions will receive a letter or certification within 30 days of ASPE's receipt of the application form. (No special certificates will be issued.) Participants who fail and wish to retake the test should resubmit the form along with an additional fee (if required).

1. Photocopy this form or download it from www.psdmagazine.org.
2. Print or type your name and address. Be sure to place your ASPE membership number in the appropriate space.
3. Answer the multiple-choice continuing education (CE) questions based on the corresponding article found on www.psdmagazine.org and the appraisal questions on this form.
4. Submit this form with payment ($35 for nonmembers of ASPE) if required by check or money order made payable to ASPE or credit card via mail (ASPE Education Credit, 8614 W. Catalpa Avenue, Suite 1007, Chicago, IL 60656) or fax (773-695-9007).

Please print or type; this information will be used to process your credits.

Name __________________________________________________________________________________________________
Title __________________________________________________________________________________________________
Access your Membership No. ___________________________________
Organization ____________________________________________________________________________________________
Billing Address ___________________________________________________________________________________________
City ______________________________________ State/Province ______________________ Zip __________________
Country __________________________________________________________ E-mail __________________
Daytime telephone _________________________________ Fax __________________

I am applying for the following continuing education credits:
I certify that I have read the article indicated above.

Signature

Expiration date: Continuing education credit will be given for this examination through May 31, 2008. Applications received after that date will not be processed.

PS&D Continuing Education Answer Sheet

Private Sewage Disposal Systems (PSD 139)
Questions appear on page 52. Circle the answer to each question.

Q 1. A B C D
Q 2. A B C D
Q 3. A B C D
Q 4. A B C D
Q 5. A B C D
Q 6. A B C D
Q 7. A B C D
Q 8. A B C D
Q 9. A B C D
Q 10. A B C D
Q 11. A B C D
Q 12. A B C D

Appraisal Questions

Private Sewage Disposal Systems (PSD 139)
1. Was the material new information for you? ☐ Yes ☐ No
2. Was the material presented clearly? ☐ Yes ☐ No
3. Was the material adequately covered? ☐ Yes ☐ No
4. Did the content help you achieve the stated objectives? ☐ Yes ☐ No
5. Did the CE questions help you identify specific ways to use ideas presented in the article? ☐ Yes ☐ No
6. How much time did you need to complete the CE offering (i.e., to read the article and answer the post-test questions)? ________________
When the ASPE certification program was created more than 20 years ago, the designation provided to those who were certified was CIPE, which stands for Certified in Plumbing Engineering. About seven years ago, the certification designation changed to CPD, or Certified in Plumbing Design. Along with the name change was a requirement for maintaining the certification with continuing education. A total of 24 hours of continuing education is required every two years to maintain the CPD certification.

When the switch to CPD was made, those holding the CIPE designation were granted the opportunity to switch their designation to CPD. Those making the switch were required to maintain their certification with continuing education. For some time, many individuals used the designation CIPE/CPD. However, the concept was to be either a CIPE or a CPD.

As ASPE has striven to gain greater recognition of the CPD, the term CIPE has gotten in the way. We were asked, “What is the difference between CIPE and CPD?” The answer to that question is rather simple and straightforward. Those holding the CIPE designation took a certification exam and passed prior to 2000. Those holding a CPD designation took the same certification exam and passed, plus they maintain their certification by obtaining 24 hours of continuing education every two years.

So, when you answer the question, what looks better? Of course, a CPD looks better as a designation. In today’s world, continuing education has become an important part of any viable certification program.

The ASPE board voted in January to do away with the CIPE designation. Every CIPE, whose address ASPE had in its files, received a letter explaining the change. Everyone was given until April 1 to return a signed letter indicating their intention to change from CIPE to CPD. On April 1, 2007, the CIPE designation was eliminated from ASPE’s files. Everyone who switched to CPD soon will receive a CPD certificate showing an expiration date of March 30, 2009. ASPE no longer will permit the term CIPE to be used.

I have received numerous telephone calls and e-mails regarding this change. Let me answer a few of the most frequent questions.

• “If I did not receive the letter, am I still entitled to the switch in designation?”
  Yes, anyone with the CIPE designation merely has to send a letter to the ASPE office indicating his desire to change his designation to CPD. It is best to indicate the year you took the test, if you remember.

• “What if I missed the April 1 deadline?”
  Don’t worry about the April 1 deadline. The reason I included April 1 as the deadline was to encourage people to act immediately. If I said you had six months, the letter would have disappeared on your desk and have been forgotten. If you have not responded, do so as soon as possible. You will not be penalized. However, after October 1, you will not be able to make the change.

• “I’m retired—do I still need to have continuing education?”
  No, you don’t, if you are completely retired and not working part time. This is explained in the recertification brochure that can be downloaded from the ASPE website, www.aspe.org.

A number of individuals were upset, thinking that ASPE is taking something away or changing the rules midstream. First, ASPE is not taking anything away. An individual who is certified remains certified. Only the designation after your name changes from CIPE to CPD.

As for changing the rules, my best response is to share what happened to me. In 1979, I took the Professional Engineering exam at McCormick Place in Chicago. The State of Illinois issued me a Professional Engineering license. At the time, all I had to do was pay my re-registration fee every two years, and I could remain a Professional Engineer for the rest of my life, assuming I followed all the rules and regulations.

About six years ago, the State of Illinois sent me a letter saying that the rules had changed. Now, if I want to remain a PE, I need to take 30 hours of continuing education every two years. If I don’t maintain my continuing education, I will lose my PE license.

Of the six states in which I am a registered PE, two of them mandate 30 hours of continuing education every two years. Two are discussing a change in the law. The other two states have to be paying attention to what is happening throughout the country.

ASPE took the course of action to strengthen its certification program. Like many states, we have implemented mandatory continuing education. For me, it is easy to justify. I think back to 1979 when I took my PE exam. The way we designed plumbing systems in 1979 is not the way we design them today. Many changes have occurred. How do you keep up with these changes? You do so through continuing education, of course.

I think you will agree that this change to the certification program helps strengthen the CPD and gain the recognition that is deserved for all plumbing engineers and designers.
Earn Continuing Education Units

All Technical Symposium Workshops offer CEUs (continuing education units) and PDHs (professional development hours), both nationally recognized units of achievement that may be used as evidence of increased performance capabilities and for job advancement. ASPE CEUs and PDHs are also valid for PE registration and licensing in all states requiring licensing or registration that do not require prior approval.

(States that have PE registration CEU requirements and/or other licensing requirements and which only require individual responsibility for reporting the CEUs/PDHs include: Alabama, Georgia, Illinois, Iowa, Kansas, Maine, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, West Virginia, and Wyoming.) (States requiring prior approval include: Arkansas, Florida, Louisiana, New York, North Carolina.)

Symposium: An Investment

● The ideas that can be brought back and implemented result in savings worth many times the cost of attending.
● Networking opportunities are impressive and unparalleled — plumbing engineering power and expertise.
● The technical and professional development workshops and collegial interaction create an extraordinary educational environment and opportunity.
● Every technical and professional development workshop provides CEUs.

4 Easy Ways to Register

ONLINE at www.aspe.org

MAIL completed registration form with check, money order, or credit card information to:
ASPE 2005 Technical Symposium
8614 W. Catalpa Ave., Suite 1007
Chicago, IL  60656

FAX completed registration form with credit card information to:
(773) 695-9007

PHONE by calling
(773) 693-2773

See Registration Form — Inside
Symposium at a Glance

THURSDAY DAILY SCHEDULE
1:00 PM to 8:00 PM
ASPE Registration

5:00 PM to 8:00 PM
TECHNICAL SYMPOSIUM PRODUCT SHOW

FRIDAY DAILY SCHEDULE
7:30 AM to 5:00 PM
ASPE Registration

ASPE Pavilion/Book

7:30 AM to 5:00 PM
ASPE Registration

ASPE Pavilion/Book

7:30 AM to 5:00 PM
ASPE Registration

ASPE Pavilion/Book

ASPE Registration

ASPE Pavilion/Book

Program Sessions by Track

Plumbing 101
Green Building
Systems
Special Systems /
Emerging Technologies
Advanced Technologies
Fire Protection

How to Start a Project
Solar Water Heating
Plastic Pipe and Fittings:
for Industrial and
Commercial Buildings
High-rise Systems
NFPA 13 -
Review of New 2007
Revisions

15-minute Break *
10:45 AM to 12:15 PM

15-minute Break *
12:30 PM to 2:00 PM

LUNCH

2:15 PM to 3:45 PM

15-minute Break *
4:00 PM to 5:30 PM

Saturday Daily Schedule
8:00 AM to 5:00 PM
ASPE Registration

ASPE Pavilion/Book

ASPE Pavilion/Book

ASPE Pavilion/Book

Program Sessions by Track

Plumbing 101
Green Building
Systems
Special Systems /
Emerging Technologies
Advanced Technologies
Fire Protection

Hot and Cold Water
Design
Sustainable LEED
Concepts and Design
Part 1
Vivarium Systems
Design (Animal Housing)
Part 1
Siphonic Roof Drain
Design
Residential Sprinkler
Systems

15-minute Break *
10:45 AM to 12:15 PM

15-minute Break *
12:30 PM to 2:00 PM

LUNCH

2:15 PM to 3:45 PM

15-minute Break *
4:00 PM to 5:30 PM

Sunday Daily Schedule
8:30 AM to 1:00 PM
ASPE Registration

ASPE Pavilion/Book

ASPE Pavilion/Book

ASPE Pavilion/Book

Program Sessions by Track

Plumbing 101
Green Building
Systems
Special Systems /
Emerging Technologies
Advanced Technologies
Fire Protection

Water Heater Sizing
Overview of LEED
(Plumbing Engineers’
Portion of Process)
Commercial Kitchen
Design
Investigation of
Plumbing Failures and
Lessons Learned
Seismic Design and
New 2007 Revisions

15-minute Break *
10:45 AM to 12:15 PM

* 15-minute breaks to occur halfway through all

NOTICE: The program sessions that are shown on this page are intended for illustrative purposes only. All program sessions are subject to change including changes in times and dates. Not all sessions or events may be listed. The final Symposium programs, events and speakers will only be listed in the on-site program book available during registration.

Unparalleled Learning Opportunity
ASPE’s Technical Symposium provides a unique forum for workshops that provide the plumbing engineer with information about new developments in the industry and new techniques for practical implementation in the field. ASPE’s 21st Annual Technical Symposium takes place November 2–4, 2007, in Atlanta, Georgia.
Symposium at a Glance

Thursday Daily Schedule
November 1, 2007
1:00 PM to 8:00 PM
ASPE Registration
ASPE Pavilion/Book Store (May be opened at 3:00 PM)
6:00 PM to 9:00 PM

Friday Daily Schedule
November 2, 2007
7:30 AM to 5:00 PM
ASPE Registration
ASPE Pavilion/Book Store
9:00 AM to 12:15 PM

How to Start a Project (Gathering Information, Plumbing Codes, Terminology, and Symboleology)
Joe Smul, P.E.
• Contact Code Official to verify which code has been adopted and is enforced. Inquire if there are any amendments to the code.
• Obtain where municipal sewer and storm water mains are located.
• Obtain location and pressure of municipal domestic water main.
• Obtain information concerning natural gas.
• Review architectural drawings.
• Prepare drainage fixture load calculation.
• Prepare domestic water load calculation.
• Determine the distance of the furthest plumbing fixture or sanitary stack from the municipal sewer.
• Determine if the building sewer main connection to the municipal sewer is above the center line of the municipal sewer. If not, has space been allocated for a sewage ejection system?
• Review domestic water load calculation to determine if a domestic water booster system is required.
• If domestic water booster pump is required, has space been allocated?
• If natural gas is available, has the meter location been determined?
• If domestic gas fixed water heaters are to be used, are the units located in a room in which combustion air can be ducted?
• Review toilet room layout. If water closets are wall hung, are the partitions large enough to accommodate chair carriers?
• In multi-story buildings, are partitions available to receive sanitary stacks, vents, and rainwater conductors?
• During this preliminary design should you discover any changes to the architectural documents, you must contact the architect immediately. DO NOT WAIT UNTIL YOUR DESIGN IS COMPLETED.

A discussion will take place after each one of the above items is identified.
We will also discuss JUST A FEW MEP ITEMS THAT IMPACT A PROJECT.

Friday Daily Schedule
November 2, 2007 (Continued)

Plastic Pipe and Fittings for Industrial and Commercial Buildings
David Chasis and/or Michael Gudahy
• This program will enhance the skills of the professional plumbing engineer/designer by describing engineering data and practices specific to industrial, chemical and other applications of plastic pipe.
• This program will describe engineering design, joining, product availability, applications and selection of TIPS.
• Attendee’s employers and their engineers will benefit by having the most up to date information regarding thermoplastic piping systems like CPVC, PVDF, PP, PE and PVC in multiple applications.
• This will be an intermediate level class.
• Handouts will be incorporated into the seminar/workshop for attendees to refer to and to attempt to answer challenges.

High-Rise Systems
Don Fogg, CPD, P.E.
NFPA 13 - Review of New 2007 Revisions
John Mertens, P.E.
The changes to the 2007 edition of NFPA 13 will be presented along with a review of the major subjects and organization of the standard. An overview of the design method and application of this sprinkler design standard will be integrated with information for those experienced or new to the subject. Subjects included will be occupancy issues, design setup, water supplies, equipment, obstructions, and hydraulics.

Solar Water Heating
Jeff Ross-Bain, P.E., LEED
Solar energy has been used to heat water for ages and is currently getting a lot of attention as industry responds to the need to provide energy efficient systems. Often overlooked, solar thermal systems are a proven way to provide for most of the hot water needs for buildings and can also provide an economical introduction to solar energy systems. Solar thermal systems can be used in residential, commercial, and industrial applications. The LEED Green Building Rating System now recognizes solar thermal as a bona fide renewable energy system.
The intent of this session is to introduce the various types of systems available and describe the best applications for those systems. Additionally, the course will introduce the system rating program developed by the Solar Rating and Certification Corporation (SRCC), a nonprofit organization whose primary purpose is the development and implementation of certification programs and national rating standards for solar energy equipment. The rating system is a means for determining the relative performance of various system configurations.
The session will also discuss the design and installation guidelines developed by the SRCC and contained in their document OG-300. These guidelines describe individual component requirements for solar hot water systems and provide a good basis for confirming that important design and installation issues are covered. Additional references to be introduced include the solar hot water system design guides developed by ASPE and ASHRAE.

12:30 PM to 2:00 PM
Lunch in Ballroom A
Awards, Prize Drawing
2:15 PM to 5:30 PM

Soil, Waste, and Vent Design
Peter Krout, CPD, P.E.

Off-grid Plumbing Design

Hotel and Cold Water Design
Harold Olsen, P.E.
This course is intended to help train the new plumbing or process piping designer, and to provide a review and update for other. The most recent design considerations will be discussed.
The first part of the course will be a discussion of piping materials, piping accessories, piping theory, etc. The second part of the course will be to design the water piping systems for a 3-story office building with a kitchen/catereteria interactive with the instructor.

Learning Objectives:
Students will learn where to start
Will go away with knowledge of piping materials
Will understand what piping accessories are available
Will understand how to size pipe per code

Sustainable LEED Concepts and Design - Enhancing the Plumbing Engineer’s Understanding (Part 1)

Friday Daily Schedule
November 2, 2007 (Continued)

Bob Bowlware, P.E.
A discussion on rainwater harvesting, composting toilets, and the application of green fields for gray water disposal.
As the frontiers of civilization expand beyond available utilities, what do you do for that remote cabin in the woods or the island hotel in the Caribbean? If the well is running dry, and the livestock still need watering, will rainwater help supplement the demand? If I want to use rainwater to water landscaping for LEED credits, what do I need to know about designing such a system? This seminar will provide solutions to these dilemmas.

Medical Gases
Mark Allen

Swimming Pool Design
Terry LeBeau, CPD
This presentation will cover topics such as related codes and standards (e.g. NSF Standard 50). Common plumbing components, circulation system components, heating systems, and water chemistry control systems will be detailed. Accepted standards for sizing and associated velocities of piping, main drain grates, and filtration products will be discussed.
Different types of pools will be addressed. Special considerations specific to each type will be outlined.
The most common types of filtration systems will be compared. Pros and cons of each will be offered for analysis. The effect of the different products on equipment room size, waste piping systems, and pump design will be discussed.

If time allows, types of heating systems and chemical feed systems will also be included. In addition, more technically advanced discussions of the use of variable-frequency drives on pool circulation pumps could be included. The special considerations necessary when implementing these devices on swimming pool systems are important topics.

NFPA 14 - Standpipes, NFPA 20 - Fire Pumps, and NFPA 11, 24, and 25
Jim Peterkin, P.E.

Saturday Daily Schedule
November 3, 2007
8:00 AM to 5:00 PM
ASPE Registration
ASPE Pavilion/Book Store
9:00 AM to 12:15 PM

Hot and Cold Water Design
Harold Olsen, P.E.
This course is intended to help train the new plumbing or process piping designer, and to provide a review and update for other. The most recent design considerations will be discussed.
The first part of the course will be a discussion of piping materials, piping accessories, piping theory, etc. The second part of the course will be to design the water piping systems for a 3-story office building with a kitchen/catereteria interactive with the instructor.

Learning Objectives:
Students will learn where to start
Will go away with knowledge of piping materials
Will understand what piping accessories are available
Will understand how to size pipe per code
Symposium at a Glance (Continued)

Saturday Daily Schedule
November 3, 2007 (Continued)

David Dexter, CPI, CPD, P.E. and Nat Natarajan

The attendee’s employer will benefit by having an employee more knowledgeable about applicable sustainable design concepts and how to apply those concepts to client project. While we anticipate this session to be at the professional level, all in attendance will enhance their understanding of sustainable design, LEED, and the specific LEED design criteria.

The presenters plan to elevate the knowledge level of those in attendance and help guide everyone in a better application of sustainable design concepts on order to conserve our limited resources.

Vivarium Systems Design (Animal Housing) Part 1
Karl Yrjanainen, P.E.

Siphonic Roof Drain Design (Objective Review Positives, Negatives, and Proper Applications)
John Rattenbury, CPD, P.E.

Invented about 40 years ago in Scandinavia, the market for siphonic drainage has grown steadily around the world with thousands of installations and hundreds of millions of square feet of roof drained by siphonic systems. The efficiency of siphonic roof drainage systems and their low impact on architectural design have made them a popular application in large and prestigious projects such as airports, convention centers and sports stadiums. Siphonic drainage is also well suited for more industrial structures such as warehouses, factories and distribution centers where expansive roof surfaces exist.

Siphonic roof drainage has recently taken hold in the United States with the first siphonic roof drainage system installed at the Boston Convention and Exhibition Center in Boston, Massachusetts in 1999. Since then, roughly seven million square feet worth or roof surface are in operation around the United States.

The American Society of Mechanical Engineers (ASME) produced and published A112.6.9 "Siphonic Roof Drains," which was accredited by the American National Standards Institute (ANSI) in July 2005. ASPE has recently published Technical Standard 100 "Siphonic Roof Drainage." Both standards provide manufacturers and engineers a consensus of accepted product testing as well as system design and installation.

This seminar is intended to describe the basic hydraulic principles of siphonic roof drainage to the experienced plumber using the published standards. The program will review basic hydraulic principles common to all fields of mechanical engineering. Attendees will benefit from a review of the basic elements of siphonic roof drainage piping systems. Furthermore, attendees will better understand both the simplicity and flexibility of siphonic roof drainage installation. Finally, the scope of responsibility among the engineer, installer and code official will be described as it differs from the typical code enforcement environment.

The technical level of this program is appropriate for intermediate to professional.

Residential Sprinkler Systems: Design, Calculation, Inspection
Jeff Shapiro and Marshall Klein with assistance from Julius Ballanco, P.E.

The Building Code has added requirements for residential sprinkler for all residential use groups. The Residential Code added sprinkler requirements to the Appendix. Residential sprinkler systems use a different sprinkler and a different design method. The method of calculating the pipe size is also unique to residential systems. This seminar will provide the participants with an understanding of the unique design, sprinkler layout, and hydraulic calculations using NFPA 13, NFPA 130, and NFPA 13R.

Each participant will receive a Excel spreadsheet that will assist them in evaluating the hydraulic calculations. The spreadsheet will be provided on a CD-ROM.

This program provides important life safety information that is paramount to having a properly installed residential sprinkler system.

12:30 PM TO 2:00 PM
# 2007 ASPE Technical Symposium
## Registration Form
### Atlanta, Georgia • November 2-4, 2007

**Registration Information**

- **Organization Membership (check one):**
  - ASPE
  - ASHRAE
  - NAPHC
  - ASSE
  - PCA
  - IAPMO
  - ICC
- **ID #:**

**Badge Nickname:** (e.g., Dave, Bob, Mar, Sue, “Doc,” “Smiley,” etc.): ____________________________

**Name:** ____________________________  
**First Name:** ____________________________  
**M.I.:** ____________________________  
**Last Name:** ____________________________

**Check One:**  
- Engineer/Designer;  
- Architect;  
- Contractor;  
- Manufacturer/Rep;  
- Wholesaler;  
- Code Official;  
- Press;  
- Educator;  
- Other: ____________________________

**Organization:** ____________________________

**Title:** ____________________________

**Billing Address:** ____________________________

**City:** ____________________________  
**State/Province:** ____________________________  
**Zip:** ____________________________

**Country:** ____________________________  
**Postal Code:** ____________________________  
**Fax Number:** ____________________________  
**E-mail Address:** ____________________________

**Daytime Phone Number:** ____________________________  
**Home Phone Number:** ____________________________  
**FAX Number:** ____________________________

**Is this your first Symposium?**  
- YES  
- NO

**Registration Fees:**

<table>
<thead>
<tr>
<th>Member (of ASPE or other organizations shown above, you must supply your membership number for discount):</th>
<th>Fee Paid by Paid After Sept 30</th>
<th>Fee Paid by Paid After Sept 30</th>
<th>Total Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Registration One Day Reg</td>
<td>$359</td>
<td>$475</td>
<td>$</td>
</tr>
<tr>
<td>Non-Member Full Registration with 1-year ASPE Membership (a completed application must be included with registration)</td>
<td>$545</td>
<td>$625</td>
<td>$</td>
</tr>
<tr>
<td>Non-Member Full Registration without ASPE Membership</td>
<td>$595</td>
<td>$675</td>
<td>$</td>
</tr>
<tr>
<td>Non-Member One Day Reg</td>
<td>$275</td>
<td>$315</td>
<td>$</td>
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</tbody>
</table>

**TOTAL:** $ ____________________________

**About Registration**

1. This form must be completed and returned with full payment before your registration can be processed.
2. Please complete a separate registration form for each Symposium Registrant.
3. Fees are in U.S. funds.
4. Cancellation and requests for refunds must be in writing. A full refund, less a $50 administration fee, will be made if written notice is postmarked by October 1, 2007. Sorry, no refunds on registration fees will be issued after October 1, 2007.
5. Refunds will be made no later than thirty days after the Symposium.

**Payment:**

- **Personal Check** ____________________________
- **Business or Government Check** ____________________________
- **Credit Card:**
  - VISA  
  - MasterCard  
  - AMEX  
  - Discover  
  - AMEX  
  - Discover  

ASPE is hereby authorized to charge my Convention Registration Fees to my credit card.

**Name:** ____________________________  
**Card #:** ____________________________  
**Exp Date:** ___ / ___  
**Cardholder’s Signature:** ____________________________

**Continuing Education:**

All Technical Symposium Workshops offer CEUs (Continuing Education Units) and PDHs (Professional Development Hours), both nationally recognized units of achievement that may be used as evidence of increased performance capabilities and for job advancement. ASPE CEUs and PDHs are valid for PE registration and licensing in all states requiring licensing or registration that do not require prior approval. (States that have PE registration CEU requirements and/or other licensing requirements and which only require individual responsibility for reporting the CEUs/PDHs include: Alabama, Georgia, Illinois, Iowa, Kansas, Maine, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Oregon, South Carolina, South Dakota, Tennessee, Texas, Utah, West Virginia, and Wyoming.) (States requiring prior approval include: Arkansas, Florida, Louisiana, New York, New York.)

**For Hotel Reservations**

**Call or write to:**

Hilton Atlanta Airport • 1031 Virginia Avenue, Atlanta, GA  
**Reservations:** 1-800-HILTONS  
**Reference code ATC when making reservations**

Attendees are responsible for hotel accommodations.

A block of rooms, at a special rate, have been reserved for the American Society of Plumbing Engineers. To receive a room at the special rates, reservations must be made no later than October 2, 2007.

**Room rates:**

- Single $101 or Double $111  
- Room Tax: 14%  

**Free/Complimentary Parking for ASPE Attendees with a room ONLY**

**Reference code ATC when making reservations**

**PLEASE MAKE EXTRA COPIES OF THIS REGISTRATION FORM, AS NEEDED.**

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**American Society of Plumbing Engineers**

8614 W. Catalpa Avenue, Suite 1007  
Chicago, IL 60656-1116  
(773) 693-2773 • E-mail: aspehq@aol.com  
For Faster Processing,  
FAX Credit Card Orders to: (773) 695-9007
ASPE Board of Directors Meeting Highlights

STANLEY M. WOLFSON, ASPE EXECUTIVE DIRECTOR

It’s that time of the year: the ASPE board of directors April meeting. During this very important meeting, the board finalized the 2007–2008 budget, which affects many programs for the coming year.

**Dues.** Dues are the No. 1 issue for virtually all ASPE members. The current dues were last changed two years ago, but due to inflation, our costs and expenses have risen each year. Thus, the board has approved a dues increase to $185 (a 5.7 percent increase over two years, or 2.85 percent a year) for full members. Associate members’ dues will remain $175; retired members’ dues will remain $35; and student dues will remain $25. Although the board believes a higher increase is warranted, it also understands the reality of members’ abilities to absorb dues increases.

Members should remember that with each authorized dues increase, the portion paid as a dues rebate to each chapter automatically increases. For the $10 dues increase, chapters will receive 20 cents of each dollar collected while the Society will receive 80 cents of each dollar.

**Technical Symposium.** The 2007 ASPE Technical Symposium is November 2–4 at the Atlanta Hilton Airport Hotel. The registration form and hotel information can be found in this magazine. The Symposium has shaped up to be one of the most impressive ever from an education standpoint. Every effort has been made to keep Symposium costs reasonable, including a hotel rate of $101 for a single room and $111 for a double with a 14 percent tax. For those driving, parking at the hotel will be complementary. Continental breakfasts will be offered each morning, and complimentary lunches will be provided on Friday and Saturday.

**Win a Laptop.** This year, four Toshiba laptops will be given away at the Symposium. The rules are in the Symposium brochure with this magazine. The odds of winning are about one in 400, and an individual can only win once. The laptops will be given away at the Friday and Saturday lunches. All attendees who have paid for the full 2½-day event will find prize-drawing tickets for both days in the Symposium packet that they receive at registration. It is each attendee’s responsibility to ensure that their name is properly spelled on the ticket and to deposit the proper ticket into the prize-drawing box on the proper day. (Sorry, single-day attendees, ASPE board members and staff, and complimentary attendees are not eligible.)

**Product Show.** As this report is written, the Atlanta Chapter has not decided whether it will pair its product show with the Symposium. In the event it doesn’t, as part of the sponsorship program the Society will provide a special ASPE-sponsored tabletop exhibition. Booth space will be restricted to those companies that have provided a sponsorship to the Symposium. The ASPE exhibition, if it occurs, will be held Thursday, November 1, from 6–9 p.m. and will include Coney Island refreshments (franks, brats, and burgers). It will continue as the staging area for Friday’s continental breakfast from 7–8:45 a.m. Stay tuned and watch this magazine for Symposium updates.

**Sponsorships.** While we’re on the subject, the Symposium Sponsorship Program has been a fantastic success. With an initial goal of $95,000, the current sponsorship program accounts for more than $125,000, and the board has re-established the goal at $165,000. A special thank you to all that have provided a sponsorship and especially to those chapters that are forgiving past dues rebates to become sponsors. Sponsors to date include Alabama Chapter, Armstrong, Atlanta Chapter, Bradford White, Bradley, Central Florida Chapter, Central Ohio Chapter, Charlotte Pipe, Delta Faucet, Gastite Division, George Fischer Piping Systems, Gerber Plumbing Fixtures, Greenville Chapter, Grundfos Pumps, IAPMO, Jay R. Smith, MIFAB, Moen, Patterson Pump, Plumbing Contractors of America, Sioux Chief, Studor, Symmons Industries, SyncroFlo, T-Drill, Viega, Willoughby Industries, and Zurn Plumbing Products Group. (My apologies to those that did not make it onto this list in time for publication.)

**CPD Examination.** Well, it’s done. The first-ever online CPD Examination was conducted on April 21. Final results were sent about a week later. A psychometrician examined all exam results to ensure that the questions and answers were consistent with past exams. All those who passed the exam will be listed in the next issue of *PS&D.*

**2008 Convention.** It’s never too early to begin talking about the next ASPE Convention and EPE, which will be held October 25–29, 2008, in Long Beach, California. The event is already shaping up to be one spectacular event for attendees. In case you missed out, in 2006 the Grand Prize winner drove away in a new Pontiac Solstice. For 2008, picture yourself in a brand-new Saturn Sky or similar sports car (actual giveaway vehicle has not yet been determined). Perhaps you’ve heard about the thousands of prizes attendees took home with them—everything from laptops and MP3 players to televisions and grandfather clocks. For 2008, once again every attendee will be a winner. Watch for details about the new, exciting EXPO-QPOLY game only at the ASPE EPE.
**New Interim Chapter.** The Puerto Rico members of ASPE have officially begun the process of creating a chapter. At a meeting in February, the members agreed that a chapter was needed and voted in an interim board of directors. We expect to see a representative of the forthcoming chapter at the June Region 1 Chapter Presidents Meeting.

**2007–2008 ASPE Budget.** The budget is essentially a break-even budget with an approximate $400 surplus. Remember, this is a non-convention year, and the Society’s revenues are reduced for the fiscal year. Some budget highlights include a $10 dues increase; two new publications; increases in online education; a new education manager on the ASPE staff; hardbound *Plumbing Engineering Design Handbooks*; *PS&D* magazine published in 10 issues rather than six; ASPE Career Center enhancements; two CPD Examinations; three practice CPD exams; a second, entry-level CPD designation and examination to be created by the Certification Committee; new online plumbing industry and professional news; and the first ASPE tabletop exhibition to possibly be unveiled at the Technical Symposium.

**Region Chapter Officers Meetings.** The June Region Chapter Presidents Meetings will occur in the first two weeks of June. Meeting dates and locations follow: Region 1, June 1–2 in Ottawa, Canada (ASPE executive director will attend this meeting); Region 2, June 8–9 in Cleveland, Ohio (ASPE executive director will attend this meeting); Region 3, June 1–2 in Miami, Florida (ASPE president will attend this meeting); Region 4, June 8–9 in Salt Lake City, Utah; and Region 5, June 8–9 in Rosemont, Illinois (ASPE president will attend this meeting).

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**2007 Grassroots Budget Meeting Goes High-tech**

*BY NORMAN PARKS, ASPE VICE PRESIDENT, TECHNICAL*

In 2003, ASPE President Larry Oliver hosted the Society’s first Grassroots Budget Meeting. It was created to allow ASPE chapter presidents to attend an open meeting to review and provide input for the next fiscal year’s budget. It also allows insight into the task the Finance Committee faces each year.

On March 18, 2007, the 2006–2008 ASPE Finance Committee hosted the fifth-annual Grassroots Meeting in Chicago at ASPE’s headquarters. As with previous years, each chapter was invited to send its chapter president or a representative. The invite this year included something extra. Chapter representatives could attend the meeting via the Internet. For the first time, the Grassroots Budget Meeting was webcast. This was done to allow those chapters that could not send a representative to Chicago to still be able to participate.

Approximately 20 chapters were represented, with more than half via the Internet. For some chapters, the entire board was participating via a central site for that chapter.

President Julius Ballanco welcomed everyone and introduced the Finance Committee: Secretary-Treasurer Jeff Ingenton, Chair; Society Vice President, Technical, Norman Parks; Region 4 Chair Steve Shayler; and Executive Director Stan Wolfson. Julius then turned the meeting over to the Chair, Jeffery Ingenton.

The meeting process followed was simple. First the expected revenues and then the expected expenditures were discussed. Input and questions were welcomed from everyone at the meeting; however, it was important for participants to keep in mind that the budget document was still in draft form. The Finance Committee would consider the recommendations made at the Grassroots Meeting and place them in the budget when applicable. Other comments would be shared with the board of directors. The final budget is subject to majority approval of the ASPE board of directors.

Participation at the meeting was excellent. The proposed budget included a $10 across-the-board increase in dues, which would raise the rate to $185 for full members. It was stated that this was the first dues increase in three years. Several chapters recommended that the committee consider raising dues $15 or $20 ($190 or $195 for full members). Chapter officers recognized that operating costs have increased and that the immediate past board and current board have reduced operating costs to improve the financial stability of the Society. The overall feeling from the chapters was that a dues increase is warranted.

Additionally, it was noted that the dues revenue in the budget was based on 6,800 members, although the current number of members is closer to 6,500. Chapters participating discussed that they need to put forth a better effort to retain members and bring in new members. This would go a long way toward helping ASPE’s budget without further cost to the membership.

*PS&D* magazine’s continued drain on the budget also was discussed. Participants expressed that they believe ASPE has the best technical publication in the market; however, they said that the Society can’t continue to accept a large loss year after year. Some expressed that they would accept the magazine just breaking even because they wish for ASPE to have its own magazine, while others indicated that a slight deficit would be acceptable, perhaps valued at $12 to $15 per member (about $80,000). It was shared that the magazine staff and board continue to seek new advertisers. The committee asked for help from all members in seeking advertisers for the magazine. The grassroots attendees, on the whole, did not understand why more manufacturers do not advertise in ASPE’s magazine.

The Finance Committee also asked the chapters for their continued help in supporting the Society by purchasing Society publications and promoting the 2007 Technical Symposium in Atlanta.

In summary, the general attitude of the attendees was that the board is moving in a positive direction to improve the finances of the Society and to make it a financially stable organization. Participants asked the board to continue these meetings in the future. It was further shared that the webcast was a welcomed media event that allowed more participation by the chapters.
New ASPE Members

Welcome to all new Society members. When you choose a chapter affiliation, you have twice the advantage. Not only can you participate in chapter functions and programs, but you also can be involved at the national level. To all members, old and new, this is your Society; your involvement enhances the plumbing engineering field as well as ASPE. Suggestions about ways to make your Society more beneficial to both fellow members and all involved in the industry are welcome.

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Charter Member of ASPE Dies
Bernard "Bernie" McCarty passed peacefully on April 27, 2007, at the age of 77. A retired plumbing engineer, Bernie was a charter member and past president of the American Society of Plumbing Engineers. He also served on the Town of Scituate Advisory Board and was involved in the Boy Scouts of America Old Colony Council for many years. He'll be remembered not only for his humor and wit, but also for his commitment to quality and ethics in all that he did. He was a special friend and mentor to many in the Society, and he will be missed.
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