A **12-Step Program** for Avoiding Liability for Hot Water System Injuries

by **Donald Wise, PE**

Those responsible for designing, constructing, maintaining, and operating hot water systems (stakeholders) must balance competing requirements to keep hot water temperatures high enough to prevent growth of potentially deadly bacteria, yet low enough to prevent water scald injuries and fatalities. A demographic shift in the population will make their task more difficult and will increasingly expose them to liability claims.

This article examines temperature requirements for hot water production and distribution that comply with established standards and minimize the risks of injury to the public. Lessons learned from litigation have been translated into 12 steps that stakeholders can apply to mitigate hazards of hot water use and personal injury liability.

BURN HAZARD

Hot water injuries occur across all age groups, but it is the young and the elderly who are barometers for hot water system safety. The degree of a burn is a function of exposure temperature and time. A third-degree burn is one that completely penetrates the skin, leaving it unable to heal. There seems to be general agreement in the literature that it takes seconds to create a third-degree burn on a healthy adult with an exposure temperature of 140°F, and several minutes with an exposure temperature of 120°F. However, because they have thinner skin, the young and the elderly burn more quickly and severely. Once injured, recovery is more tenuous for elderly patients.

"As age advances, the immune system is less effective, resulting in decreased resistance to infection. Elderly people are at risk for potential problems in healing due to skin changes, slower metabolism, poorer nutrition and hydration, and compromised respiratory status. In addition, older patients have a higher incidence of chronic health conditions such as circulatory problems and diabetes. Cognitive deficits are also more common in elderly patients, which can seriously reduce their comprehension of hazards, as well as impair their perception of skin problems and communication of symptoms to caregivers."[1]

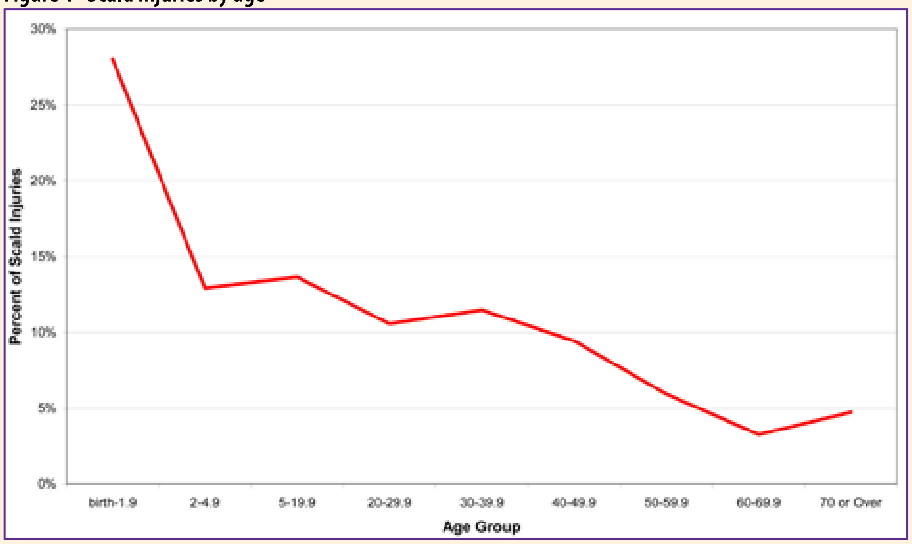
The American Burn Association (ABA) collects data and reports on burn injuries occurring in the United States and Canada annually. Its 2005 report indicates that children from birth to 1.9 years of age account for 28 percent of all tap water scald injuries (see Figure 1). ABA data also indicates that mortality rates increase steadily with age (see Figure 2) and amount of burn area. Mortality rates for those 70 years of age and older increase disproportionately to those of younger scald victims and trend above 90 percent once 50 percent of the body area has been burned; this compares to a mortality rate of approximately 10 percent for those under two years of age with similar burn sizes.

BACTERIA HAZARD

Legionnaires' disease (LD) was identified in 1975 when it was associated with a deadly outbreak of pneumonia at an American Legion convention in Philadelphia. This is a deadly form of pneumonia that develops after infection with Legionella bacteria (LB). LB are commonly found in small concentrations in mud and sediment from rivers, lakes, and other naturally occurring habitats. They are transported into buildings with well or municipal water, but are relatively inactive at temperatures below 68°F. LB are not eradicated by chlorination used for water purification. Non-detectible concentrations of LB can multiply rapidly under favorable conditions. Water heated to temperatures between 95°F and 115°F creates an ideal condition for multiplication and growth.

The Occupational Safety and Health Administration (OSHA) devotes a chapter in its Technical Manual to LD. It summarizes the incidence and risk factors of LD

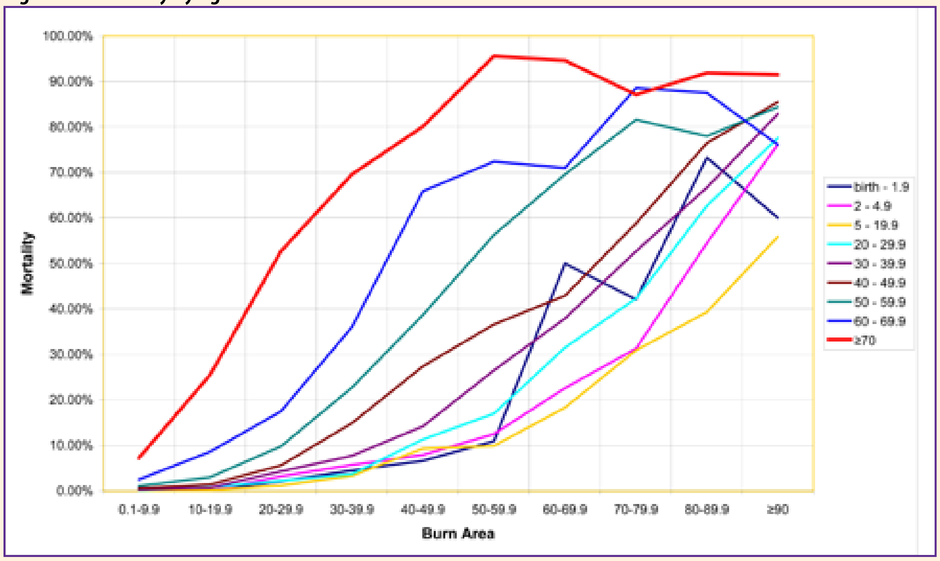
Figure 1 Scald injuries by age



Source: American Burn Association, 2005

as follows: "In the United States, Legionnaire's disease is considered to be fairly common and serious, and the Legionella organism is one of the top three causes of sporadic, community-acquired pneumonia. Because it is difficult to distinguish this disease from other forms of pneumonia, many cases go unreported. Approximately 1,000 cases are reported annually to the Centers for Disease Control (CDC), but it is estimated that over 25,000 cases of the illness occur each year and cause more than 4,000 deaths.

Figure 2 Mortality by age and burn size



Source: American Burn Association, 2005

"Legionnaires' disease is frequently characterized as an 'opportunistic' disease that most frequently attacks individuals who have an underlying illness or weakened immune system. The most susceptible include persons who are **elderly,** smokers, and immunosuppressed."[2] (Emphasis added.)

Mortality associated with LD is generally about 15–20 percent, but can be as high as 80 percent depending on risk factors, which include age.[3] LD can be contracted after breathing water vapor that contains the organisms.

Domestic hot water systems have been identified as sources of Legionnaires' outbreaks. Residential water heaters, boilers, and hot-water storage tanks often have cooler water near the tank bottom than they do near the top due to stratification and the introduction of cold water near the bottom of tanks. If temperatures fall to 95°F or less, and scale and sediment accumulate, an ideal LB habitat is created.

Segments of our population who are most at-risk for either scald injuries or Legionnaires' disease are projected to increase. Life expectancy in developed regions of the world will increase from 76 years today to 82 years by mid-century, according to United Nations projections.[4] In most developed regions, approximately one out of five people will be 65 or older by 2050.[5] In addition, the total number of children (ages 0–14) in North America is projected to increase by 10 million during the time period of 2005 to 2050.[6] Taken together, the elderly and the young will grow both as a percent of the population and in total numbers. Combined with the mentally handicapped, they account for 88 percent of tap water scald injuries according to one 10-year study.[7] Tap water scald injuries requiring hospital visits occurred at least 3,859 times in 2005 in the United States and Canada.[8]

Water that suddenly and unexpectedly changes temperature is another frequent cause of injury. The elderly frequently suffer from slip and fall injuries while attempting to escape the onslaught of suddenly hot water. Victims often report being unable to remove themselves from hot water after they have fallen, which prolongs exposure and intensifies thermal injuries. In one suddenly hot experience, water filling a half-filled tub of water became so hot (later measured at over 186°F) that the victim couldn't move to the end of the tub where the fill spout and valve were located to close the water valve. The victim received third-degree burns on her legs and buttocks before she could get out of the bathtub.

Legionnaires' disease and water scald injuries are preventable. Hot water systems that comply with OSHA Technical Manual, American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), and American Society of Plumbing Engineering (ASPE) standards provide reasonable protection against both LD and water scald injuries. Since the elderly and the young are disproportionately affected by water scald injuries and LD, an increase in personal injury lawsuits can be expected for those who do not implement practices necessary to mitigate the heightened risks associated with these hazards and growing populations.

The best defense is a strong offense. Once you are named in a lawsuit, you become a victim of the legal system even if you obtain a favorable judgment. Preparing a defense is expensive in terms of both time and money, and diverts valuable resources from running your business. The following 12 practices can help reduce the likelihood of experiencing this unpleasant experience.

1. MINIMIZE HOT WATER TEMPERATURES

ASHRAE Standard 12 recommends storing hot water at a minimum temperature of 120°F to prevent Legionella bacteria growth. OSHA prescribes storing water at 140°F, and delivering it at a minimum of 122°F to all outlets.

ASPE recommends using 5°F as the recommended temperature drop for a properly designed recirculating water system. Water entering the piping distribution loop (recirculating loop) at its distribution temperature cools as it circulates throughout the building and can be returned at a temperature up to 5°F less than the supply temperature.

Maintaining 122°F as a minimum water temperature throughout the main hot water piping loop would require supplying it at 127°F. Water distributed to branch piping would vary in temperature between 122°F and 127°F depending on where the branch is located along the pipe's path. Branch piping in which water stagnates at times should be as short as possible. If branch piping is not recirculated, it should be insulated so that water reaches its destination before cooling. Water at temperatures of 122–127°F is significantly above the 105°F needed for bathing, and can supply hot water at a temperature sufficient to reheat bath water that has cooled.

Past objections to using water temperatures as low as 122°F at water taps cited the need to maintain higher temperatures for clothes and dishwashing equipment. However, modern appliances such as dishwashers and clothes washers have their own internal heaters (high-end models often have sterilizing cycles and heat water to 160°F), so they no longer rely on the house water heating system to provide hot water for cleaning and disinfecting.

Figure 3 schematically illustrates achieving a balance between the competing needs to keep water temperatures high enough to control Legionella bacteria amplification (multiplication) but as low as possible to prevent scald injuries. 122°F is hot enough to prevent LB amplification, but low enough to prevent many scalding injuries.

Water temperatures of 140°F and higher are necessary to destroy Legionella bacteria where an infestation has occurred. Temperatures between 122°F and 127°F are sufficient to prevent LB amplification, but will not eradicate LB in a system already infested. There are a variety of procedures that can be used to sterilize such a system, including shocking it with chlorine and flushing it with water at a temperature of 158°F.

Activities necessary to restore a contaminated system should not be confused with those required to maintain proper balance in a non-contaminated system. As illustrated in Figure 3, 122°F represents the balance point between these two competing interests, and is the point of lowest combined health risk that maintains the minimum temperature recommended in OSHA's Technical Manual.

If hot water systems were operated in accordance with this recommendation only, even without point-of-use mixing valves, most water scald injuries would be avoided; the ones that still occurred would be substantially less severe. The difference in burn potential between water that is 140°F or higher and water at a maximum temperature of 127°F is huge; it represents the difference in having a minute rather than a second or two before you are irreparably burned.

2. INSTALL POINT-OF-USE PRESSURE-BALANCED THERMOSTATIC MIXING VALVES

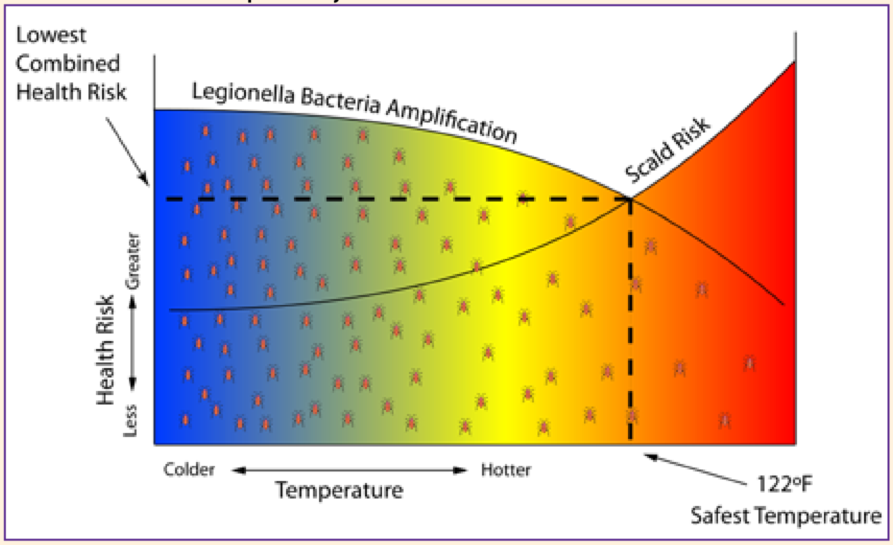
It is consistent with ASHRAE, OSHA, and ASPE recommendations to store water at 140°F, and deliver recirculating water to the distribution loop at temperatures between 122°F and 127°F. Water could arrive at a faucet at a temperature as high as 127°F, which could create a scald hazard.

A pressure-balanced thermostatic mixing valve installed as an integral part of a bathtub and shower valve limits water temperature to 120°F. This point-of-use mixing valve has been required by model plumbing codes for installation on new bathing facilities since the mid-1990s. OSHA Technical Manual states that anti-scald devices should be considered at these locations.

I have investigated several injuries involving infants who were scalded while being bathed in a kitchen sink. Installing an anti-scald device on kitchen sinks, although not required by any code of which I am aware, provides protection for infants who are bathed there.

The 1975 report commissioned by the Consumer Product Safety Commission (CPSC) on bathroom safety, which laid the groundwork for installing point-of-use mixing valves on all new bathing facilities, stopped short of recommending that point-of-use mixing valves be installed on existing facilities. At the time, it was determined that requiring them on existing bathtubs and showers was not cost-effective due to the high cost of installation. However, an appendix to the report includes a summary of opinions expressed at a conference that was held in conjunction with the bathtub safety investigation. It states: "A simpler cut-off device, which cuts off the flow of water after it reaches a hazardous temperature, has the disadvantage that it will take up to 15 minutes for the water flow to be restarted. An inexpensive device without this characteristic would be an ideal product innovation for either new or retrofit installations."[9]

Figure 3 Schematic representation of safest temperature for combined threats of Legionnaires' disease and hot tap water injuries



Such a device (see Figure 4) manufactured by AntiScald Inc. was installed on my bathtub spout and shower arm. Installation required tape dope and an adjustable wrench and could easily have been accomplished by a non-professional handyman. Water flow shutoff occurs at 117°F. The AntiScald device stopped water flow, except for a small trickle, when the water reached this temperature. Supplying cold water to the valve caused it to reopen in approximately 15 seconds.

The retail cost of this device is approximately $35 each if purchased individually. It eliminates the need to open walls and floors to install mixing valves and can be installed in a few minutes. If such a device was available in 1975, the above opinion suggests that there might have been a retrofit requirement for existing bathtub and shower faucets.

3. PROVIDE REDUNDANT PROTECTION

Hot water systems are complex, and their components fail. Temperatures as high as 200°F have been delivered to domestic water outlets as a result of a single component failure (a mixing

Figure 4 Temperature actuated flow reducer and typical applications

Source: AntiScald Inc.

valve). OSHA's Technical Manual states that fail-safe scald protection equipment should be installed where potential for scalding exists. A recirculating water system with a main mixing valve located at the boiler and a point-of-use pressure-balanced thermostatic mixing valve has redundant protection against instantaneous or nearly instantaneous third-degree burns when one of the valves fails. In larger buildings, redundancy can also be provided by employing a secondary hot water loop with its own mixing valve or heat exchanger, or by providing additional hot water storage tanks with their own temperature controls.

4. TEST THE FINISHED SYSTEM AND PROVIDE ONGOING MONITORING

An automatically controlled water heating system is a complex system, one that requires testing to ensure that it will function under the range of conditions that it is expected to encounter once placed in service. A hot water system custom designed to fit unique requirements should be tested to ensure compliance with those requirements. Yet many installers of domestic water heating equipment, multifamily as well as single family, do not verify that the system performs as intended.

Testing should verify that the water temperature remains at its set point while the water-heating device is fired over its range of operation. In addition, operation during both routine and infrequently occurring conditions such as pump failures, blocked strainers, unintended manual valve positioning, and power failures should be simulated. Water temperature and pressure variations should be examined at the most remote locations where water will be used. Toilets should be flushed in adjacent units while monitoring temperatures and pressures at test locations.

A document showing the test procedure and results is strong evidence supporting a claim that a system was implemented properly, and should be retained after project closeout. Time and date stamp the as-built system performance testing by distributing the test results to other stakeholders. This can aid in separating responsibility for proper system design and construction from poor performance resulting from system modifications or a failure to maintain the system that may occur long after project closeout.

Testing should be continued on an ongoing basis by monitoring domestic water supply temperatures. The cost of installing the equipment necessary to accomplish this is minimal compared to the remaining system costs. Domestic water temperature monitoring, alarming, and notification can often be accomplished through a combustion computer.

At a recent injury investigation, it was discovered that a boiler's combustion computer contained the hardware and software, and could alarm and/or page an operator if temperatures exceeded a preset level. However, it was never configured to do so even though paging for other conditions was operational. As a result, a child was severely injured when water at a temperature of approximately 180°F poured into the tub in which she was bathing after the main mixing valve failed.

In addition to monitoring for water temperature changes, water should be periodically monitored for LB levels. OSHA Technical Manual provides guidance for safe bacteria levels and sampling procedures.

5. RECIRCULATE WATER CONTINUOUSLY

Water systems that depend on water recirculation to sense and control temperatures are uncontrolled if the water is not circulating. At a recent investigation, it was determined that the buoyant forces in a domestic water riser created a column of excessively hot water during a period that the recirculating pump was not operating (an energy management measure). This water was discharged onto an infant who was being bathed by a parent.

Control of LB requires continuously recirculating water. OSHA Technical Manual states that circulating pumps should not be placed on energy management systems for this reason.

6. PROPERLY SIZE WATER PIPES (THE "FLUSH" EXPERIENCE)

Bathers often experience unanticipated, sudden, and extreme changes in water temperature when an appliance or fixture imposes a demand for water on a system with undersized piping. Many have had the unpleasant experience of water temperature changing from warm to excessively hot in a matter of seconds due to a toilet flushing or other instantaneous demand placed on the system. I refer to this as the "flush" experience. One boys' school solved this problem by imposing the rule that "flush!" is yelled before flushing the toilet, which worked most of the time; unfortunately, a student slipped and was injured when it didn't.

The "flush" experience is a hazardous condition, one that has been responsible for many injuries—some of them fatal. Many of the injuries are related to falls that occur when someone is trying to escape the hot water while standing on a wet, soapy surface.

Improperly sized piping and/or system pressures cause this problem. When a large amount of water is quickly removed from an undersized piping system, water cannot flow to the point of removal quickly enough to meet the demand; pressure drops and there is a delay before the water is able to rush in and restore pressure to normal system pressures. Usually, a toilet flush, with its demand for cold water, leaves the hot water side of the valve functioning normally but deprives the cold water side of the valve of the water necessary to produce the desired mixed water temperature. Increasing pipe size and/or pressure or replacing partially obstructed piping can remedy the condition.

The magnitude of the thermal shock caused by the "flush" experience can be diminished or eliminated by either reducing the hot water temperature, pressure, or both, or increasing cold water pressure. Reducing hot water pressure or temperature reduces the volume of hot water or its heat value that enters a valve during a cold water pressure dip. Increasing cold water pressure helps overcome the resistance to flow offered by a small pipe diameter and shortens the period required to reestablish water pressure. In either case, the effect of thermal shock can be lessened.

7. MAINTAIN EQUIPMENT IN ACCORDANCE WITH MANUFACTURERS' RECOMMENDATIONS

Circulating pumps, controllers, and power supplies fail, and temperature sensors require calibration. Ongoing monitoring and adjusting are required to compensate for system changes. Unfortunately, however, equipment is often effectively abandoned after installation. Domestic water heating equipment is part of the potable water system and requires that a plumber service it in many locations. Since boiler contractors are often not licensed plumbers, they frequently do not examine or adjust water-mixing equipment, even though they have been hired to maintain boilers that contain a coil for domestic water heating purposes. Many tempering or mixing valves are examined only after years of neglect lead to catastrophic failure. Building superintendents sometimes believe that either the boiler contractor is maintaining the water heating equipment or there are no serviceable components in an automatically controlled domestic water heating system. In either case, routine maintenance is ignored.

Installers often miss an opportunity to supply additional services by providing the owner with a service schedule. If you don't perform service work, work out an agreement with another service provider to offer such a service plan. Ensuring that the equipment is properly maintained will substantially reduce the likelihood of its causing an injury. Educate the owner about the hazards associated with improperly maintaining the equipment and document your communications.

8. PERIODICALLY ADJUST CENTRAL MIXING VALVES

Many thermostatic mixing valves installed on central boilers require seasonal adjustments to accommodate ambient, boiler water, and seasonal cold water temperature fluctuations. Multifamily buildings can have as much as a 45 percent reduction in demand in domestic hot water from winter to summer.[9] Combustion computers often have a reset mode that allows reducing the boiler water temperature when the outside air temperature rises. Doing so changes the proportion of hot and cold water required to maintain the mixed water temperature at its set point. Finally, city water that is used to make up water drawn from the hot water system is colder in winter months than it is during summer months, which again changes the proportion of required hot and cold water. These factors, combined with operational limitations of some thermostatic mixing valves and the normal wide swings—frequently 10 to 80 percent of maximum demand—in daily demand, often require seasonal adjustments to maintain proper temperature control.

Building operators may believe that a mixing valve is capable of compensating for the full range of conditions that occur throughout the year. Without periodic monitoring, or complaints from tenants, they have no feedback on how well the system is performing. Often tenants don't complain about water that is too hot for fear of overcompensation making it too cold. Examining and adjusting the mixing valve as part of a scheduled maintenance program will ensure that it is seasonally adjusted and operating within its range of control.

9. TREAT HARD WATER OR MONITOR PIPE CONDITIONS FOR MINERAL DEPOSIT BUILDUP

The condition of pipes and other hot water system components changes over time and must be monitored. Failure to treat hard water conditions or to replace piping that has restricted flow due to mineral buildup can cause wide pressure fluctuations. Small-diameter hot water piping in old buildings, such as that serving tubs and showers, is especially susceptible to experiencing a reduction in diameter due to scale and mineral deposits in areas with hard water. As a result, local demands for water become more difficult to satisfy without starving the system of water and water pressure, exposing bathers to the unpleasant, and sometimes injurious, "flush" experience.

After removing insulation from hot water piping, scale accumulations may show up as an uneven temperature distribution on the piping surface. Mineral deposits insulate the piping from the hot water and generally are thicker on the bottom half of the piping, causing it to be cooler.

Mineral buildup in pipes, valves, and tanks provides a dual threat: It forms an ideal habitat for LB and causes an increase in resistance to flow, which can cause the "flush" experience. OSHA Technical Manual requires that hot water tanks and boilers be taken out of service and periodically cleaned to remove scale. Commercial products and equipment are available to treat piping systems for scale and sediment removal, but require disrupting the hot water service to clean and purge it to remove chemical solutions prior to placing it back into operation.

Scale buildup on boiler tubes degrades efficiency and can be used to monitor scale buildup. In addition, monitoring pressures at a piping system's most remote points provides a means of monitoring for scale buildup or pressure disturbances caused by other means.

10. EXAMINE BUILDING HOT WATER LOADS TO ENSURE THAT DESIGN CONDITIONS HAVEN'T CHANGED

Water heating equipment must be adjusted when a building's occupants and equipment utilizing hot water cause the load profile to change. Periodic hot water system assessments should be conducted to determine if a hot water plant is providing water in sufficient quantity, at a safe temperature, and without excessive pressure variations to satisfy a building's requirements. If it's not, some part of the system may be failing and need attention. It also may be an indication that system loads have changed and that the system needs to be adapted to the new requirements.

Water distribution systems in older buildings may have been designed before widespread use of washing machines, dishwashers, hot tubs, and other devices. Since piping replaced in a piecemeal fashion is frequently sized to match the replaced piping, and not according to new codes or current demands, chronic water pressure fluctuations and temperature changes can occur in older buildings.

11. ELIMINATE THE DESIRE TO INCREASE WATER TEMPERATURES TO HAZARDOUS LEVELS BY PROVIDING WATER THAT MEETS USERS' NEEDS

Attempts to compensate for deficiencies in hot water systems frequently create additional hazards. Homeowners, tenants, and building superintendents may increase water temperatures so remote portions of the building don't run out of hot water during periods of peak demand. Sometimes it is believed (incorrectly) that increasing water temperature reduces delay times in getting warm water to remote locations. Increasing the temperature is frequently perceived as an inexpensive way to deal with a structural problem, which should have been identified and eliminated during post-construction testing.

12. REPLACE DAMAGED TEMPERATURE ELEMENTS

Damaged plumbing system components should be repaired or replaced. A mixing valve, however, is particularly susceptible to latent damage that is difficult to detect unless it is tested and/or monitored. It is not uncommon to find mixing valves that have never been adjusted and simply pass heated water through without mixing it with any appreciable amount of cold water. This exposes the thermostatic element to excessively hot water, eventually causing it to fail. Whenever a valve's thermostatic element (or a temperature sensing element on electronically controlled systems) has been exposed to excessively hot water, it should be monitored closely to see if the control elements function properly and mixed water temperatures can be maintained. A neglected element frequently requires replacement.

A properly designed system-wide test as mentioned previously would detect this condition. This again emphasizes the need for ongoing testing and evaluation or a continuous monitoring program.

KEEP OUT OF THE LEGAL TANGLE

If no one is injured, you won't be the target of a personal injury lawsuit. The objective is clear: Design, construct, operate, and maintain a hot water system in such a manner that it will not injure anyone. I have yet to encounter a case in which such a system was the cause of an injury.

There are numerous stakeholders in a modern hot water production and delivery system. Unfortunately, this means that no single person accepts cradle-to-grave responsibility for the system.

If every part of the design, build, operate, and maintain process was implemented as it should be, hand-offs between stakeholders would be conducted seamlessly, and everyone would know the project's essential history, including design changes, equipment substitutions, calculated risks, and other aspects of a project that introduce uncertainty into its performance. Since this level of communication does not typically take place, testing is the only way a hot water system's performance can be ensured, and the public's health protected. Since equipment fails, instruments loose their calibration, demands on water systems change, and environmental conditions change, ongoing monitoring is necessary to ensure proper system operation and alert operators and users when a hazardous condition goes unchecked.

LB control requires higher temperatures than are safe for human exposure. Boiler water and stored hot water should be maintained at 140°F or above. A mixing valve at the storage tank should supply water to the recirculating loop at the lowest possible temperature while allowing it to cool by 5°F as it circulates and yet maintain a 122°F minimum temperature throughout the loop. A point-of-use mixing valve is required to further limit water temperature to 120°F in areas where scalding may occur and to provide a redundant means of protection.

Providing a safe hot water system requires ongoing diligent reassessment of hot water requirements, system monitoring, adjusting, and testing. When commissioning a new system or a newly modified one: Ensure quality workmanship; test the finished product; add monitoring and alarming for hot water temperature; provide pressure-balanced thermostatic mixing valves at all bathtubs and showers (even existing ones); recirculate water continuously; minimize hot water temperatures to the extent possible; provide redundant safety devices or alarms; size components in accordance with the prevailing code, ASPE's *Domestic Water Heating Design Manual,* OSHA's Technical Manual, and the equipment manufacturer's recommendations; ensure that the mixing valves and other control equipment are examined seasonally and adjusted as necessary; and finally, ensure parity between the building loads and the system capacity.

Hot water injuries have occurred ever since man heated the first pot of water, but a rapidly growing vulnerable population will not dodge the effects of plumbing design and maintenance flaws as easily as the dominate, largely young and more agile population does at present. As the population ages, previously overlooked flaws in hot water systems will be discovered when bathers are injured.

Bathers between the ages of 10 and 65 are forgiving bathers. For the most part, they sense changes in water temperature and react quickly, and they are strong and agile enough to remove themselves from danger. Those under 10 and over 65 are growing both in numbers and as a percentage of our population. They are more likely to place themselves at risk by bathing rather than showering, and when they are injured, their injuries are more severe. This translates into an increase in the number of severe injuries and personal injury lawsuits associated with hot water systems.

Following the above recommendations will result in a safer, more energy-efficient, reliable, and long-lasting hot water system, one that is less likely to cause injury. The list may seem long, but after crossing off the recommendations that are just good design, construction, operation, and maintenance practices, there isn't much left. **PSD**

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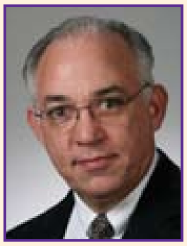

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