Russell Fote & Associates, Inc.

FOTE·REPORT

SAFETY ENGINEERING UPDATE

FOTE NOTES

At Russell Fote & Associates, our purpose is to provide our clients with the very best safety engineering and expert consulting services.

Since starting Russell Fote & Associates, Mr. Fote has given over **150 depositions** and has testified at over **25 trials**. He has been recognized as an expert in the state courts of: Illinois, Wisconsin, Iowa, Kentucky, Tennessee, Nebraska, Oklahoma, and West Virginia, plus U.S. District Courts in Atlanta, GA and Central Islip, NY.

We have two offices to serve you. Our Chicago office is located at 8770 W. Bryn Mawr Ave., Suite 1300, Chicago, IL 60631, which is about three miles east of O'Hare International Airport. Our other office is located in Wisconsin at 3635 Stonebrook Ct., Brookfield, WI 53005. You may reach us using the contact information listed at the bottom of this newsletter.

At Russell Fote & Associates, we continue to remain current on all safety engineering-related issues.

We invite you to visit our "home page" on the Internet. You may access our web site at: **www.fote-engineering.com** or E-mail information to our office at: **rfote@wi.rr.com**.

Scalding Tap Water and Serious Burns

The National Fire Protection Association (NFPA) released a report late last year titled "Burns Seen In Hospital Emergency Rooms in 2008 by Burn Type and Victim's Age."

Statistics in this report were gathered using the National Fire Incident Reporting System (NIRS), which is comprised of local fire departments as well as state and federal fire authorities.

For 2008, an estimated 216,000 individuals visited hospital emergency rooms because of various burn injuries.

These injuries were categorized as follows: 42 percent thermo burns from non-fire causes such as contact with a hot radiator, 28 percent (60,000) scalds, 13 percent thermal burns from fire causes and 17 percent miscellaneous.

Although not specifically stated, we may expect many of the 60,000 scalds reported resulted from too hot tap water.

Children under the age of 15 were the most susceptible to scald burns. They comprised 36 percent of the total scalds reported, which is over 21,000 burns.

Anatomy of the Skin and Burns

Human skin is comprised of two distinct layers, the epidermis and the dermis. The epidermis is the most outer layer of skin that contains skin cells but has no blood vessels or nerve endings. Its thickness is about 0.8 mm.

The next skin layer is the dermis; it contains blood vessels, nerve endings and has thickness of about 2 mm. A first-degree burn causes minor harm to the epidermis but no permanent damage. Most discomfort from a first-degree burn results from exposure of the superficial blood vessels, which causes reddening of the skin.

A second-degree burn involves damage to both the epidermis and the dermis, generally resulting in blistering the epidermis.

A third-degree burn involves more damage to the dermis than a second-degree burn resulting in open sores. These burns cause permanent skin damage, the formation of scar tissue and require skin grafts.

For the purpose of our discussion, serious burns will be defined as full-thickness, that being the complete destruction of the epidermal. Serious burns include all third-degree burns and many second-degree burns.

Time-Temperature Relationship

Most adults know contacting very hot water can result in a burn. However, most adults don't know contact with, for example, 150 F water will cause a serious skin burn in two seconds, or that serious burns will occur with a six second exposure with 140 F water, or a 30 second exposure with 130 F water.

This time-temperature relationship of hot tap water contact and serious skin burns dates back to the 1940s when research was conducted at the Harvard Medical College by researchers, A.R. Moritz, M.D. and F.C. Henriques, PhD.

(continued on page two)

Using both animals and humans as test subjects, their findings were published in 1947 by *The American Journal of Pathology*.

Past Studies

Two major studies involving in part, tap water scalds, were released in 1975 by the U.S. Consumer Products Safety Commission (CPSC).

The first study was written by Calspan, a CPSC contractor, which was issued under "The Investigation of Safety Standards of Flame Fire Furnaces, Hot Water Heaters, Clothes Dryers and Ranges."

The other study was performed by another CPSC contractor, ABT Associates, and its report titled: "A Systematic Program to Reduce the Incidents and Severity of Bathtub and Shower Area Injuries."

Both of these studies cite the time-temperature burn relationship of hot tap water, as reported by researchers Moritz and Henriques in 1947.

NEISS (National Electronic Information Surveillance System) data was used to obtain injury statistical sampling of hospital emergency rooms. The studies indicated the need for scald devices and to set water heater thermostats at 120 F.

The study also cited the Massachusetts state plumbing code 1973-1974, which required anti-scald devices.

Thermostat Settings

During the 1970s, residential water heater manufacturers' instruction manuals cited 140 F as a normal thermostat setting.

This changed in the early 1980s to a normal setting of 130 F and that setting was changed again in the early 1990s to 120 F.

Scald Warnings

During the early to mid 1980s, water heater manufacturers began placing warnings on their products. Printing on thermostat knobs stated: "Caution Hotter Water Increases the Risk of Scald Injury." Also, printed warnings were attached to water heaters citing water over 130 F may cause scalding.

In 1991, the water heater manufacturers consensus standard (ANSI) American National Standard Institute Z21.10.1a-1991 included a pictorial scald warning depicting a possible burned hand under a bathtub's hot water spigot. The warning states: "Danger, Water Temperature Over 125 F Can Cause Severe Burns Instantly or Death From Scalds."

Plumbing Codes

There are three major U.S. plumbing codes, Uniform Plumbing Code (UPC), Standard Plumbing Code (SPC), and the International Plumbing Code (IPC).

Although not specifically stated, we may expect many of the 60,000 scalds reported resulted from too hot tap water.

Since the early to mid-1990s, these codes had sections addressing scald protection for new and remodeled construction. Their wording is similar to: "Shower and tub/shower combinations shall be provided with pressure balance or thermostatic mixing controls. Such valves shall be equipped with handle stop positions and shall be adjustable to deliver water at a maximum of 120 F."

Although existing installations may be exempt from providing specific scald protection, the Codes' language does indicate the need to provide a safe installation such as: "The plumbing and drainage system of any premises under the Authority Having Jurisdiction shall be maintained in a sanitary and safe operating condition by the owner or the owner's agent . . . . . no hazard to life, health or property is created by such plumbing system."

There is general agreement in the plumbing industry that tap water temperatures above 120 F are not safe and proper precautions are required to reduce this scalding hazard.

Scald Protection

For residential applications, the most widely used device for preventing tap water scalds is the pressure balancing control valve. As stated above, these devices were required by plumbing codes starting during the early to mid 1990s.

These would be installed as either the control valve for the combination tub and shower unit, or for just the shower stall. Most of these valves are designed with a flexible diaphragm in combination with a cylinder bored with two holes, one for hot water and one for cold water. The edges of the diaphragm serve as valve seats, which control the both the hot and cold water entering and exiting the valve.

For example, when taking a shower, if cold water is activated in the home such as a flushed toilet, cold water pressure may suddenly drop and hot water would not be thoroughly mixed with the cold water thereby, causing much hotter water to exit the showerhead.

With a pressure balancing valve, a drop in pressure of cold water would move the cylinder inside the diaphragm toward the cold side, allowing more cold water to enter the control valve and less hot water.

This is accomplished almost instantaneously so the person taking the shower would not be affected by changes in water temperature.

The key to proper operation of a pressure balancing control valve is its initial setting.

For example, to ensure maximum hot water exiting the valve is 120 F, the control lever's maximum hot water

(continued on next page)

position must be set. This usually involves adjusting a set-screw while using a thermometer to measure the exiting tap water.

In the past these devices were required only for stand-alone showers and combination shower and bathtubs, not bathtubs without showers such as those equipped with whirlpool jets. However, current plumbing codes now require similar scald protection devices for these types of installations.

Scald protection can be provided for older existing applications, which do not have pressure-balancing valves. There are add-on thermostatic control devices, which attach to sink spouts, showerheads and bathtub spigots.

Usually these devices are factory set at 114 F for exiting hot water. If water above this temperature contacts the device, it will stop the hot water exiting the spout or spigot. Most individuals take showers or baths using water between 105 and 110 F.

For commercial hot water applications such as hotels, schools and apartment complexes, a combination mixing and thermostatic valve is generally installed. Such a master valve is usually attached to the main hot water pipe as it exits the water heater. The cold water supply pipe also enters this valve; a mixing action occurs, which results in tempered water exiting the valve. This tempered water, usually at 120 F, is then piped for tap water use throughout the building.

Legionella Bacteria

Some experts contend lower water temperatures allow growth of Legionella bacteria. Legionella bacteria was named after the lung disease that killed dozens of American Legion conventioneers attending a convention in a Philadelphia hotel during the mid 1970s.

This bacteria flourish at water temperatures between 68 and 122 F, usually on water slime, bio-film, sediment and scale. The assertion is Legionella bacteria can form at relatively low hot water temperatures, which are then released and inhaled when taking a shower. To date, the majority of Legionella bacteria were found in large commercial buildings and none have been found in residential homes.

Layering Phenomenon

Thermostats on residential water heaters are not precise controls of water temperature. ANSI Z21.10.1 standard for residential water heater manufacturing allows gas fired water heaters to vary ten degrees above or below the thermostat setting.

If the setting is incorrect, reset the control knob according to the manual's instructions for 120 F water.

Also, allowed by ANSI Z21.10.1 is the phenomenon known as stacking or layering. Short repeated draws of hot water from the water heater could cause changes in water temperature within the water heater itself.

This is due to the inherent design of residential gas fired water heaters where the thermostat and burner are near the bottom of the tank, with cold water entering the top of the tank and hot water exiting at the top of the tank.

This layering phenomenon can increase as much as 30 degrees F to the hot water exiting the tank versus the thermostat setting. Although rare, it is possible and it reinforces the need for applicable scald protection devices and warnings.

Liability Issues

Since 1996, our firm has been involved with over three-dozen scald cases involving excessively hot tap water. Some cases centered on landlord liability, which pertained to the necessity of maintaining a safe property for tenants.

Other cases focused on contractor liability, such as improper installation of the water heater. Product liability issues were also involved, usually against the water heater manufacturers, primarily for inadequate warnings.

Under the ANSI standard, the manufacturer is required to use a detent or legible mark on the heater's adjustable thermostat, consistent with a water temperature of approximately 120 F. Each thermostat manufacturer uses a different type of adjustable dial for temperature settings.

For example, one manufacturer states their "Hot" setting approximates 120 F. Another manufacturer states the setting that approximates 120 F is at the detent about 1/3 the distance between their "Warm" and "Hot" marks.

Although these settings are usually fully explained in the manufacturer's instruction manual, these may or may not be explained on the water heater itself. Simply, in order to properly set the water heater's temperature at or, at least near 120 F, a consumer is required to read the manual.

This may seem obvious, but if the instruction manual is not available, a consumer then needs to rely on trial and error in establishing a proper thermostat setting. That, of course, is just not safe.

Preventative Action

First, if the home's water heater is gas fired, check the setting of the thermostat on your water heater.

The heater's thermostat control knob is usually visible on the outside of the heater. As noted above, this may require the need to refer to the water heater's instruction manual.

(continued on back page)

Scalding Tap Water and Serious Burns *(continued from page three)*

If the setting is incorrect, reset the control knob according to the manual's instructions for 120 F water.

If you reset the thermostat, wait a day before you test the water temperature. To test, start with the tap closest to the water heater. Run the water for at least several minutes over a candy or meat thermometer and then read the temperature.

If the tap water check indicates the water is too hot, simply turn the control knob to a lower setting.

Wait a day and then recheck the same tap water to ensure a 120 F temperature. If the water is still too hot, repeat the above procedure to attain the correct temperature.

The thermostat on an electric water heater is located under a metal cover, which needs to be removed with a screwdriver. You will definitely need to read your heater's instruction manual before attempting to reset the thermostat.

Remember, first turn off the main electrical connection to the water heater, either by switching a circuit breaker or by pulling a fuse. If the procedure appears difficult or confusing, we recommend you contact a service technician.

Summarizing

Preventing serious tap water scalds is relatively easy. First, you must realize the hazards of too hot tap water. You then need a basic knowledge of your water heater's thermostat function. Finally, you must conduct a simple test to ensure 120 F water. ❑

Russell Fote, P.E.,
C.S.P., C.F.E.I.
Expert Safety Engineer

For Expert Testimony, Talk to an Expert

Russell Fote & Associates has over 30 years of safety engineering experience. The firm's field of expertise includes: **fires, explosions, carbon monoxide, scalds, flammable liquids/gases, water heaters, appliances, furnaces, slips/falls** and **motor vehicle collisions**.

- Investigations & Reconstructions
- Hazard Analysis & Evaluations
- Depositions & Trial Testimony

Since starting Russell Fote & Associates, Mr. Fote has given over **150 depositions** and testified at over **25 trials**. He has been recognized as an expert in the state courts of: Illinois, Wisconsin, Iowa, Kentucky, Tennessee, Nebraska, Oklahoma, and West Virginia, plus U.S. District Courts in Atlanta, GA and Central Islip, NY.

We have two offices to serve you, one in the Milwaukee area and the other in Chicago, near O'Hare International. Our contact information is listed at the bottom of this newsletter.

Russell Fote & Associates, Inc.
3636 Stonebrook Ct.
Brookfield, WI 53005

◆

8770 W. Bryn Mawr Ave., Suite 1300
Chicago, IL 60631

**For Expert Testimony,
Talk to an Expert**

FREE Newsletter Inside

Scalding Tap Water and Serious Burns

FIRST CLASS
U.S. POSTAGE
PAID
BROOKFIELD,
WI
PERMIT NO. 951