
Recommended Installation Practices for Residential Storage Type Water Heaters to Reduce the Danger of Scalds

A White Paper

Developed by the ASSE International Scald Awareness Task Group

ASSE International
18927 Hickory Creek Drive, Suite 220, Mokena, Illinois 60448
Phone: (708) 995-3019 | <http://www.asse-plumbing.org>





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Section 1 - Executive Summary

The ASSE International Scald Awareness Task Group was formed to educate and give guidance to the general public and plumbing industry on scalding hazards associated with hot water at the point of use. This White Paper will focus on the recommended installation practices for residential storage type water heaters that the plumber, installer or plumbing contractor should follow to reduce the dangers of scald injuries at the point of use which is the plumbing fixture such as showers, bathtubs, lavatory faucets, and kitchen faucets. Automatic residential storage type water heaters have been in use for well over one hundred years and have become a safe and reliable appliance in almost every type of residential dwelling, when installed correctly.

The ASSE International and the professional plumbing community are very aware of improperly installed storage type water heaters and the scald burns that have been caused by these improper installations.

As this paper will point out, there are many installation practices that if not followed completely may lead to potential scald burns caused by excessive temperature of the hot water at the point of use. It will also point out what can be done to lower the risk of scald burns at the point of use.

The do-it-yourselfer or the uninformed installer may be unaware of these installation practices. The best choice is to have a licensed professional install the water heater to avoid these potential hazards.

Note: There is another class of residential water heaters that have little or no storage and provide hot water on demand – Tankless/On-Demand Water Heaters. The heat source of some of these heaters is relatively constant and therefore the discharge water temperature can increase into the scalding range as the rate of flow decreases. This type of water heater, if not installed properly, can also lead to scald hazards. Some of the causes of these scald hazards are similar to what we speak of in this paper, yet some are distinctly different. We hope to address these issues in another White Paper at a later date.

This paper will only address the recommended installation practices of the residential storage type heaters.

Section 2 - Purpose

The ASSE International Scald Awareness Task Group was formed to educate and give guidance to the general public and plumbing industry on the many ways that someone can be exposed to the potential scalding hazards associated with residential hot water at the point of use.

This White Paper will focus on recommendations for the installer to follow when installing or replacing a residential water heater. There has been a misconception that the water heater alone is capable of delivering a consistent water temperature at the point of use. This paper will explore why this misconception can create a false sense of security, and most importantly, how the dangers of scalding from excessive water temperature can be reduced.

The focus will be on what must be done within the hot water distribution system when replacing a residential water heater. Too often the installer only replaces the water heater without checking the effect that the new water heater has on the system.

This paper will give the installer some of the tools to help identify potential scald situations and protect the customer for the life of the water heater.

Section 3 - The Problem

The four most common causes for hot water scalds are:

- #1 – The perception that water heaters alone sufficiently control water temperature at the point of use. The water heater thermostat on standard residential tank type water heaters is NOT capable of controlling the temperature of the hot water distribution system.
- #2 – Failure to address the impact of a new or replacement water heater on the hot water distribution system temperature;
- #3 – Improperly installed water heaters;
- #4 – The Stacking Effect.

To expand on these common causes:

Many plumbing installers and consumers believe that water heaters alone sufficiently control water temperature at the point of use. However, this misconception can create a false sense of security and result in scalds. Other temperature controlling devices may be necessary to properly control the temperature of water delivered to the point of use.

Often when a water heater is installed its impact on the distribution system and points of use is not considered. For example, in a replacement scenario, the new water heater may have a different rating or may be set to a higher temperature. Both of these changes will impact the water temperature at the point of use, which can result in a scald.

When water heaters are not installed in accordance with local codes and the manufacturer's installation instructions, the potential for scalds is greatly increased.

The "Stacking Effect" is caused by short repeated water heating cycles from small hot water uses, which transfers more heat to the already heated water. This can increase the water heater outlet temperature by 20 or more degrees above the set point of the water heater thermostat at the outlet. This increase in water temperature may increase the risk of scalds.

While the topics discussed are the most common, other scald risks exist. Each installation is unique and scald risks must be considered on a case-by-case basis. Additional issues with storage type water heaters are identified in previously published white papers.

Section 4 - The Recommended Solutions

#1 – The water heater thermostat control should never be used to control the final temperature of the hot water distribution system.

One of the basic tenets listed in earlier papers published by the ASSE Scald Awareness Task Group – Understanding Potential Water Heater Scald Hazards - is that the water heater thermostat is not capable of controlling the temperature of the hot water distribution system.

Water heater thermostats cannot be considered precision controls. Water heaters can experience wide variations in storage temperatures. These variations in water temperatures can be attributed to causes other than the accuracy of the thermostats. For many types of storage water heaters, the location of the thermostat near the bottom of the tank reacts to the incoming cold water temperature to activate the means to heat the water. The hotter water accumulates at the top of the storage tank.

The only true solution to control the water temperature to the system is to install a Temperature Actuated Mixing Valve listed to ASSE 1017 at or near the water heater.

#2 – When a new water heater is installed as a replacement, the installer must be aware of the effect that the new water heater will have on the temperature of the hot water distribution system.

The temperature of the water to the hot water distribution system can be significantly higher than with the previous water heater. All of the downstream temperature limiting devices (shower or tub/shower combination compensating type valves, whirlpool or soaking tub compensating type valves, etc.) must be checked for proper water delivery temperatures and the temperature limit stops must be reset when necessary.

If temperature-limiting devices are not installed in the hot water distribution system, the installer must inform the owner of the potential scald hazard that is present.

All of the model codes require a temperature compensating type shower or tub/shower combination valve, listed to ASSE 1016-2017 / ASME A112.1016-2017 / CSA B125.16-17. These valves must be installed on every shower or bathtub/shower combination because an ASSE 1017 device does not provide thermal shock protection due to pressure changes in the system.

#3 – All water heaters, new installation or replacement, must be installed per the manufacturers' installation instructions or the prevailing codes, whichever is more stringent.

When a water heater is not properly installed including verifying the required temperature settings of the downstream temperature control devices, the potential for scald injuries is dramatically increased. It is recommended that in all scenarios, to help reduce the danger of scald burns from extremely hot water

at the point of use, to install a Temperature Actuated Mixing Valve for Hot Water Distribution Systems compliant to ASSE 1017 at the hot water source, the water heater. This will allow the water heater thermostat to be set at a higher temperature, which accomplishes two additional benefits:

- Increases the available amount of hot water and
- Controls the growth of legionella bacteria in the water heater.

The ASSE 1017 device at the outlet of the water heater then can be set to the industry recommended maximum temperature of 120° F to control the hot water system temperature. The accuracy of an ASSE 1017 listed device, for a typical residence, flowing a total of less than 5 gpm will control the outlet water temperature within plus or minus 3° F based upon the performance requirements of the standard.

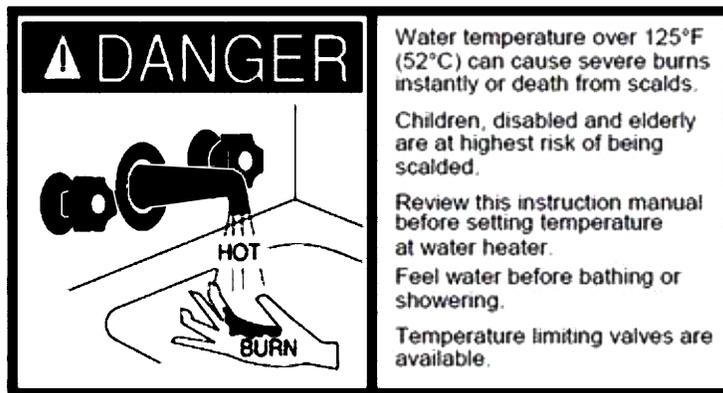
Installing an ASSE 1017 Temperature Actuated Mixing Valve at the water heater does not replace or negate the requirement of point of use temperature limiting devices at showers, tub/shower combinations, whirlpool bathtubs, soaking tubs, etc.

#4 – The most effective way to control the potential increase in water temperature in the hot water distribution system due to the Stacking Effect is to install a Temperature Actuated Mixing Valve listed to ASSE 1017 at or near the water heater.

Section 5 - Manufacturers' Recommendations

Water heater manufacturers include information and warnings regarding the potential scald hazards associated with water heaters. Typical warnings read as follows:

A water heater can deliver scalding temperature water at any faucet in the system. Be careful whenever using hot water to avoid scalding injury. Certain appliances such as dishwashers and automatic clothes washers may require increased temperature water. By setting the thermostat on this water heater to obtain the increased temperature water required by these appliances, the potential for scald injury increases. To protect against injury, you should install an ASSE approved mixing valve in the water system. This valve will reduce point of discharge temperature by mixing cold and hot water in branch supply lines. Such valves are available from the manufacturer of this water heater or a local plumbing supplier. Please consult with a plumbing professional.



APPROXIMATE TIME/TEMPERATURE RELATIONSHIPS IN SCALDS	
120°F (49°C)	More than 5 minutes
125°F (52°C)	1½ to 2 minutes
130°F (54°C)	About 30 seconds
135°F (57°C)	About 10 seconds
140°F (60°C)	Less than 5 seconds
145°F (63°C)	Less than 3 seconds
150°F (66°C)	About 1½ seconds
155°F (68°C)	About 1 second

⚠ WARNING

Hotter water increases the risk of scald injury. Scalding may occur within 5 seconds at a temperature setting of 140°F (60°C). To protect against hot water injury, install an ASSE approved mixing valve in the water system. This valve will reduce point of discharge temperature by mixing cold and hot water in branch water lines. A licensed plumbing professional or local plumbing authority should be consulted.

Note: This water heater is equipped with an energy cut out device to prevent overheating. Should overheating occur or the gas supply fail to shut off, turn off the manual gas control valve to the appliance and call a qualified service technician.

Note: Whenever the water heater is filled with cold water, condensate will form on the cool tank surface and drops of water will fall on the hot burner and combustion chamber surfaces producing a "sizzling" noise. Condensation is normal and does not indicate a leak. It will disappear when the tank becomes heated.

⚠ CAUTION

INCREASING THE THERMOSTAT SETTING ABOVE THE PRESET TEMPERATURE MAY CAUSE SEVERE BURNS AND CONSUME EXCESSIVE ENERGY. HOTTER WATER INCREASES THE RISK OF SCALD INJURY.

⚠ CAUTION

Hotter water increases the risk of scald injury. Scalding may occur within five (5) seconds at a temperature setting of 140°F (60°C). To protect against hot water injury, install an ASSE approved mixing valve in the water system. This valve will reduce point of discharge water temperatures by mixing cold and hot water in branch water lines. A licensed plumbing professional or local plumbing authority should be consulted.

Note: This water heater is equipped with an energy cut out device to prevent overheating. Should overheating occur, turn off the electrical supply to the water heater and contact a qualified service technician.

For electric water heaters, make sure that the heater is full of water before turning the power on to the appliance. The thermostats are preset to the “HOT” setting to provide a water temperature of approximately 120°F (49°C) to reduce the risk of scald injury.

CAUTION! Scalding may occur within 5 seconds at a temperature setting of 140°F (60°C).

In addition to the current manufacturer’s instructions and the local plumbing codes, ASSE strongly recommends that the solutions found in Section 4 be followed to reduce the risk of scald burns.

Section 6 - Plumbing Codes

Most model plumbing codes identify the maximum safe temperature to prevent scalding as 120° F. The plumbing codes also state that the water heater thermostat should not be used as a control for scald prevention

All codes are constantly changing and updating, and it is the installers' responsibility to check with the local authority having jurisdiction (AHJ) for any local requirements or amendments to the code in their jurisdiction before installation.

Refer to the current Model or Local Code in your area:

ICC – International Plumbing Code

ICC – International Residential Code

National Plumbing Code of Canada

IAPMO – National Standard Plumbing Code

IAPMO – Uniform Plumbing Code



Section 7 - Installer Responsibilities

Some of the responsibilities that the installer must be aware are:

- Water heaters are to be installed per the manufacturer's installation instructions or the local codes, whichever is more stringent.
- In all installations, the installer must check the water temperature at the outlet of the water heater, at the closest fixture, and at all shower, tub, or tub/shower combination units. Set the limit stops on any temperature limiting devices to 110° F or at a temperature not to exceed that in the local codes.
- If temperature-limiting devices are not installed in the hot water distribution system, the installer should make the owner aware of the potential scald hazards that are present.
- TO LOWER THE POTENTIAL OF SCALD INURIES, IT IS STRONGLY RECOMMENDED TO INSTALL A TEMPERATURE ACTUATED MIXING VALVE FOR HOT WATER DISTRIBUTION SYSTEMS LISTED TO ASSE STANDARD #1017 NEAR OR AT THE SOURCE. Once properly set, this valve will reduce the temperature in the water distribution system to a safer temperature.



Section 8 - Definitions

Automatic Compensating Type Shower Valve: One of three types of valves that compensate for changes in incoming pressure, temperature or pressure and temperature. These valves conform to the following consensus industry standards: ASSE 1016, Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations, or ASME A112.18.1 /CSA B125.1-05, Plumbing Supply Fittings.

See the three types of valves below:

1. **Pressure Balancing Type Shower Valve:** A pressure balancing valve (Type P) senses incoming hot and cold water pressures and compensates for fluctuations in either hot or cold water to stabilize outlet temperature.
2. **Thermostatic Type Shower Valve:** A thermostatic balancing valve (Type T) which senses outlet temperature and compensates for fluctuations in either incoming hot and cold water temperatures and/or pressure to stabilize the outlet temperature.
3. **Combination Thermostatic and Pressure Balancing Type Shower Valve:** A combination thermostatic/pressure balancing valve (Type TP) which senses outlet temperature and incoming hot and cold water pressures and compensates for fluctuations in incoming hot and cold water temperatures and/or pressures to stabilize the outlet temperature.

Residential Storage Type Water Heater: An appliance for supplying hot water for residential purposes other than for space heating. A residential storage type heater is a water heater that heats and stores water.

Stacking Effect: The Stacking Effect is caused by short repeated water heating cycles from small hot water uses, which transfers more heat to the already heated water. This can increase the water heater outlet temperature by 20 or more degrees above the set point of the water heater thermostat at the outlet of the water heater. This increase in water temperature may increase the risk of scalds.

Temperature Actuated Mixing Valves: Temperature Actuated Mixing Valves for Hot Water Distribution Systems used for controlling in-line water temperatures in domestic hot water systems. These devices shall be installed at or near the hot water source. These valves shall conform to the following industry consensus standard: ASSE 1017 Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems.

Temperature Limiting Devices: Water Temperature Limiting Devices are intended to limit the hot or tempered water temperature supplied to fittings for fixtures such as sinks, lavatories, bidets or bathtubs to reduce the risk of scalding. These devices must conform to ASSE 1070-2015 / ASME A112.1070-2015 / CSA B125.70-15 Performance Requirements for Water Temperature Limiting Devices.

Thermal Shock: A significant sudden change in temperature from hot to cold, cold to hot, or hot to hotter that causes a bather to violently react, which can lead to a slip and/or fall injury.

Tankless/On-Demand Water Heaters: Residential water heaters, without storage capabilities, intended for individual or small groups of fixtures that generally heat water from cold up to a usage temperature. It can be heated by any source of heat energy. The temperature is affected by the flow.

White Paper: An authoritative report or guide that informs readers concisely about a complex issue and presents the issuing body's philosophy on the matter. It is meant to help readers understand an issue, solve a problem, or make a decision.

Section 9 - Task Group Members & Affiliation

Richard J. Prospal	<i>Chair, IPP, FASSE, Prospal Consulting Services, Inc.</i>
Julius Ballanco, PE	<i>JB Engineering and Code Consulting, P.C.</i>
Bill Chapin	<i>Professional Code Consulting, LLC.</i>
Lee Clifton	<i>Senior Director of PMG Resources, International Code Council</i>
David Dertz	<i>President, Illinois Plumbing Inspectors Association</i>
Woody Dickinson	<i>Marketing Technical Manager, Caleffi North America (Milwaukee, WI)</i>
Richard (Dick)Emmerson	<i>FASSE</i>
Charles Erickson, PE	<i>Sr. Project Manager, UL LLC</i>
Matthew Frantantonio	<i>Engineering Manager, Thermostatics, Watts Water Technology</i>
Ron George, CPD	<i>President, Plumb-Tech Design & Consulting Services, LLC</i>
Roger W. Griffith, PE	<i>President, Griffith Engineering & Consulting, Inc.</i>
Chris Haldiman	<i>Codes & Standards Manager, Watts Water Technology</i>
Guy Wayne Harrison	<i>Consultant, Master Plumber, OSHA Trainer</i>
Conrad Jahrling	<i>Staff Engineering Supervisor, ASSE International</i>
Donald M. Jones	<i>General Interest</i>
Mannan Mohammed	<i>Engineering Manager, Reliance Worldwide Corp (Canada) Inc.</i>
John Parizek	<i>ASSE International President, Training Coordinator-Minneapolis Plumbers Joint Training Comm.</i>
Frederick Schilling	<i>Master Plumber, Commissioner, Florida Building Commission</i>

ASSE International expresses its sincerest gratitude to all of the members of this Scald Awareness Task Group for their dedication and contributions to this project.

A total of 22 industry professionals contributed both time and expertise to the development of this paper; however, some requested to not have their names included. The group is comprised of: manufacturers, engineers, industry association members, master plumbers, general interest individuals, code officials, inspectors, a building commissioner and labor representatives.

There are 4 other Scald Awareness Task Group white papers available for free download at www.asse-plumbing.org.



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