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# Recommended Installation Practices for Residential Tankless Water Heaters to Reduce the Danger of Scalding

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***A White Paper***

*Prepared by the ASSE International Scald Awareness Task Group*

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# Executive Summary

The ASSE International Scald Awareness Task Group was formed to educate and give guidance to the general public and plumbing industry on scald hazards associated with hot water. This white paper focuses on the recommended installation practices that plumbers, installers, and/or plumbing contractors should follow to reduce the dangers of scald injuries or thermal shock when installing any type of residential tankless water heater. This paper also addresses some of the potential problems with poor, unprofessional installations and the solutions to those problems. The paper also points out the responsibilities of the installer.

With the advent of tankless water heater technology that can control the outlet temperatures of the water heater to the same specifications as various ASSE International product performance standards for mixing valves, ASSE International developed three new ANSI Approved product performance standards. Two of these standards will be featured in this paper:

- ASSE Standard #1082-2018, *Performance Requirements for Water Heaters with Integral Temperature Control Devices for Hot Water Distribution Systems*
- ASSE Standard #1084-2018, *Performance Requirements for Water Heaters with Temperature Limiting Capacity*

# 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 and thermal shock hazards associated with hot water at the point of use.

This white paper will focus on recommendations for the installer to follow when installing a residential tankless water heater or replacing a residential tank water heater with a tankless water heater.

To better understand the differences of tank and tankless water heaters:

**STORAGE TANK WATER HEATER:** A storage tank water heater heats and stores water. It is the most common and traditional type of water heater found in North American households. These are commonly installed in a variety of locations within a home, such as, but not limited to, basements, utility/mechanical rooms, attics, garages, and outdoor closets. This type of water heater heats the cold water coming in from municipal supply or well and maintains the temperature in the tank, even when water is not in demand. Energy in the form of electricity, oil, or fuel gas is required to heat the water to maintain the temperature at the set point. Storage tank water heaters have an adjustable thermostat. **NOTE:** See previously published white paper, “Understanding Potential Water Heater Scald Hazards,” for more details concerning the thermostat controls. The quantity of hot water available for a peak period of time is dependent on the storage volume, the storage temperature selected, in-line hot water temperature controls, recovery rate of the water heater, and any prior usage during the same peak period.

**TANKLESS WATER HEATER:** As the name indicates, this type of water heater does not store water in a tank – it stores water in small water tubes. It heats water as it passes through the water heater on an on-demand basis. Tankless water heaters are also known as on-demand water heaters. When there is a demand for hot water, the cold water from municipal supply or well is drawn through the heat exchanger of the tankless water heater. The flow of the water causes the gas or oil burner(s), or the electric heating element(s), to be activated. With this type of water heater, there can be a continuous supply of hot water. The water heater only consumes energy when there is a call for hot water. There are several types of tankless water heaters with varying degrees of temperature controls. Depending on the tankless heater technology, the temperature can change as the flow changes, or with some technologies, the flow rate can be reduced, or the burner or heating element can be modulated for temperature control within specified limits. Proper capacity sizing is very important for this type of water heater to ensure the temperature and flow requirements can be met.

ASSE International has developed two ANSI Approved product performance standards for water heaters:

Tankless water heaters listed to ASSE 1082, *Performance Requirements for Water Heaters with Integral Temperature Control Devices for Hot Water Distribution Systems*, are intended to be installed for distribution. They serve a similar function as devices listed to ASSE 1017, *Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems*, in that they are intended to provide similar temperature control tolerances at steady-state flow rates. They are not intended for controlling or limiting point-of-use temperature.

Tankless water heaters listed to ASSE 1084, *Performance Requirements for Water Heaters with Temperature Limiting Capacity*, are intended for point-of-use applications. They have the necessary control and safety requirements to prevent scalding and to fail safely. However, they are not intended to prevent thermal shock.

# Potential Problems

Not all water heaters comply with ASSE product performance standards for water heaters. Some tankless water heaters may allow the hot water temperature to fluctuate, either up or down, dependent on flow. For example, ASSE listed water heaters minimize the temperature fluctuations experienced at the point of use.

- 1.** As with many water heating devices, tankless water heaters may allow the outlet temperature to overrun the outlet set point. When the flow increases the temperature will drop and when the flow decreases the temperature will increase.
- 2.** Most tankless water heaters have a minimum flow rate before the unit activates to heat the water. Flow rates below the minimum activation flow rate would result in the delivery of cold water.
- 3.** Some models of tankless water heaters can experience temperature or pressure fluctuations when flows change from simultaneous fixture usage.
- 4.** When water heaters are not installed in accordance with local codes and the manufacturer's installation instructions, the potential for scalding and thermal shock is greatly increased.
- 5.** When a water heater is installed, its impact on the hot water distribution system and points of use need to be considered. For example, in a replacement scenario, the new water heater, even with the same rating, may be set to a higher temperature. These changes can impact the water temperature at the point of use, which can result in scalding or thermal shock.

# Recommended Solutions

We highly recommend contacting a licensed professional who is able to properly perform or assist in retrofitting and/or installing new plumbing systems.

- 1.** In order to control the outlet temperature variation:
  - a.** Install a tankless water heater that is listed to ASSE 1082, or
  - b.** Install a mixing valve listed to ASSE 1017 at or near the outlet of the water heater, which is not listed to ASSE 1082.
- 2.** In order to prevent the minimum flow rate being too low to activate the tankless water heater:
  - a.** The required minimum flow rate of each fixture supply fitting (faucet, showerhead, etc.) must be considered when choosing the proper tankless water heater for your residence.
  - b.** When adding or replacing a fixture supply fitting (faucet, showerhead, etc.) that will have hot water supplied by an existing tankless water heater, verify that the flow rate of that new fixture is greater than the minimum flow rate needed to activate the tankless water heater.
- 3.** When choosing a tankless water heater, consideration must be given to the simultaneous use of multiple fixtures requiring hot water with their maximum flow rates to determine the required maximum demand flow. The demand flow is a fraction of the mixed water flow.
- 4.** All water heaters, new installation or replacement, must be installed per the manufacturers' installation instructions and the prevailing codes, whichever is more stringent.
- 5.** When a new water heater is installed, the installer must be aware of the effect that the new water heater might have on the temperature of the hot water distribution system.

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

All of the current model codes require protection against scalding for bathtubs and showers. Thermal shock protection is also required for shower and tub/shower combinations.

A water heater listed to ASSE 1082 or ASSE 1084 does not provide thermal shock protection due to pressure changes in the system.

When temperature limiting devices are not installed in the hot water distribution system at the point of use, the installer must inform the owner of the potential scald hazard that is present and recommend the use of a temperature limiting device.

# Manufacturers' Recommendations

Water heater manufacturers include thorough installation instructions, which must be followed explicitly, along with information and warnings regarding the potential scald hazards associated with water heaters.

Water heater manufacturers also include maintenance and service instructions that must be followed in order to ensure proper operation of the water heater.

Many tankless water heaters have an inlet water filter that must be checked at least annually and cleaned or replaced as necessary.

Scale buildup in the heat exchanger is a common occurrence dependent on the mineral content of the water. This scale buildup will affect the operation and/or efficiency and can shorten the life of the water heater. Heat exchanger cleaning must be in accordance with the manufacturer's recommendations.

# Installer Responsibilities

Water heaters must be installed per the manufacturer's installation instructions and the local codes, whichever is more stringent.

We highly recommend that a licensed professional install these tankless water heaters to ensure that the manufacturer's instructions were followed and that all work was performed per the local codes.

Prior to installation, many considerations must be made to choose the correct unit(s):

- 1.** The plumbing system(s) designer is responsible for determining the necessary sizes of water heating equipment to serve the needs of the building operation.
- 2.** The water heater installer shall verify that the fuel piping is of adequate size to deliver the proper amount of fuel to correctly operate the unit.
- 3.** The water heater installer shall determine that the circuit and wiring are adequate to safely deliver power to the unit.
- 4.** If the water heater is a condensing type, the water heater installer shall make provisions for proper disposal of the condensate.

After installation:

- 1.** Check for proper water temperature at all downstream fixtures. Adjust temperature limit stops at all compensating type shower or tub/shower valves.
- 2.** Review maintenance and operating instructions with homeowner



# Definitions

For any definitions other than those listed below, please consult the ASSE Plumbing Dictionary, Sixth Edition, or your local Authority Having Jurisdiction

## **Maximum Demand Flow**

The greatest estimated flow or use to satisfy system requirements.

## **Residential Storage Water Heater**

An appliance for heating, storing, and supplying water for residential purposes other than for space heating.

## **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 may be affected by the flow.

# Appendix

The potential for Legionella and other micro-organism bacteria growth is possible when heating water to its growth temperature range. This paper does not cover that topic. If you require more information regarding Legionella and other opportunistic pathogens, please consult ANSI/ASHRAE Standard 188-2018, *Risk Management for Building Water Systems*, and Guideline 12-2000, *Minimizing the Risk of Legionellosis Associated with Building Water Systems*.

# Task Group Members & Affiliations

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*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 16 industry professionals contributed both time and expertise to the development of this paper; however, some have 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, and labor representatives.*

*There are five other Scald Awareness Task Group white papers available for free download at [www.asse-plumbing.org/resources](http://www.asse-plumbing.org/resources)*



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