Basic Fundamentals of Domestic Hot Water Heating Sizing and Design
To ask a question, type into the [Enter a question for staff] field and click Send.
About This Presentation

- We assume contractors have the current version of the [NYSERDA Home Performance with ENERGY STAR® & EmPower Programs Material & Installation Guidelines](#) and have reviewed and understand these Guidelines.
- This presentation will primarily focus on Basic Fundamentals of Domestic Hot Water Heating Sizing and Design along with the M&I Guidelines.
- This presentation will focus on residential water heaters.
- Where applicable we will refer to certain sections of the guidelines during this presentation.
Polling Question

When selecting space heating and water heating equipment where is your organization's biggest weakness?

1. Sales/design
2. Installation/Commissioning
3. Up to date information on the most recent products
4. None of the above
Agenda

- Domestic Water Heater Efficiency: Program Requirements!
- Domestic Water Heater Efficiency: 2015 Energy Conservation Standards
- Energy Factor (EF)/Uniform Energy Factor (UEF)
- Domestic Hot Water System Load Calculations, Sizing, and Selection
  - Storage water heater
  - Indirect Water Heaters
  - Tankless water heater
  - Combi Systems
- Installation Essentials and Best Practices
- Water Quality Demands
- Basic overview of the following DHW systems
  - Air Source Heat Pump Water Heaters
  - Ground Source Heat Pump Water Heaters and Desuperheaters
  - Solar Hot Water Heater
- Start-up and Commissioning

CLEAResult
## Domestic Water Heater Efficiency – Program Requirements

<table>
<thead>
<tr>
<th>Water Heater Type</th>
<th>Eligible Measures</th>
<th>Minimum Efficiency Requirements</th>
<th>Prequalified</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Natural Gas</strong></td>
<td>Tank: 40-100 gallons, EF &gt;= 0.67, FHR &gt;= 67 gallons per hour, &lt;75,000 BTU, ENERGY STAR Qualified</td>
<td>On-Demand: EF &gt;= 0.82, GPM &gt;= 2.5 over a 77°F rise, &lt;2 gallons storage, &lt;200,000 BTU, ENERGY STAR Qualified. Must replace a conventional 40 or 50 gallon tank.</td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Electric</strong></td>
<td>EF &gt;= 0.93</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Propane</strong></td>
<td>Tank: 20-100 gallons, EF &gt;= 0.67, FHR &gt;= 67 gallons per hour, &lt;75,000 BTU, ENERGY STAR Qualified</td>
<td>On-Demand: EF &gt;= 0.82, GPM &gt;= 2.5 over a 77°F rise, &lt;2 gallons storage, &lt;200,000 BTU, ENERGY STAR Qualified.</td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Oil</strong></td>
<td>Tank: 20-100 gallons, EF &gt;= 0.67</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Indirect-Fired Tank</strong></td>
<td>UL Approved</td>
<td></td>
<td>✔️</td>
</tr>
<tr>
<td><strong>Heat Pump Water Heaters</strong></td>
<td>50 gallon tank, EF &gt;= 2.2, ENERGY STAR Qualified. Must be installed in an unconditioned space.</td>
<td></td>
<td>✔️</td>
</tr>
</tbody>
</table>

### Eligible Measures

- **Solar Thermal**: CG-100 or CG-300 certification from SRCC. SF 0.5. Warranty: 10 years on the panel, 5 years on the system. System needs to be reviewed and approved by the NYSERDA or PSEG Long Island Solar Thermal Program prior to submission to HPwES.

Source: [HPwES Eligible Measures and Accessories List](#)
Domestic Water Heater Efficiency – 2015 Energy Conservation Standards

![2015 Energy Conservation Standards for Residential Water Heaters]

<table>
<thead>
<tr>
<th>Product Class</th>
<th>Rated Storage Volumes/Inputs Affected by Change</th>
<th>New Energy Factor Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas-fired</td>
<td>≥ 20 gal and ≤ 55 gal, ≤ 75,000 BTU/HR.</td>
<td>0.675 – (0.0015 x V)</td>
</tr>
<tr>
<td></td>
<td>&gt; 55 gal and ≤ 100 gal, ≤ 75,000 BTU/HR.</td>
<td>0.8012 – (0.00078 x V)</td>
</tr>
<tr>
<td>Oil-fired</td>
<td>≤ 50 gal, ≤ 105,000 BTU/HR.</td>
<td>0.68 – (0.0019 x V)</td>
</tr>
<tr>
<td>Electric</td>
<td>≥ 20 gal and ≤ 55 gal, ≤ 12 KW input</td>
<td>0.960 – (0.0003 x V)</td>
</tr>
<tr>
<td></td>
<td>&gt; 55 gal and ≤ 120 gal, ≤ 12 KW input</td>
<td>2.057 – (0.00113 x V)</td>
</tr>
<tr>
<td>Instantaneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas-fired</td>
<td>≤ 2 gal, ≤ 200,000 BTU/HR.</td>
<td>0.82 – (0.0019 x V)</td>
</tr>
<tr>
<td>Instantaneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electric*</td>
<td>≤ 2 gal, ≤ 12 KW input</td>
<td>0.93 – (0.00132 x V)</td>
</tr>
</tbody>
</table>

* no change

V = Rated Storage Volume in U.S. Gallons

Source: Bradford White
Domestic Water Heater Efficiency – 2015 Energy Conservation Standards

• Which water heaters are affected?
  ➢ The updated rules apply to all residential storage and tankless water heaters fired by gas, oil, and electricity and sold in the US. Standards vary by fuel and style. For example, affected gas-fired storage water heaters have tank sizes up to 100 gallons (inclusive) and input ratings of 75,000 Btu/h or less, while a residential gas-fired tankless water heater stores less than 2 gallons of hot water and with input ratings up to 200,000 Btu/h.
  ➢ Commercial units, including light-duty commercial models, and residential gas fired models with inputs above 75,000 Btu/h are not affected by the higher standards.
Domestic Water Heater Efficiency – 2015 Energy Conservation Standards

**ENERGY STAR Criteria**
A water heater model must meet all of the identified criteria to be labeled as ENERGY STAR.

**Criteria for Qualified Electric Storage Water Heaters**

<table>
<thead>
<tr>
<th>Criteria</th>
<th>ENERGY STAR Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Factor</td>
<td></td>
</tr>
<tr>
<td>≤ 55 gallons</td>
<td>EF ≥ 2.00</td>
</tr>
<tr>
<td>&gt; 55 gallons</td>
<td>EF ≥ 2.20</td>
</tr>
<tr>
<td>First Hour Rating</td>
<td>FHR ≥ 50 gallons per hour</td>
</tr>
<tr>
<td>Warranty</td>
<td>Warranty ≥ 6 years on sealed system</td>
</tr>
<tr>
<td>Safety</td>
<td>UL 174 and UL1995</td>
</tr>
<tr>
<td>Lower Compressor Cut-Off Temperature (Reporting Requirement Only)</td>
<td>Report ambient temperature below which the compressor cuts off and electric resistance only operation begins</td>
</tr>
</tbody>
</table>

Source: Bradford White
# Domestic Water Heater Efficiency – 2015 Energy Conservation Standards

## Criteria for Qualified Gas Storage Water Heaters

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<thead>
<tr>
<th>Criteria</th>
<th>ENERGY STAR Requirements</th>
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</thead>
<tbody>
<tr>
<td>Energy Factor</td>
<td></td>
</tr>
<tr>
<td>≤ 55 gallons</td>
<td>EF ≥ 0.87</td>
</tr>
<tr>
<td>&gt; 55 gallons</td>
<td>EF ≥ 0.77</td>
</tr>
<tr>
<td>First Hour Rating</td>
<td></td>
</tr>
<tr>
<td>FHR ≥ 67 gallons per hour</td>
<td></td>
</tr>
<tr>
<td>Warranty</td>
<td>Warranty ≥ 6 years on system (including parts)</td>
</tr>
<tr>
<td>Safety</td>
<td>ANSI Z21.10.1/CSA 4.1</td>
</tr>
</tbody>
</table>

## Criteria for Qualified Gas Instantaneous Water Heaters

<table>
<thead>
<tr>
<th>Criteria</th>
<th>ENERGY STAR Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Factor</td>
<td>EF ≥ 0.90</td>
</tr>
<tr>
<td>Gallons-Per-Minute</td>
<td>GPM ≥ 2.5 over a 77° rise</td>
</tr>
<tr>
<td>Warranty</td>
<td>Warranty ≥ 6 years on heat exchanger and ≥ 5 years on parts</td>
</tr>
<tr>
<td>Safety</td>
<td>ANSI Z21.10.3/CSA 4.3</td>
</tr>
</tbody>
</table>
Energy Factor (EF)/Uniform Energy Factor (UEF)

- The efficiency metric for residential water heaters is the energy factor (EF), which indicates a water heater's overall energy efficiency based on the amount of hot water produced per unit of fuel consumed over a typical day. The EF accounts for the following:
  - Recovery efficiency - how efficiently the heat from the energy source is transferred to the water;
  - Standby losses - the percentage of heat loss per hour from the stored water compared to the heat content of the water (for water heaters with storage tanks); and
  - Cycling losses - the loss of heat as the water circulates through a water heater tank, and/or inlet and outlet pipes.
- During 2015, EF ratings will be replaced by a new Uniform Energy Factor (UEF) that will better reflect water heater efficiency. Higher ratings will still indicate better energy efficiency.
Polling Question

How would you size a replacement gas storage water heater?

1. Replace with the same size tank as the existing tank.
2. Use the GAMA Water Heater Sizing Tool to get the Peak-hour demand.
3. Multiply the number of occupants by 15 to get the replacement tank size.
4. Measure the GPM of the largest shower and multiply by 20 to get the replacement tank size.
Domestic Hot Water System Load Calculations, Sizing, and Selection

- Storage water heater
  - Storage water heater: Peak-hour demand (the busiest one-hour), which can be determined by using GAMA Water Heater Sizing Tool. The water heaters First Hour Rating (FHR) must match within 1 - 5 gallons of peak-hour demand (M & I Standards).
  - Water Heater Selection Guide for Storage Water Heaters
- Manufacturer procedure (M & I Standards)
Polling Question

Typically a 40 gallon storage electric water heater will have the same First Hour Rating as a 40 gallon storage gas water heater?

1. True
2. False
Domestic Hot Water System Load Calculations, Sizing, and Selection

• Indirect Water Heaters
  ➢ Indirect storage heater: In addition to the above storage design guideline, the installed boiler output must meet the manufacturer's minimum Btu/hr requirements to achieve First Hour Rating with the specified GPM through the Indirect coil at the design water temperature (M & I Standards).
  ➢ Tank must have a minimum tank standby loss of 1.5°F or less with AHRI certification.
  ➢ Indirect water heater must be piped as priority zone on boiler.
  ➢ Cold-start control strategy must be used.
• Manufacturer procedure (M & I Standards)
Domestic Hot Water System Load Calculations, Sizing, and Selection

• Indirect Water Heaters
  ➢ First determine Peak-hour demand or Max flow (gpm) demand (use manufacturer’s procedure).
    ▪ Determine worst case temperature rise.
    ▪ Using manufacturer’s specs determine what Indirect tank and Boiler capacity will be used.
    ▪ Document manufacturer’s pressure drop/Boiler supply temperature and gpm for the Indirect coil and then calculate the pressure drop of all straight pipe and fittings on the supply and return of the water heater at the selected flow rate. Add the piping/fitting pressure drop to the pressure drop through the indirect water heater coil.
    ▪ Select a circulator that will provide an appropriate flow rate at the combined pressure drop.
Domestic Hot Water System Load Calculations, Sizing, and Selection

Squire Indirect Water Heater
AHRI Rating

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SIT030</td>
<td>27.0</td>
<td>1.1</td>
<td>1.5</td>
<td>180</td>
<td>183</td>
<td>99,000</td>
<td>14.0</td>
<td>3.0</td>
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<tr>
<td>SIT040</td>
<td>40.0</td>
<td>1.6</td>
<td>0.9</td>
<td>181</td>
<td>208</td>
<td>115,000</td>
<td>14.0</td>
<td>4.5</td>
</tr>
<tr>
<td>SIT050</td>
<td>51.8</td>
<td>1.7</td>
<td>0.9</td>
<td>209</td>
<td>256</td>
<td>133,000</td>
<td>14.0</td>
<td>5.0</td>
</tr>
<tr>
<td>SIT065</td>
<td>61.0</td>
<td>1.9</td>
<td>0.7</td>
<td>263</td>
<td>327</td>
<td>154,000</td>
<td>14.0</td>
<td>5.7</td>
</tr>
<tr>
<td>SIT080</td>
<td>81.5</td>
<td>2.1</td>
<td>0.6</td>
<td>280</td>
<td>342</td>
<td>160,000</td>
<td>14.0</td>
<td>5.7</td>
</tr>
<tr>
<td>SIT110</td>
<td>113.4</td>
<td>3.2</td>
<td>0.5</td>
<td>308</td>
<td>418</td>
<td>190,000</td>
<td>12.1</td>
<td>5.5</td>
</tr>
</tbody>
</table>

*These ratings were obtained with a heat source output and heat source flow rate as listed in the chart using the parameters of the Domestic Cold Water Inlet at 58°F, Domestic Temperature Rise of 77°F, and a Boiler Temperature Output of 180°F. Other results will be obtained under different conditions.*

Source: Lochinvar
Domestic Hot Water System Load Calculations, Sizing, and Selection

- Tankless water heater
  - Tankless water heaters may not be installed with new boilers. Peak-hour demand (the busiest one-hour) flow rate, in gallons per minute (GPM) if possible measure the flow rate, (GPM) for each point of use, to determine how many gallons will be required during that peak demand time period flow rate (GPM), if not use GAMA Water Heater Sizing Tool to determine estimated Peak-hour flow rate GPM. Then determine temperature rise using coldest anticipated inlet water temperature and design outlet water temperature, the difference being the design temperature rise. Match Peak-hour flow rate (GPM) and anticipated temperature rise with manufacturer's rated flow rate (GPM) and temperature rise (M & I Standards).
  - Most demand water heaters are rated for a variety of inlet temperatures. Typically, a 70°F water temperature rise is possible at a flow rate of 5 gallons per minute through gas-fired demand water heaters.
  - Manufacturer procedure (M & I Standards).
Domestic Hot Water System Load Calculations, Sizing, and Selection

• Combi Systems
  ➢ System selected for combination applications must be sized to meet the space heating demand and the peak domestic hot water demand.
  ➢ In order to maximize condensing operation, heating water supply temperature should be as low as possible.
  ➢ Note: Short cycling can lead to customer dissatisfaction and premature failure of component parts.
  ➢ Recommend analyzing ROI vs. installed costs.
  ➢ Some existing conditions may not be suitable for Combi system.
  ➢ ECM fan motors and water pumps must be installed on all equipment (M & I Standards).
  ➢ Manufacturer procedure (M & I Standards).
## Installation Essentials and Best Practices

### Mixing Valves

| Approximate Temperature | Time / Temperature Relationship
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>120°F</td>
<td>More than 5 minutes</td>
</tr>
<tr>
<td>125°F</td>
<td>1 1/2 to 2 minutes</td>
</tr>
<tr>
<td>130°F</td>
<td>About 30 seconds</td>
</tr>
<tr>
<td>135°F</td>
<td>About 10 seconds</td>
</tr>
<tr>
<td>140°F</td>
<td>Less than 5 seconds</td>
</tr>
<tr>
<td>145°F</td>
<td>Less than 3 seconds</td>
</tr>
<tr>
<td>150°F</td>
<td>About 1 1/2 seconds</td>
</tr>
<tr>
<td>155°F</td>
<td>About 1 second</td>
</tr>
</tbody>
</table>

Installation Essentials and Best Practices

TEMPERATURE AND PRESSURE RELIEF (T&P) VALVES

- Installation is not complete unless a pressure and temperature relief valve is installed into the side of the water heater.
  - T&P Valve must be capable of discharging more BTUs than the heater is capable of putting into the water.
  - Installation of a temperature and pressure relief valve is critical to the safe operation of a water heater.
  - The basic rule is that the T&P valve must be installed so that the temperature-sensing probe is immersed in the hottest water - which is typically in the top six inches of the tank.
Installation Essentials and Best Practices

ANODE RODS / DIP TUBE

• ANODE RODS
  ➢ The anode rod is used as a sacrificial element within the volume of the storage tank. The purpose of the magnesium anode rod is to protect the inside of the tank against corrosion. Anode rods should be inspected twice in the first year and at least yearly once a time interval for inspection has been developed. Water conditions can influence the consumption rate of the anode rods. Customer should be advised on the maintenance of the Anode Rod.

• DIP TUBE
  ➢ A non-metallic tube extending from the cold water inlet to a predetermined area near the bottom of the tank that feeds cold water into the water heater. The length of the dip tube will vary based on the tank dimensions and efficiency of the heater. The length of the tube is precisely measured in order to prevent excessively high temperatures at the top of the tank (stacking) during short draws of water.
Installation Essentials and Best Practices

BACK-FLOW PREVENTER

• BACK-FLOW PREVENTER
  ➢ Where back-flow preventers are required, it will be necessary to install a thermal expansion tank (designed for use with potable water) in order to prevent pressure build up in the indirect heater and associated piping, which could cause the T&P valve to discharge. Follow the expansion tank manufacturer’s recommendations when selecting a tank for your hot water system.

• CAUTION
  ➢ Hydrogen gas can be produced in a hot water system that has not been used for a long period of time (generally two weeks or more). Hydrogen gas is extremely flammable. To reduce the risk of injury under these conditions, it is recommended that the hot water faucet be opened for several minutes at the kitchen sink before using any electrical appliance connected to the hot water system. When hydrogen is present, there will probably be an unusual sound such as air escaping through the pipe as the water begins to flow. There should be no smoking or open flame near the faucet at the time it is open.
Installation Essentials and Best Practices

HEAT TRAP FITTINGS

- **HEAT TRAP FITTINGS**
  - A device that helps reduce heat transfer from the water heater to the pipes. It contains a thermoplastic ball that seat themselves in place to help restrict heat transfer when hot water is not running. Some manufacturers do not provide them and require the Installer to make and install them.
  - Install heat traps or one-way valves, which allow water to flow into the tank and prevent unwanted hot-water flow out of the tank in both hot and cold lines. Note: This is for new water heaters not equipped factory-installed heat traps (M & I Standards).

Source: Rheem Manufacturer
Installation Essentials and Best Practices

DRAIN PAN

- DRAIN PAN

- A drain pan must be installed underneath the water heater if it is located where leaks could cause damage. A 1-inch line must be installed between the pan and an appropriate drain. A water alarm/shut-off can be installed in the pan if there is no place to run a drain line (M & I Standards).
LEGIONELLOSIS

- LEGIONELLOSIS
  - is a common name for one of the several illnesses caused by Legionnaires’ disease bacteria (LDB). Legionnaires' disease is an infection of the lungs that is a form of pneumonia. A person can develop Legionnaires' disease by inhaling water mist contaminated with LDB.
  - The EPA has established the Safe Drinking Water Hotline, a toll-free number for further information on drinking water quality, treatment technologies, and for obtaining Health Advisories or other regulatory information. Safe Drinking Water Hotline: 800-426-4791 9:00 a.m. - 5:30 p.m. (Eastern Time) Monday-Friday (excluding holidays) or contact the New York Health Department.
Polling Question

If two or more water heaters are needed, typically what is the best installation practice is to install them?

1. Install them in series.
2. Install them in parallel.
3. Install per manufacturer recommendations to provide the most efficient operation while meeting the hot water demands of the consumer.
Water Quality Demands

• WATER QUALITY
  ➢ In an area where the water quality is not known, a water quality test must be performed. Improper water quality will reduce the expected life of the water heater. Hard water, sediment, high or low pH, and high levels of chlorides in the domestic water must be avoided. Follow manufacturer's recommendations (M & I Standards).
Water Quality Demands

“The water must be potable, free of corrosive chemicals, sand, dirt, or other contaminates. It is up to the installer to ensure the water does not contain corrosive chemicals, or elements that can affect or damage the heat exchanger.”

-Rinnai Installation Manual
Water Quality Demands

- Chemical
- Physical
- Affected systems
- Manufacturer’s recommendations
- Solutions
Water Quality Demands

• Chemical – Minerals in water
  ➢ Calcium
  ➢ Magnesium
  ➢ Iron
  ➢ Sulfur
  ➢ pH

Hardness
Water Quality Demands

- HARD WATER
  - When hard water is heated minerals will precipitate out of solution and settle on the bottom of the tank, or attach to the source of the heat (heat exchanger or electric heating element) and pipe walls.
  - This is called scale build-up.
Water Quality Demands

• SCALE
  ➢ Reduced flow
  ➢ Reduced heat transfer
  ➢ Reduced system efficiency
Water Quality Demands

• Signs of hard water
  ➢ Reduced sudsing and cleaning capabilities.
  ➢ Difficult to remove soap scum on tubs, showers, basins, and faucet fixtures.
  ➢ Scale build up around faucet fixtures and plumbing.
Water Quality Demands

- Affected fixtures
  - Gas/electric storage tanks
  - Electric heating elements
    - (both upper and lower)
  - Storage tank anodes
  - Valves
  - Faucet screens
  - Mixing valves
**Water Quality Demands**

- Typical municipal water quality requirements.
- Well water is not regulated (for mineral content).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Maximum Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Hardness</td>
<td>Up to 200 mg / L</td>
</tr>
<tr>
<td>Aluminum *</td>
<td>Up to 0.2 mg / L</td>
</tr>
<tr>
<td>Chlorides *</td>
<td>Up to 250 mg / L</td>
</tr>
<tr>
<td>Copper *</td>
<td>Up to 1.0 mg / L</td>
</tr>
<tr>
<td>Dissolved Carbon Dioxide (CO2)</td>
<td>Up to 15.0 mg / L or PPM</td>
</tr>
<tr>
<td>Iron *</td>
<td>Up to 0.3 mg / L</td>
</tr>
<tr>
<td>Manganese *</td>
<td>Up to 0.05 mg / L</td>
</tr>
<tr>
<td>pH *</td>
<td>6.5 to 8.5</td>
</tr>
<tr>
<td>TDS (Total Dissolved Solids) *</td>
<td>Up to 500 mg / L</td>
</tr>
<tr>
<td>Zinc *</td>
<td>Up to 5 mg / L</td>
</tr>
</tbody>
</table>

* Source: Part 143 National Secondary Drinking Water Regulations
Water Quality Demands

- Soft water vs. hard water

<table>
<thead>
<tr>
<th>Classification</th>
<th>Hardness in mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft</td>
<td>0 - 60</td>
</tr>
<tr>
<td>Moderately hard</td>
<td>61 - 120</td>
</tr>
<tr>
<td>Hard</td>
<td>121 - 180</td>
</tr>
<tr>
<td>Very hard</td>
<td>≥ 181</td>
</tr>
</tbody>
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<table>
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<tr>
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<tbody>
<tr>
<td>Soft</td>
<td>0 - 60</td>
</tr>
<tr>
<td>Moderately hard</td>
<td>61 - 120</td>
</tr>
<tr>
<td>Hard</td>
<td>121 - 180</td>
</tr>
<tr>
<td>Very hard</td>
<td>≥ 181</td>
</tr>
</tbody>
</table>
Water Quality Demands

- Total Hardness
- Tankless manufacturer’s requirements
  - “Water hardness levels must not exceed 7 grains per gallon (120 mg/l) for single family domestic applications or more than 4 grains per gallon (70 mg/l) for all other types of applications. Water hardness leads to scale formation and may affect / damage the water heater. Hard water scaling must be avoided or controlled by proper water treatment. Well water must be treated.”

<table>
<thead>
<tr>
<th>Classification</th>
<th>Hardness in mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft</td>
<td>0 - 60</td>
</tr>
<tr>
<td>Moderately hard</td>
<td>61 - 120</td>
</tr>
<tr>
<td>Hard</td>
<td>121 - 180</td>
</tr>
<tr>
<td>Very hard</td>
<td>≥ 181</td>
</tr>
</tbody>
</table>
Water Quality Demands

• TESTING
  – Test strips
    ▪ Total Hardness
    ▪ pH
  – Chemical drops
  – 3rd Party Laboratories
Water Quality Demands

- SOLUTIONS
  - Lower water temperature
  - Ion exchange (water softening)
  - Non-chemical / anti-scale media filtration
  - Built in Scale detection
  - Maintenance
Water Quality Demands

- Flushing the Heat Exchanger
  - Use manufacturer’s procedural recommendations and recommended chemicals.
    - Distilled Vinegar
    - Calci-free™ (Do not use on aluminum)
    - Flow-Aide™
  - Annually, or more frequent.
Water Quality Demands

- Flushing the Heat Exchanger
  - Customer Education
  - Service Agreement?
  - Not just for tankless units
Water Quality Demands

- ACIDITY / pH
  - Manufacturers commonly specify a range of 6.5 – 8.5 (7.0 is neutral).
  - Below this water is acidic.
  - Acidic water is erosive to metal (heat exchangers, faucets, fixtures, and other plumbing).
Water Quality Demands

- Physical impurities (sand, sediment)
  - Internal
    - Some equipment may contain micron filtration.
  - External
Polling Question

What services does your company provide? (Select all that apply)

1. We install domestic water heaters.
2. We install combination space/water heaters.
3. We install water treatment systems.
4. We offer service contracts for any/all of the above.

CLEAResult
Basic overview of the following DHW Systems

Air Source Heat Pump Water Heaters

- Installed systems must be located outside of the conditioned area. Installed system must be located in space temperatures between 45-90 degrees. Or for system that uses inlet air ducts: entering air must be between 40 – 90 degrees. Water heater location to be a 750 - 1,000 cubic feet of area or as required by manufacturer's specifications (M & I Standards).
Basic overview of the following DHW Systems

Ground Source Heat Pump Water Heaters and Desuperheaters

- If installing Desuperheater, the system must have a preheat insulated tank (minimum 40 gallon) before the water heater and pipe / install per manufacturer instructions with all piping insulated. In some cases, the Desuperheater option must not be recommended due to hard water conditions and additional maintenance requirements (M & I Standards).

Source: Climate Master
Basic overview of the following DHW Systems

Solar Hot Water Heater

- Systems must be sized to displace between 60-80% of the historical or expected (if new construction) amount of electricity, natural gas, or other fossil fuel consumed for water heating purposes (M & I Standards).

Source: Bradford White
Start-up and Commissioning

• Fill system and check for water leaks.
• Check for fuel leaks and adjust fuel rate per manufacturer’s specifications.
• Follow manufacturers commissioning process.
• Check water temperature at faucets.
• Review maintenance, system operation, and warranties with customer.
Polling Question

When reviewing company call backs or service calls related to installations, what do you find as the root cause?

1. Improper installation.
2. Improper setup/commissioning.
3. Issues with cleanliness and/or customer satisfaction.
4. Improper equipment selection.
Questions
To ask a question, type into the [Enter a question for staff] field and click Send.
Thank You