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## Tankless Water Heating Solutions

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# Tankless Water Heating Solutions

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Presented by: Rinnai America Corporation  
103 International Drive.  
Peachtree City, GA 30269.

Description: Provides an overview of tankless water heating technologies, including the history, features and functions, and the energy and environmental benefits of a tankless system, as well as a discussion on how they compare to existing tank heater technology.

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**REGISTERED CONTINUING EDUCATION PROGRAM**

# Purpose and Learning Objectives

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**Purpose:** Provides an overview of tankless water heating technologies, including the history, features and functions, and the energy and environmental benefits of a tankless system, as well as a discussion on how they compare to existing tank heater technology.


## Learning Objectives:

At the end of this program, participants will be able to:

- explain how a tankless water heater works in comparison to other water heaters and the advantages of specifying a tankless system as part of a sustainable design strategy
- state the components, operation, and energy saving benefits of tankless water systems and the acceptable circulating methods
- describe the many environmental benefits of using a tankless water heater over other water heating technologies, and
- evaluate the design options available for tankless water heater technologies in residential and commercial applications.

# How to Use This Online Learning Course

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- To **print or exit** the course at any time, press the **ESC** key on your keyboard. This will minimize the full-screen presentation and display the menu bar.
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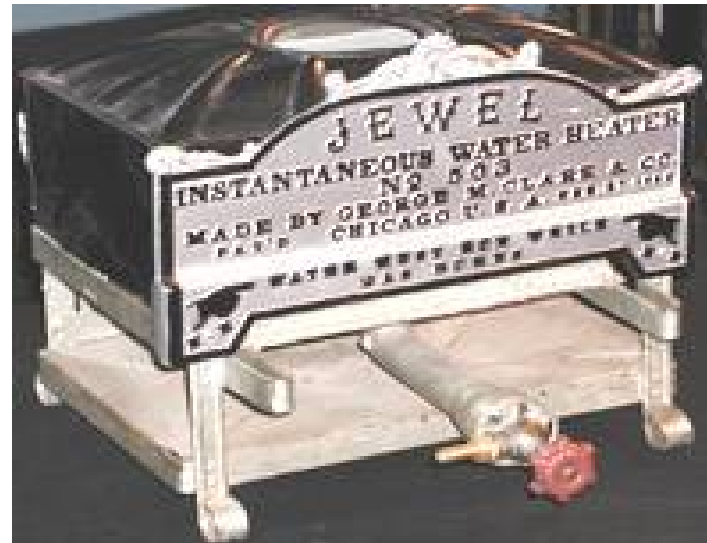
# Table of Contents

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History of Water Heaters	7
Features and Benefits of Tankless Water Heaters	14
Tankless Technologies	32
Tankless Water Heaters with Recirculation	67
Residential Applications	70
Commercial Applications	78
Summary	89

[Click on title to view](#)





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## History of Water Heaters

# Introduction

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Water heating technology has dramatically improved over the years, from the tank water heater that first appeared in the United States in 1883, to the tankless technologies available today. This course begins with a review of the history of water heaters, starting with the introduction of the first instantaneous water heater in 1901.





# The Jewel No. 503

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Manufactured in 1901 by George M. Clark & Co. of Chicago, the Jewel No. 503 was one of the first instantaneous water heaters available. Although it came with two sets of brackets and was designed to be carried from place to place as needed, the Jewel was made of iron and weighed 40 pounds, which made transportation difficult.

The water heater was connected to cold water and a gas line from either a gas lamp or cigar lighter, both of which were common in that era. To heat the water, the gas was turned on and the burner lit.

In 1932, the first domestic gas water heater to work efficiently was the Progras instantaneous water heater. It was developed by Bernard Friedman and was introduced in Britain under the name of Ascot.



# Venting

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Note that in the past, people thought gas fumes were of no consequence.

Not only did they not provide for venting, they made it impossible by placing a chrome piece on top of the heater.



# Tank Heater Inefficiencies

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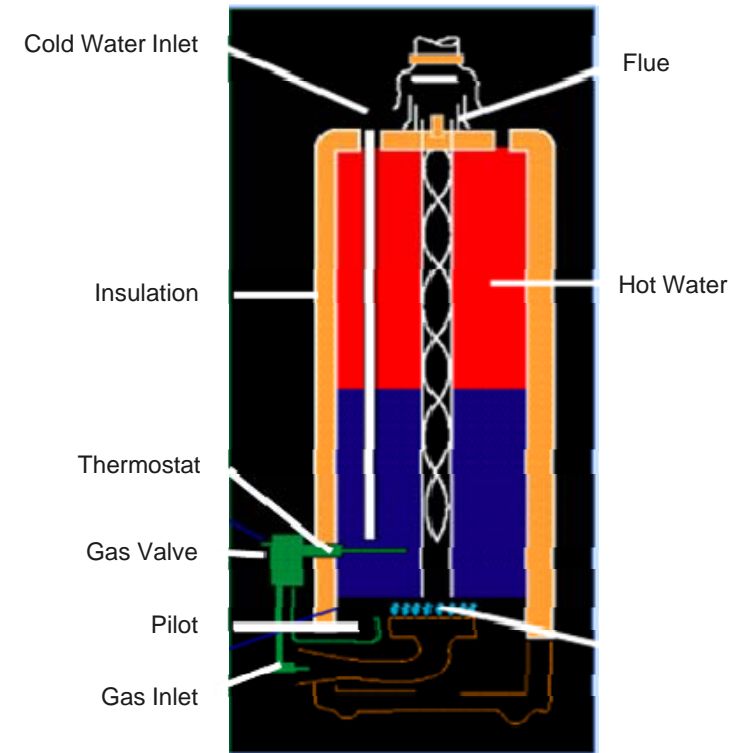
Advancements in water heating technology led to the development of the modern tank water heater.

The components of a basic tank water heater are illustrated at right.

Although most Americans still heat their water in a tank with a flame under the bottom, this method heats the water all day, wasting a significant amount of energy.

As well, many of the same problems that existed with the first tank water heaters are still problematic today.

For example, many tank water heaters are still unable to fill most large tubs installed in homes today and cannot provide back-to-back showers in many cases.



# Tank Heater Inefficiencies

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With a broad temperature range, tank water heaters can be very inefficient, many being 0.59 EF (Energy Factor) or less, and they are required to operate around the clock to maintain a set temperature range.

Plus, every time a tap is opened for ten seconds, cold water is diluting the hot water that was just heated by as much as 25 percent.

Also, not only do standard tanks empty quickly, but they have approximately 70 percent usable capacity (e.g., 40 gallon tank = 28 gallons).

Tank water heaters typically heat water to a factory preset temperature. When using hot water at a fixture, cold water is needed to temper or reduce the water temperature to an acceptable level. As the hot water is depleted from the tank, the fixture has to be adjusted to increase the amount of hot water exiting the fixture.

Lastly, tank-style water heaters are one of the leading causes of damage and accidents in homes today.

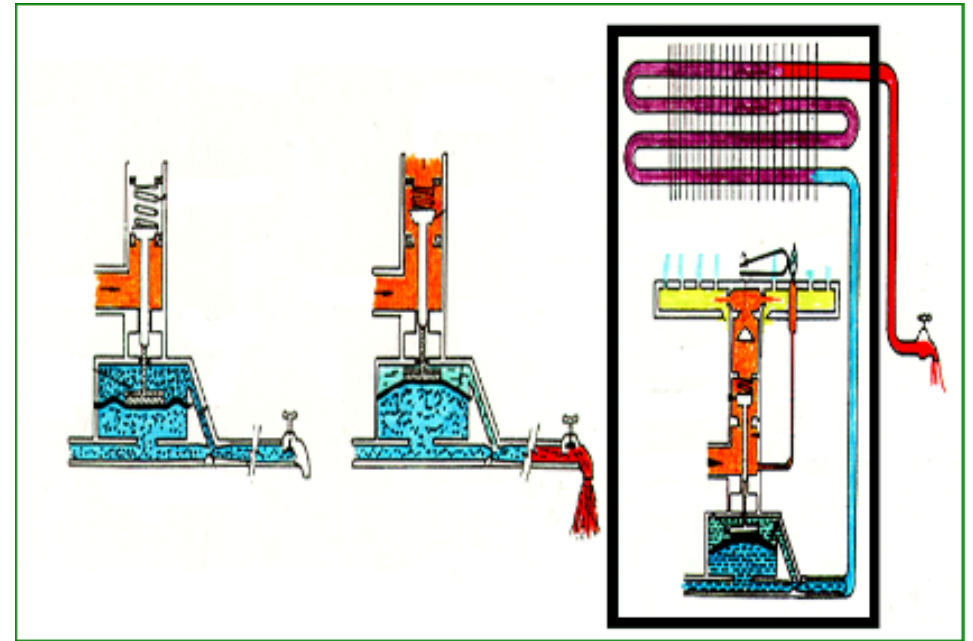
# Old Technology: Tankless Gas Water Heaters

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The early gas water heaters could provide an endless supply of flowing hot water, but with limited control.

These old tankless water heaters had a very limited flow rate that would only allow for the heating of water for one fixture at a time.

The early gas instantaneous water heaters are similar to electric tankless water heaters seen today.





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## Features and Benefits of Tankless Water Heaters

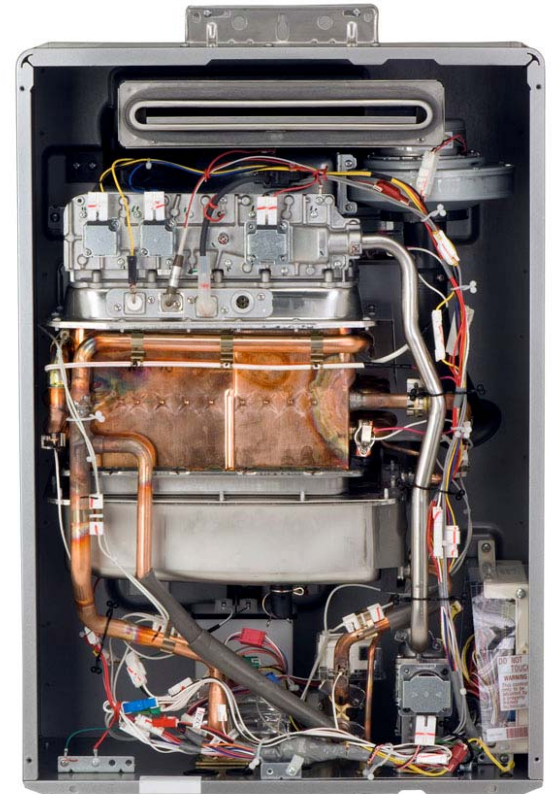
# Introduction

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## Why consider tankless?

- Energy savings/space savings
- Green features
- Lower operating costs
- Rebates or tax incentives from local, state or federal agencies may be available
- Ease of installation and maintenance
- Low noise levels (under 49 dBs)
- Safer water temperatures
- Some provide no combustion air concerns
- Note that tankless units are available with freeze protection

In this section of the course, a discussion of the features and benefits of tankless water heaters is presented, beginning with a review of the energy factor.



# Energy Factor

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The energy factor (EF) 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. This includes:

- 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 (water heaters with storage tanks), and
- cycling losses:
  - the amount of heat that is lost as the water circulates through a water heater tank, or inlet and outlet pipes.



# Energy Factor

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The higher the energy factor, the more efficient the water heater.

However, higher energy factor values don't always mean lower annual operating costs, especially when fuel sources are compared.

It is recommended not to choose a water heater model solely on its energy factor. When selecting a water heater, it's also important to consider size of the heater, what type of fuel it uses, the overall cost, and the first hour rating.

All of these considerations will be explored in greater detail further in the course.

Source: [www.energysavers.gov](http://www.energysavers.gov)

# Energy Issues

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Natural gas is a primary fuel source for generating electricity at electric power plants. With rising demands for electricity, the need for utilizing energy responsibly is critical to our way of life more than ever before.

According to the Federal Energy Information Administration: “America will need 34 percent more energy from all sources by 2030. That means using the energy we have more wisely.”

Consequently, energy security is now an issue alongside personal financial and environmental security.

# Gas Tank Water Heaters vs. Tankless Units

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The water heater is the third largest consumer of energy in the home; the furnace and air conditioner are #1 and #2 respectively.

The Department of Energy (DOE) estimates that 23-28 percent of the average home's energy bill is associated with heating water.

In terms of energy efficiency (EF), gas tank water heaters are very inefficient compared to tankless units. A gas tank-style water heater on the first day of use has an EF between 0.59 and 0.62. However, after a few years of operation, a tank water heater rating can be less than .50 EF.

Gas tankless water heaters, on the other hand, have an EF between 0.80 and 0.96. This is an EF gain of 33 percent compared to tank systems, which is particularly significant when considering national implications.

# National Implications

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Sixty million gas storage water heaters are estimated to be in use with efficiency less than 60 percent.

Out of this 60 million, 42 million families use electric storage water heaters to meet their home hot water needs. Electricity is a two to three times less efficient method of heating water versus gas.

Approximately 10,000,000 tank water heaters are sold each year. Of those, 80 percent are replacement heaters and 20 percent are due to new construction.

Consequently, purchasing gas and electric tank style water heaters is a vicious cycle of inefficiency which majorly contributes to the energy crisis.

# Tankless Water Heaters

## Tank Water Heaters (The Old Way)

Energy Factor	49% - 62% (Average)
Recovery Efficiency	0.76 to 0.82
1 <sup>st</sup> Hour Rating	30-100 gallons
Serviceability	Must Replace Entire Unit
Warranty	3-10 Years Average
Ignition	Standing Pilot
Safety Devices	Thermocouple

### Gas Consumption

- Pilot is constantly using gas
- Every time hot water is used, the end user is paying to Re-Heat the several gallons of water remaining inside
- When a tap is turned on for even 10 seconds, cold water is diluting the hot water you just paid to heat by as much as 25%



## Tankless (The Future)

80% - 96% (Title 24 Compliant)
Continuous Flow (No Recovery Needed)
Never Ending Supply (However 1 unit can do up to 510GPH)
All Parts are Repairable or Replaceable
12 Years Heat Exchanger, 5 Parts, 1 Labor
Electronic Ignition – No Standing Pilot
Over 1 Dozen Safety Devices (All Monitored by Computer)

### Gas Consumption

- Gas is only used when hot water is demanded
- When fixture(s) are shut off, unit returns to the standby mode
- Fully Modulating Gas valve uses only the gas needed to heat the water



# Green Advantages

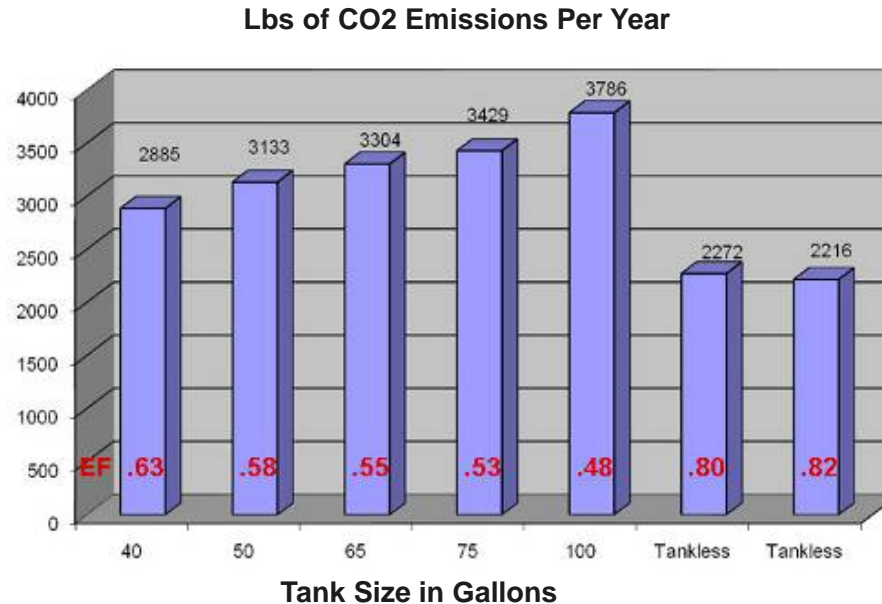
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Tankless water heater systems have many green advantages:

- Tankless units save 30 to 50 percent on the amount of energy it takes to heat water over conventional tank water heaters.
- Tankless water heaters can last up to twice as long as a typical tank.
- All components of many tankless water heaters are replaceable, unlike standard tank water heaters that are typically replaced when they fail or leak.
- 95 percent of many tankless components are recyclable, and
- Tankless water heaters produce very low NOx and CO2 emissions, making them environmentally sound gas appliances.

# CO<sub>2</sub> Emissions

CO<sub>2</sub> emissions increase as the EF of a unit is reduced, as indicated in the graph below that compares the pounds of annual CO<sub>2</sub> emissions from various sizes of tank water heaters versus tankless systems. Therefore, the EF of a unit is important not only in terms of energy consumption and cost, but also as it relates to CO<sub>2</sub> emissions.



# ENERGY STAR®

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Residential water heaters are now eligible for the ENERGY STAR® label.

Effective January 1, 2009, whole-home gas tankless water heaters which carry the ENERGY STAR® label must have a minimum EF of 0.82, minimum gallons-per-minute flow of 2.5 at a 77 degrees Fahrenheit rise, or be 41.4 percent more efficient than the current Federal standard.

Note: Energy Star appliances may be eligible for state or federal tax credits. Consult your tax advisor.





# Water Heater Disposal

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The disposal of water tanks in the U.S. creates an extreme pressure on landfills and the environment.

However, tankless water heaters are one-third the size of tank heaters and have up to twice the life expectancy.

Therefore, tankless water heaters could cut the landfill disposal frequency of water heaters in half, and substantially reduce the landfill volume.



# Water Heater Disposal

In fact, this graph illustrates that over a ten year period, reduction on landfill load just from water heaters would reduce by approximately 600 million pounds.

- **Storage Hot Water Tank:**

Life: 8 to 13 years

Weight: 130 lbs. at time of disposal

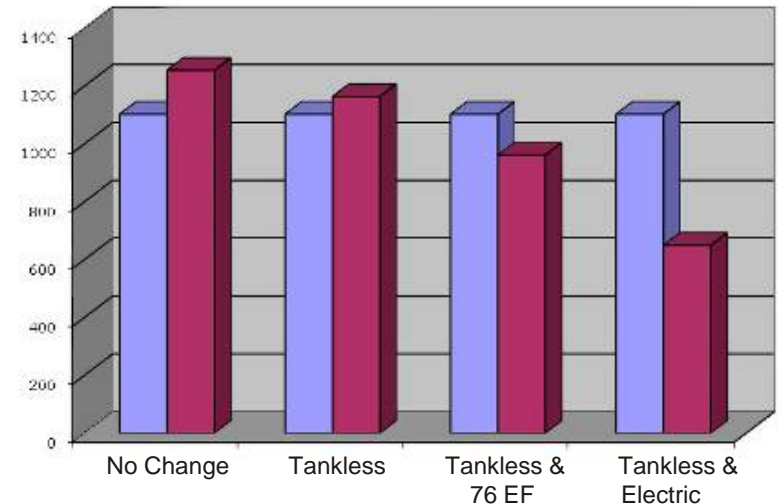
- **Tankless Water Heater:**

Life: Up to twice as long as a tank

Weight: Up to 65 lbs. at time of disposal

Note: 75% of the weight is valuable recyclable material, i.e., copper/stainless steel.

Change in Waste Disposal 2006-2016, Million Lbs/Year



# Initial Costs and Operating Costs

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The initial costs of tankless units can be up to two or three times more than 40-gallon self-installed tanks, but nearly break even on a 50- or 75-gallon installation by a plumber. Also, they are often less expensive than a commercial tank or commercial boiler.

In terms of operating costs, 20 to 50% savings can be realized using a tankless unit, depending on energy source and operation.



# Space Savings

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Tankless water heaters provide opportunities for space savings.

Unlike tank installations that require large amounts of floor space, tankless units are vertically mounted, freeing up valuable space for other applications.

Tankless units can be installed in:

- closets
- attics
- crawl spaces
- rooftops, outdoor locations, and
- garages and confined areas.



## Exterior Models / Recessed Applications

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A major installation advantage of tankless units is the availability of exterior models (top image) and recessed applications (lower image). Exterior models may be mounted on an exterior wall of the home or on the rooftop.

Recessed units protect the appliance from wind, weather, and unwanted tampering. They are available with an integrated, seamless moisture seal flange for easy installation and maximum protection from moisture infiltration.

The recessed heaters include a lock ring for increased security against theft and damage.

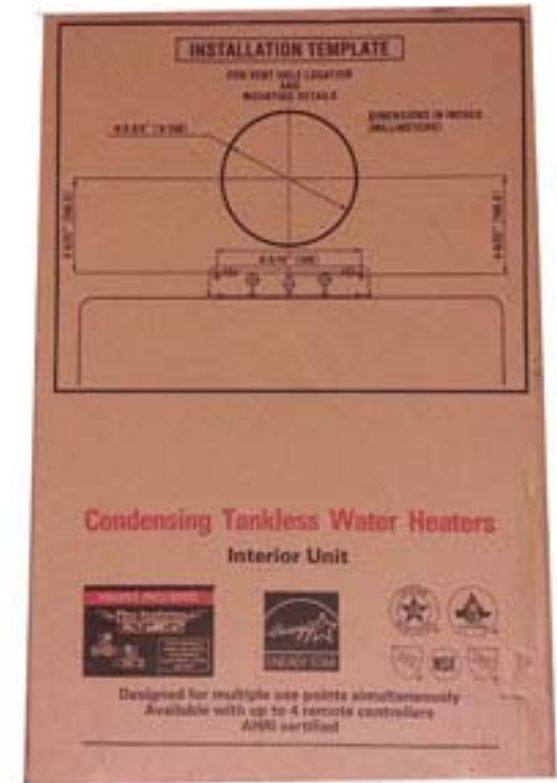


# Ease of Installation

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Installation has been made easier by some tankless manufacturers by the development of a wall thimble and template.

The template is included with the thimble to provide guidelines for gas, water, and power connections.



# Ease of Maintenance

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Recommended annually is the visual inspection of the water heater compartment, burner, and venting.

Most tankless water heaters include a filter on the cold inlet connection. It is recommended that the inlet water filter be cleaned prior to initial use and annually thereafter. If the owner experiences a problem with low hot water flow, this would be the first thing to check.

Some manufacturers provide a warning code on the controller that indicates when flushing is required. An authorized service professional can flush the heat exchanger in approximately one hour.



Water Filter - Before removing the filter for cleaning, ensure the water is turned off and the system has been drained by opening a hot water tap.



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## Tankless Technologies



# Introduction

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Innovations in technology led to the development of today's tankless units that offer an endless supply of hot water, with direct electronic ignition and fully modulating gas valves.

In this next section of the course, a review of topics pertaining to tankless systems is presented, including:

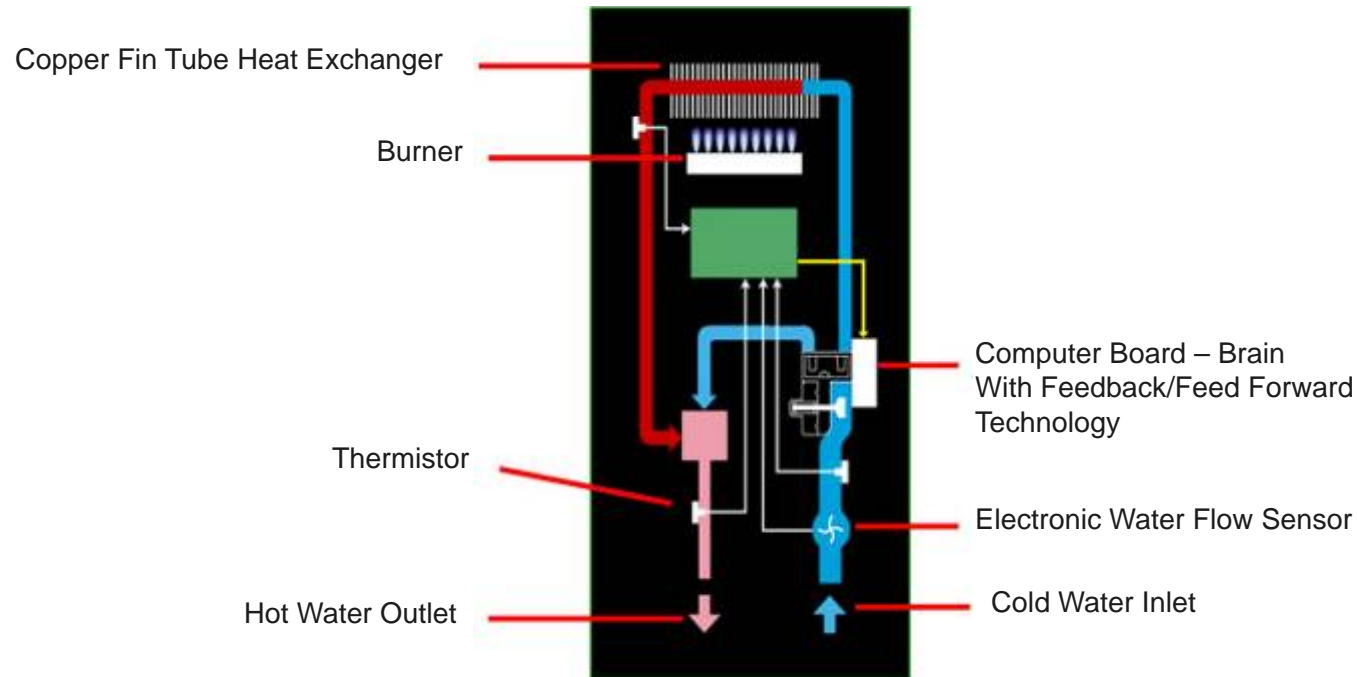
- components
- operation
- temperature controllers
- gas/water pressure requirements
- venting, and
- circulation methods.



# Components

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Below is a diagram of a basic tankless water heater with labeled components. A description of how this type of system functions is presented on subsequent slides.



# Sequence of Operation

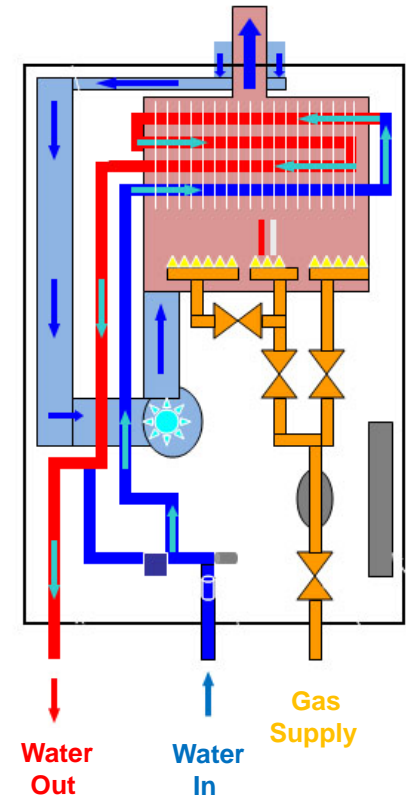
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First, the temperature is set on the remote controller (recommended temperature is between 115-120 degrees Fahrenheit).

The hot water tap opens and water begins to flow.

Next, the turbine spins and sends a signal to the PC board via a flow sensor. The PC board determines the water flow, firing rate, and temperature of the water.

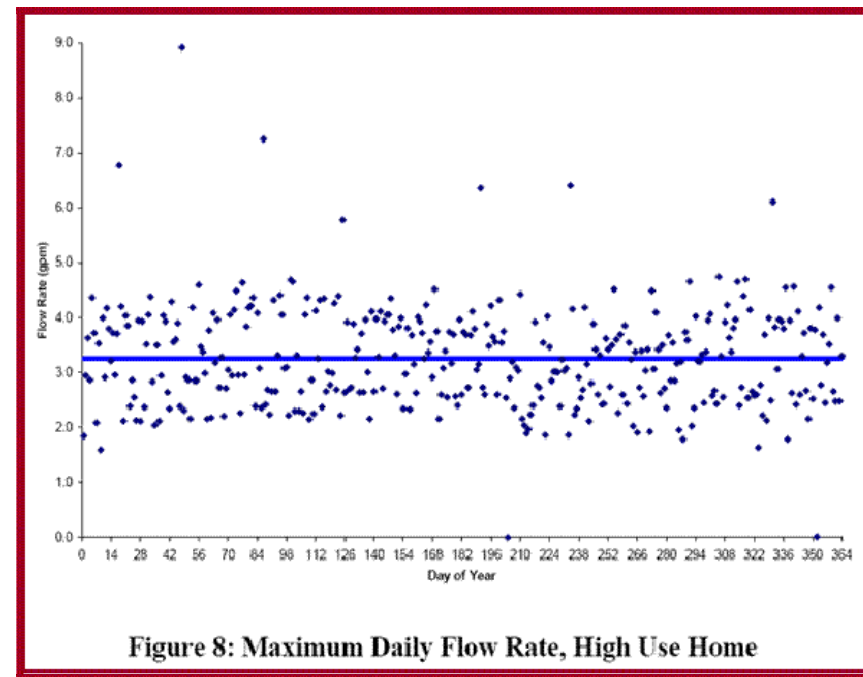
Then, the combustion fan motor starts and the burner is ignited by direct electronic ignition. Tankless units have no standing pilot.



# Sequence of Operation

The unit fires while the flame rod senses flame in the burner. When the hot water tap is turned off, the unit returns to standby mode.

Note: When specifying tankless water heaters, look for units that have low flow requirements (i.e., 0.4 gpm flow rate to initiate the firing of the tankless water heater and 0.26 gpm to maintain operation). The maximum daily flow rate for a high-use home according to the National Association of Home Builders (NAHB) Research Center is indicated in this chart.



Source: NAHB Research Center

# Temperature Controllers

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Some tankless water heaters include a temperature controller which provides the ability to adjust the water temperature. It also performs diagnostics and alerts the user when maintenance is required.

When fixtures are in use, the controller provides the ability to check flow rate and water temperature. Note that some units provide temperature controls within +/- 2 degrees.

In many cases, indoor units include an integrated controller on the front panel, whereas outdoor units include a separate controller to be installed in an indoor location.



Integrated Controller

# Temperature Controllers

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Many models will accept up to four temperature controllers installed in parallel in almost any combination. Here are a few examples of available controllers.



# Gas and Water Pressure Requirements

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Gas pressure for natural and propane gas is measured in inches of water, expressed as WC (water column).

Tankless units have a gas delivery pressure range from 5 to 10.5 inches WC for natural gas, and 8 to 13.5 inches WC for propane.

The water pressure requirements for tankless heaters are 20 psig to 150 psig. Psig (pound-force per square inch gauge) is a unit of pressure relative to the surrounding atmosphere.

# Proper Venting

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Proper venting is crucial for a successful installation. Without proper drainage or disposal, condensate that can accumulate during operation of the tankless water heater can enter the water heater and damage the heat exchanger.

Some manufacturers offer venting systems through a 3-inch pipe within the center of a 5-inch concentric air intake pipe. A concentric vent results in only one wall or roof penetration and uses no indoor make-up air. As well, it allows for installation in areas with limited space.

Furthermore, unlike some other venting systems, a concentric vent has zero clearance to combustibles. Concentric venting is offered in plastic and metal to suit various construction or code requirements.



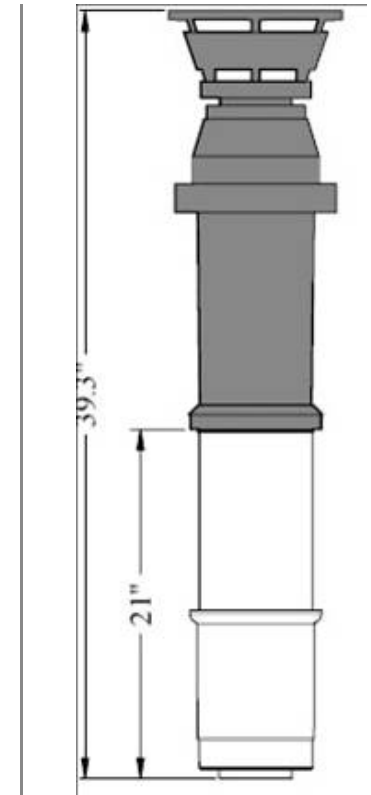
# Vertical Venting

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Depending on the application, vertical venting could be the only way of obtaining fresh make-up air and dispensing of exhaust gases.

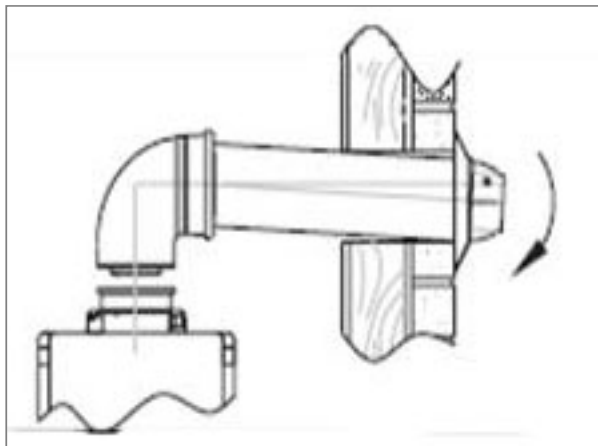
With minor modification, the existing roof vent penetration can be used to accommodate a tankless water heater's vent termination.

An example of a vertical venting option is illustrated at the right.

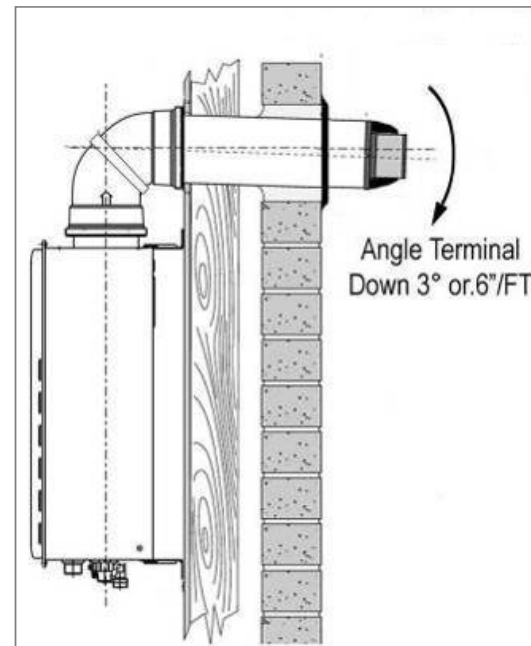


## Horizontal Termination: Short Run

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If the condensate collector is not used, the drain pipe must be capped to prevent exhaust gases and condensate from entering the building. The cap is supplied on the appliance.

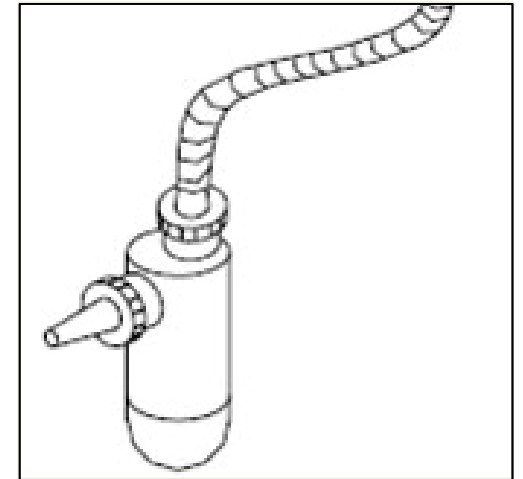
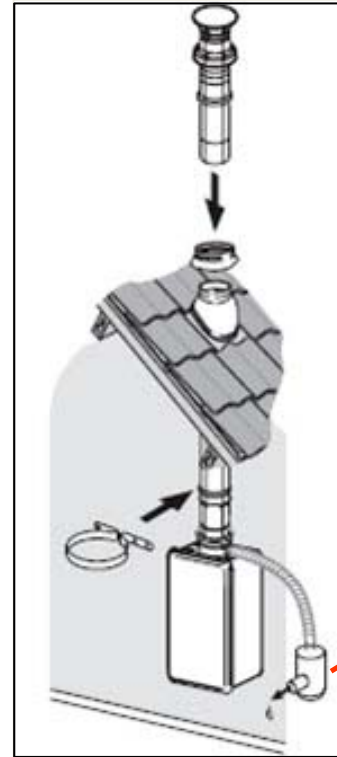


Above is a short horizontal vent termination using concentric vent pipe. Components include wall termination, horizontal discharge adapter, and two rubber wall plates. For proper installation, a 3° or .6"/FT slope is required to account for condensate.

# Condensate Trap

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Longer vent runs could require the installation of a condensate trap and change in the vent angle to allow the condensate to flow back into the vent pipe, to the condensate trap and into a drain. The next slide references applications for vertical and horizontal venting with a condensate trap.



Condensate Trap

# Vertical / Horizontal Termination with Condensate Trap

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Vertical venting with condensate trap

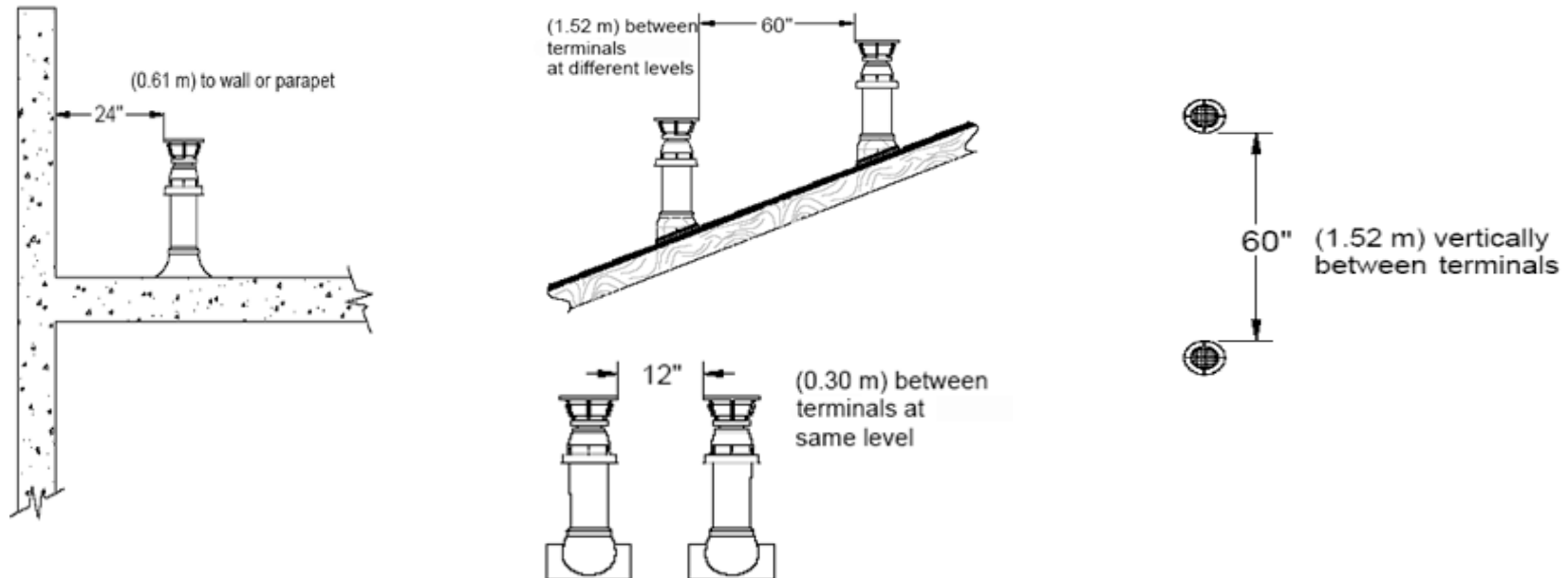


Horizontal venting with condensate trap

# Locating the Exhaust Vent Terminal

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Venting code requirements are covered under ANSI Z223.1. Note that local codes may supersede these recommendations. Always refer to the manufacturer's installation manual for all clearances. Below are examples of manufacturer's clearance recommendations.



# Circulation Methods

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Circulation methods of tankless water heaters vary.

This section of the course ends with a review of the acceptable circulation methods including:

- circulating through the tankless water heater
- circulating through a small tank, and
- demand type circulation systems.

# Circulation Through Tankless Unit

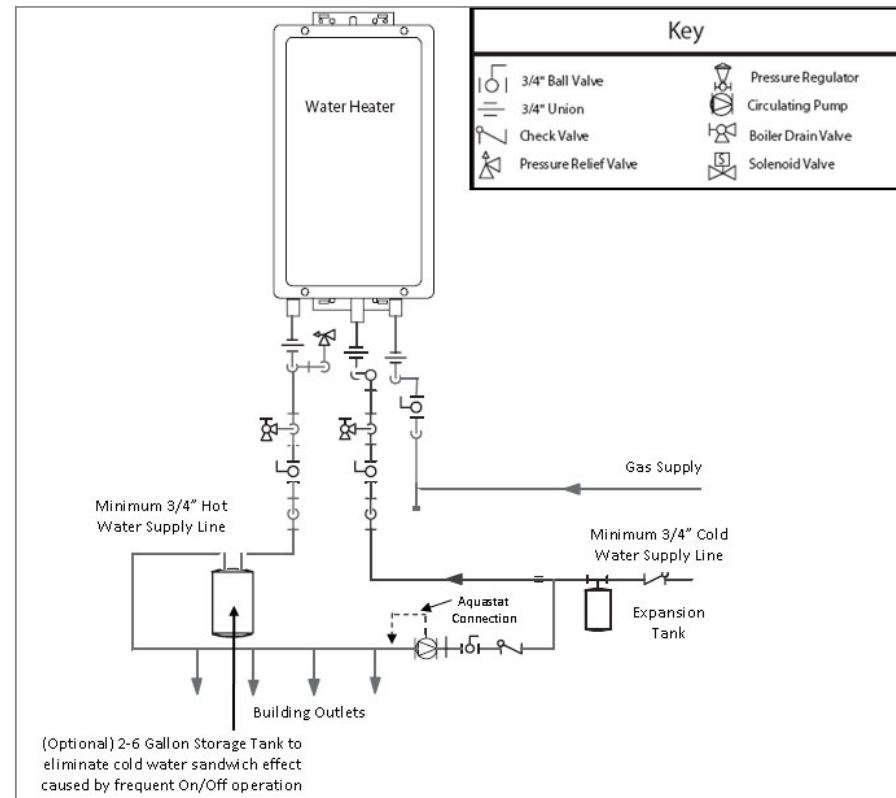
This diagram exemplifies how a residence could be plumbed using a circulation system to move hot water throughout the hot water loop by means of a storage tank, a pump, ball valve, and an aquastat (a device used to sense water temperature in the plumbing system).

For this application:

Pump to be sized to maintain circulation loop temperature. The pump should be sized to overcome the pressure loss through the tankless water heater and supply/return piping in the circulation loop. Pump to be of bronze or stainless construction.

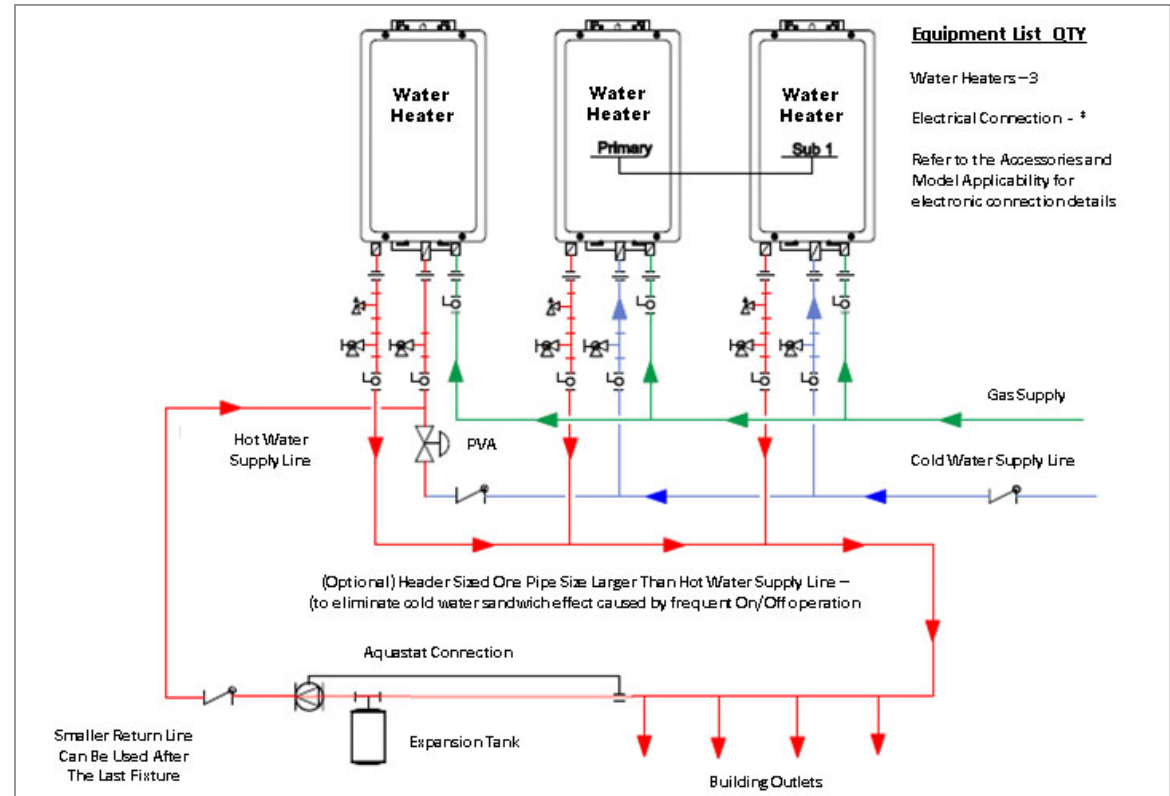
These added components, combined with the tankless water heater, enable hot water to be at each fixture throughout the structure at any given time.

Note that this type of circulation may reduce the warranty.



# Tankless Technologies

For this application: Pump should be controlled by an aquastat, timer or combination aquastat and timer. Pump to be sized to maintain circulation loop temperature. The pump should be sized to overcome the pressure loss through the tankless water heater and supply/return piping in the circulation loop. Pump to be of bronze or stainless construction. PVA to remain at factory default setting. Circulation unit should not be connected electronically to the multiple system controller(s).





# Tankless Technologies

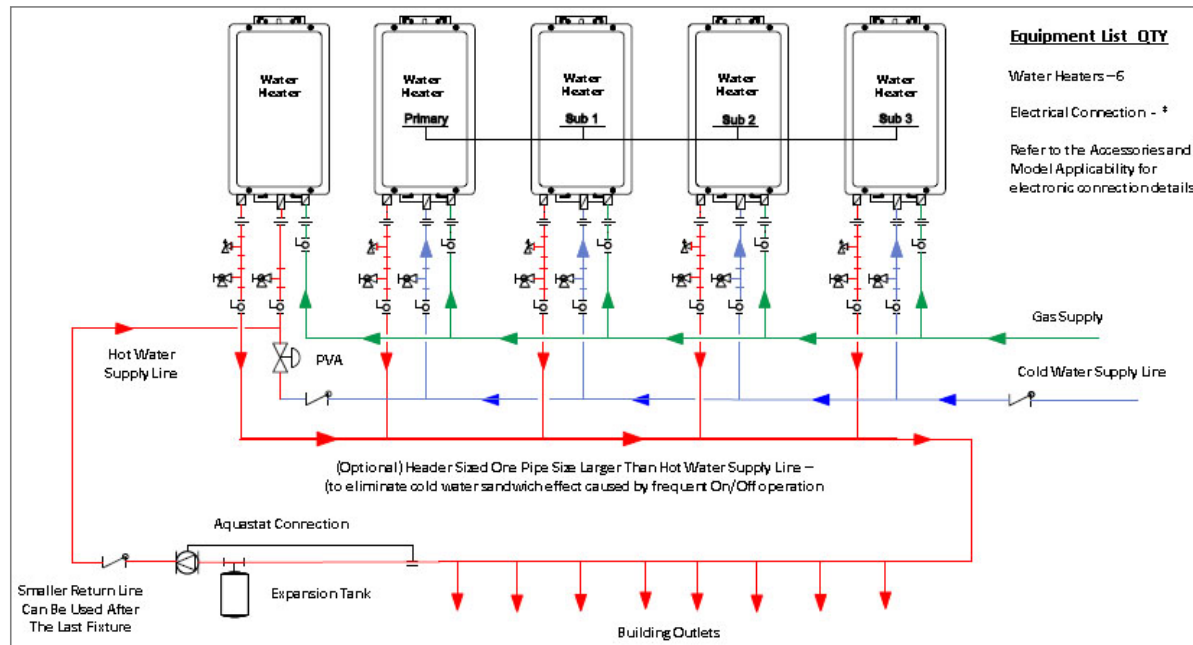
For this application:

Pump should be controlled by an aquastat, timer or combination aquastat and timer.

Pump to be sized to maintain circulation loop temperature. The pump should be sized to overcome the pressure loss through the tankless water heater and supply/return piping in the circulation loop. Pump to be of bronze or stainless construction.

PVA to remain at factory default setting.

Circulation unit should not be connected electronically to the multiple system controller(s).



Illustrated above is a typical commercial application that has a requirement for hot water at each fixture with minimal delay. Note the number of fixtures as indicated by the arrows. This is circulation through a single tankless unit. Note that warranty is maintained on the units not being recirculated through, while the first unit warranty is reduced to three years. The first unit assist with capacity when needed so the warranty is reduced on a single unit instead of the entire system. This design helps control upfront costs.

# Demand System

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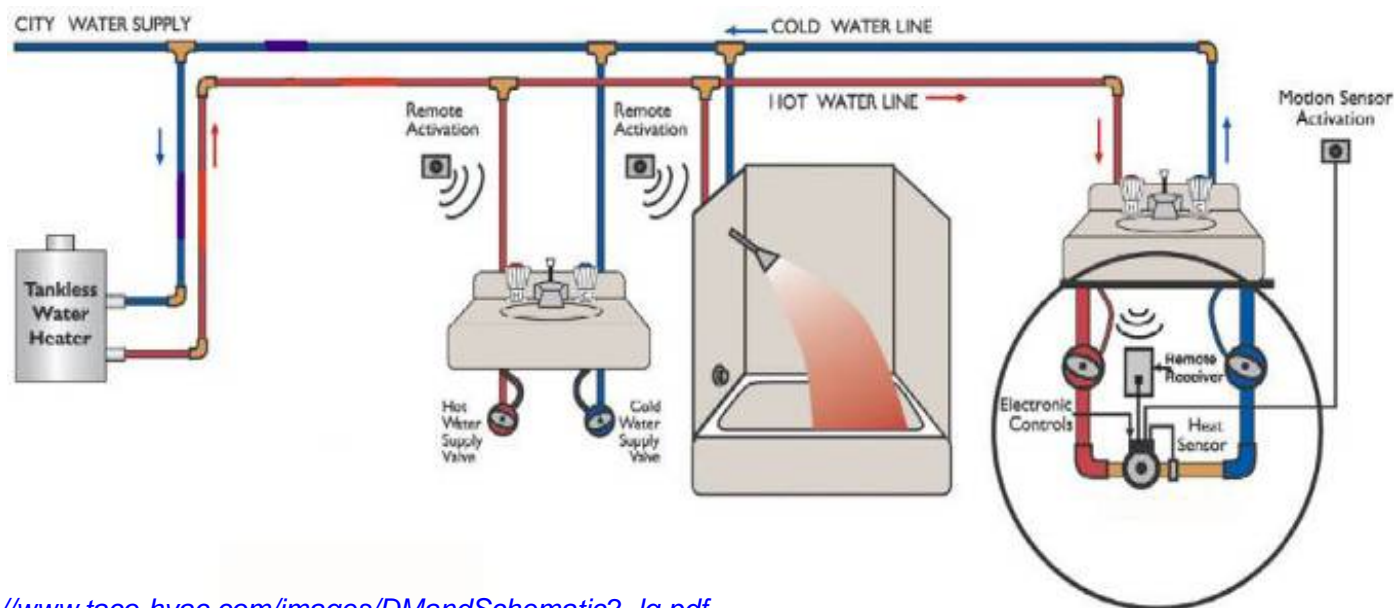


Image source: [http://www.taco-hvac.com/images/DemandSchematic2\\_lq.pdf](http://www.taco-hvac.com/images/DemandSchematic2_lq.pdf)

Demand systems consist of an electronically controlled pump that connects to the hot and cold water lines under the fixture. There are several brands of hot water demand systems available in the market. The system shown above has motion sensors in key locations that activate the tankless unit to supply hot water throughout the system. Generally, this type of setup will maintain full warranty.

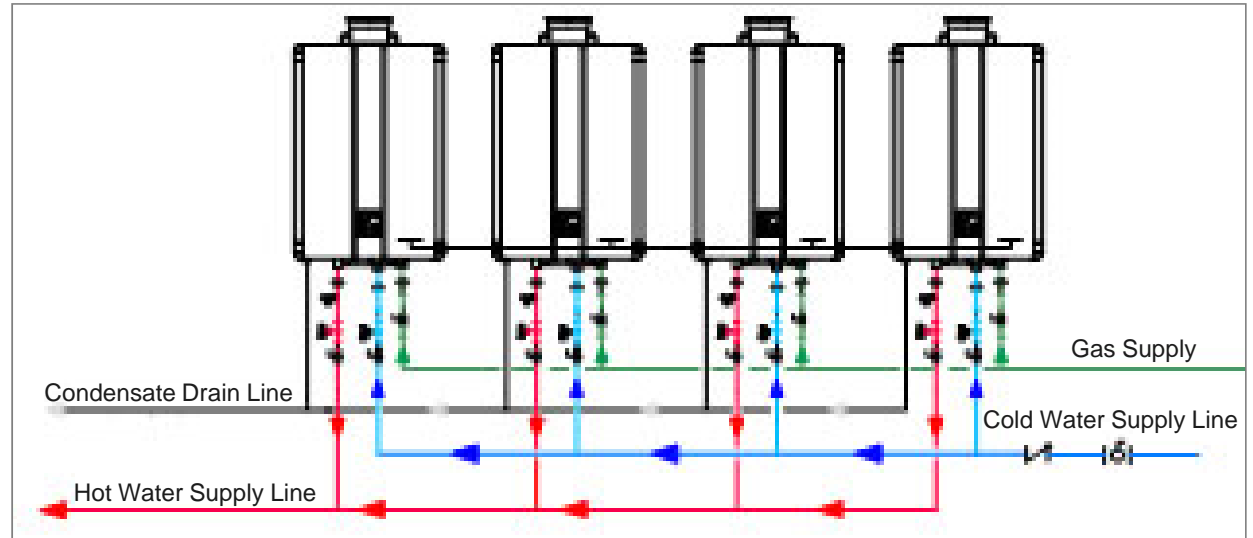
# Multiple Unit Plumbing Diagram

Note: Condensate piping shall be CPVC or PVC material and shall not be smaller than the drain connection on the appliance.

Components of the condensate drainage shall be CPVC or PVC material. All components shall be selected for the pressure and temperature rating of the installation.

Where the drain pipes from more than one unit are manifolded together for condensate drainage, the pipe or tubing shall be sized in accordance with an approved method as dictated by local codes.

Condensate must be disposed of according to local codes.



This type of application is used where a high volume of hot water is needed based on the fixture count, fixture type, and size of the structure; however, because there is not a recirculation system installed, there may be a lag time before hot water is supplied to the fixtures.

# Condensing Tankless Water Heaters

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As a result of new technologies, condensing tankless water heaters are available in the market that deliver up to 96% thermal efficiency with an energy factor rating of .93. For even greater capacity, condensing tankless water heaters can be banked.

These units boast an industry leading activation rate of 0.4 gpm and lower minimum gas input rate of 10,000 Btu. This allows ignition for smaller amounts of water at higher incoming temperatures. Water flow deactivation is 0.26 gpm.

Delivering superior energy efficiency and performance, these new products are ENERGY STAR qualified and eligible for various utility and tax incentives.

# Internal and External Models

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Condensing water heaters are available in natural gas and propane models and are ideal for residential and commercial installations (interior and exterior) up to 10,200 feet.



Internal Unit



External Unit

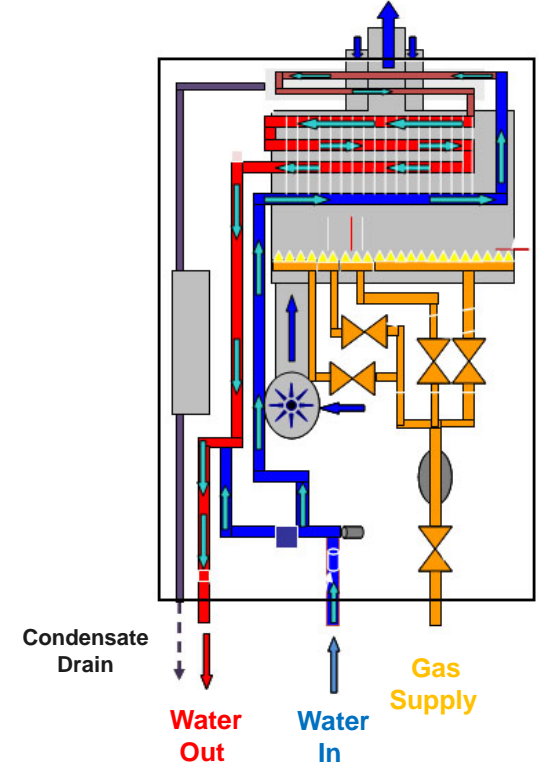
# Condensing Technology

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## How does condensing technology work?

Condensing appliances capture the extra heat (or latent heat) before it escapes into the vent system and transfers it, in the case of a water heater, into the water being heated.

Sequence of Operation: Indoor Unit



# Condensing Technology

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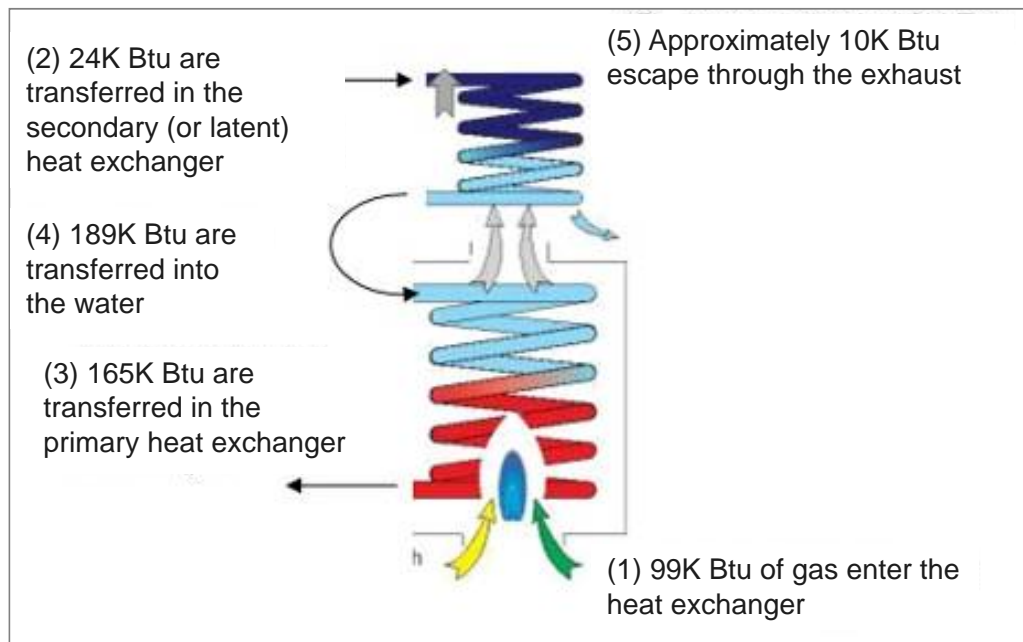
Condensation occurs when the water created in the combustion process cools below the dew point. As this water vapor condenses, it combines with other combustion by-products to form an acid solution.

Condensing appliances are designed to properly drain this condensation.

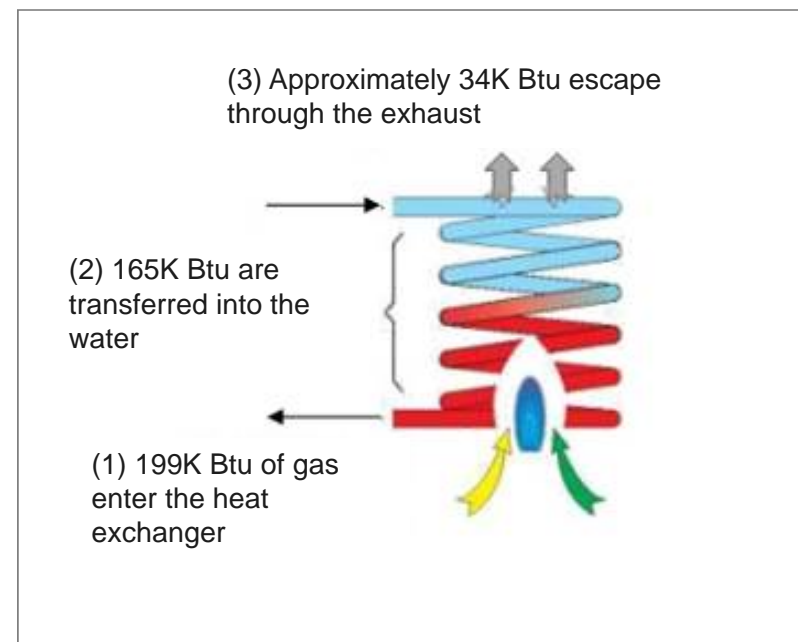
When vented combustion occurs, there will always be some level of heat loss in the form of exhaust exiting through the vent system.

Note that the thermal efficiency of a gas-fired appliance is measured by how much heat is actually transferred to the heating medium (water, air, etc.) and how much is lost through the vent system.

# Condensing Technology vs. Non-Condensing Technology



Condensing Water Heater: This appliance has 95% thermal efficiency  
 $(24K + 165K) \div 199K = .95$



Non-Condensing Water Heater: This appliance has 83% thermal efficiency  
 $165K \div 199K = .83$



# Intake / Exhaust Guidelines

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Indoor condensing water heaters are direct vent water heaters and therefore are certified and listed with the vent system. It is important that only vent components that are certified and listed with the water heater model should be used.

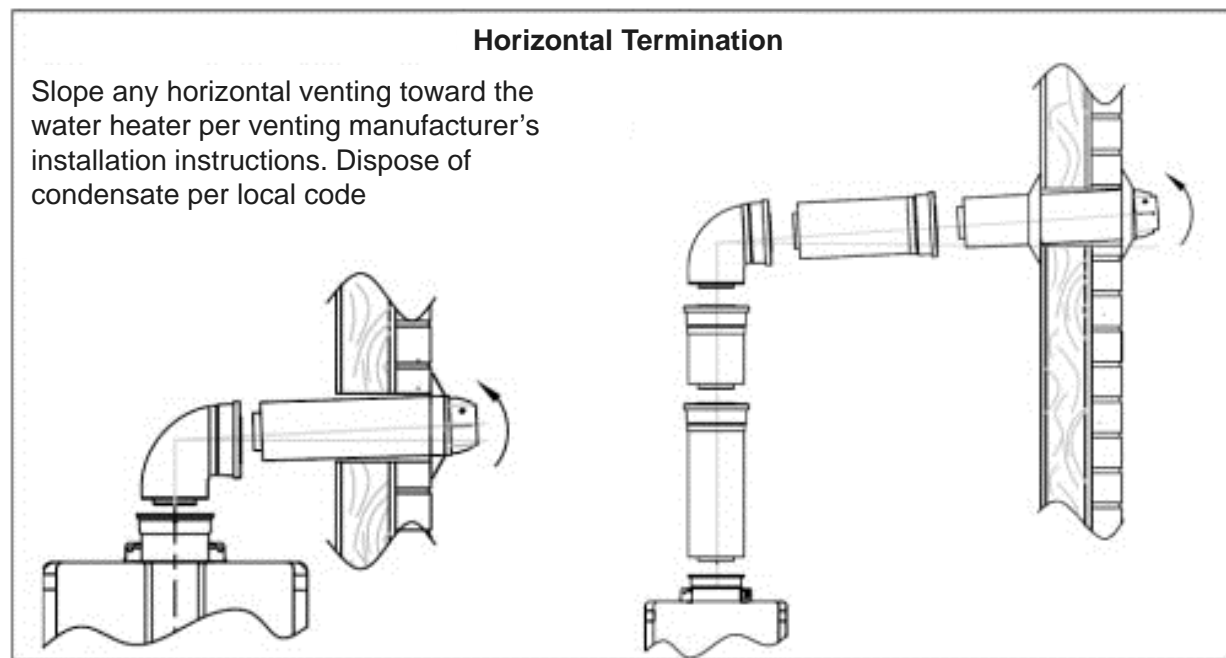
Some vent systems use gaskets to ensure all seals are secure; therefore, no gluing or cure time is required.

Ensure venting materials are compatible with the condensing water heater as some materials are not approved for this application.

# Horizontal Termination

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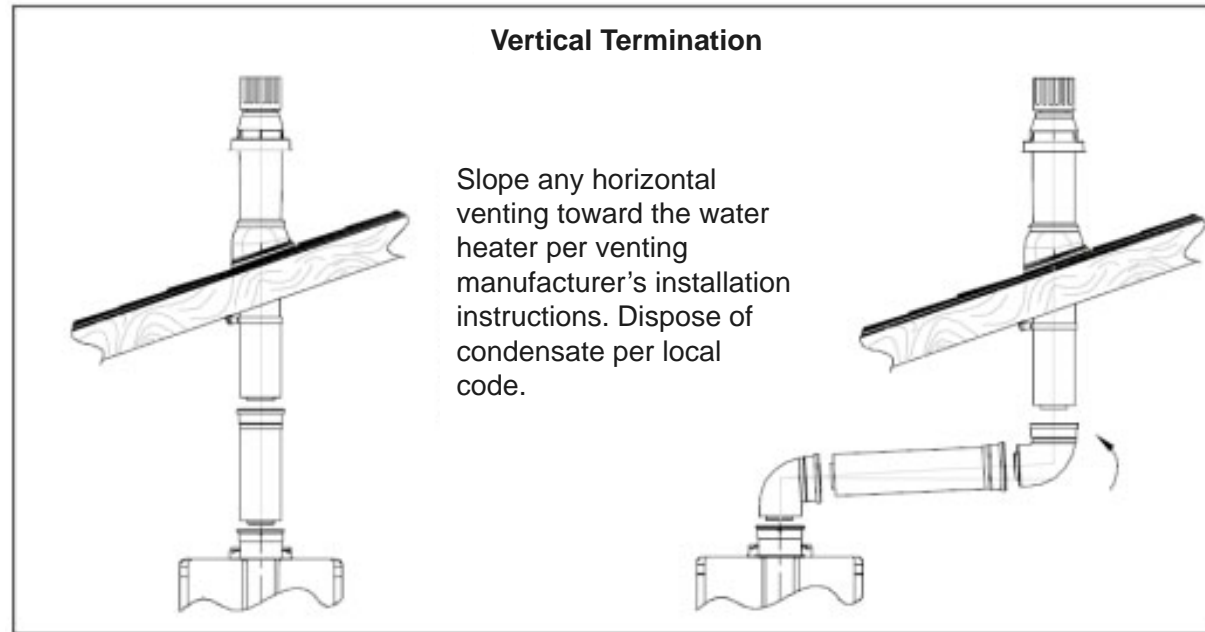
Illustrated below is a horizontal termination for a condensing tankless water heater. Note that water heaters with polypropylene venting materials require a  $\frac{3}{4}$ -inch per foot slope.



# Vertical Termination

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A vertical termination is illustrated in this diagram. Condensing tankless water heaters have an integrated condensation trap inside the water heater; as a result, no condensation collector in the vent system is needed.



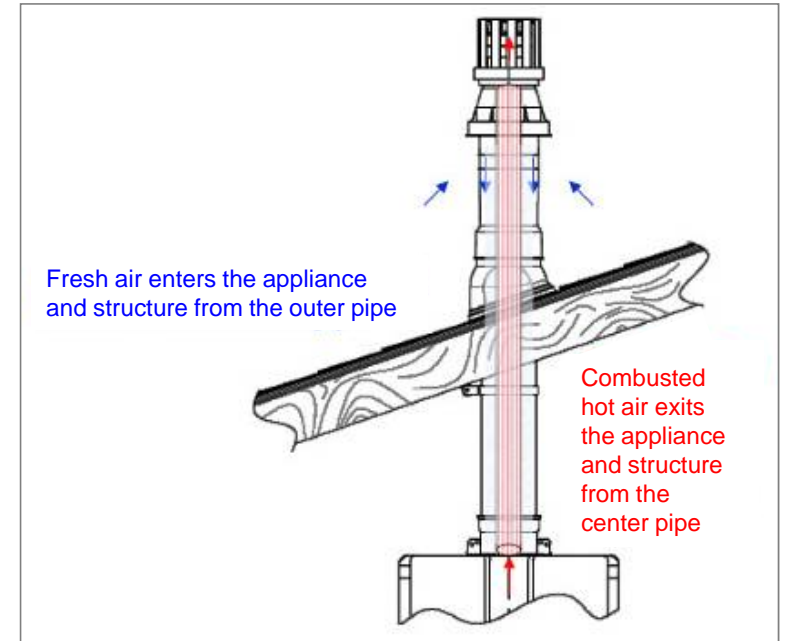
# Venting System

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Condensing tankless water heaters use concentric venting which allows zero clearance from combustibles around vent penetrations.

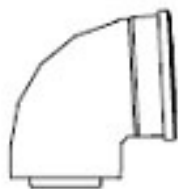
## Cautions:

- Do not connect the venting system with an existing vent or chimney
- Do not common vent with the vent pipe of any other water heater or appliance, and
- Do not use a Class B vent.



Example of a balanced flue system. The incoming air keeps the pipe cool, allowing zero clearance for the venting system.

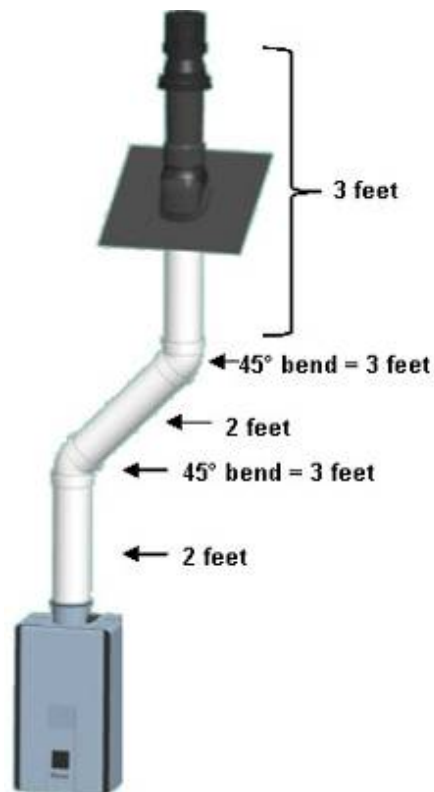
# Indoor - Air Intake and Exhaust Vent Pipe Length



Each 90° bend is equivalent to 6 feet of vent pipe



Each 45° bend is equivalent to 3 feet of vent pipe



## Vent Length Calculator

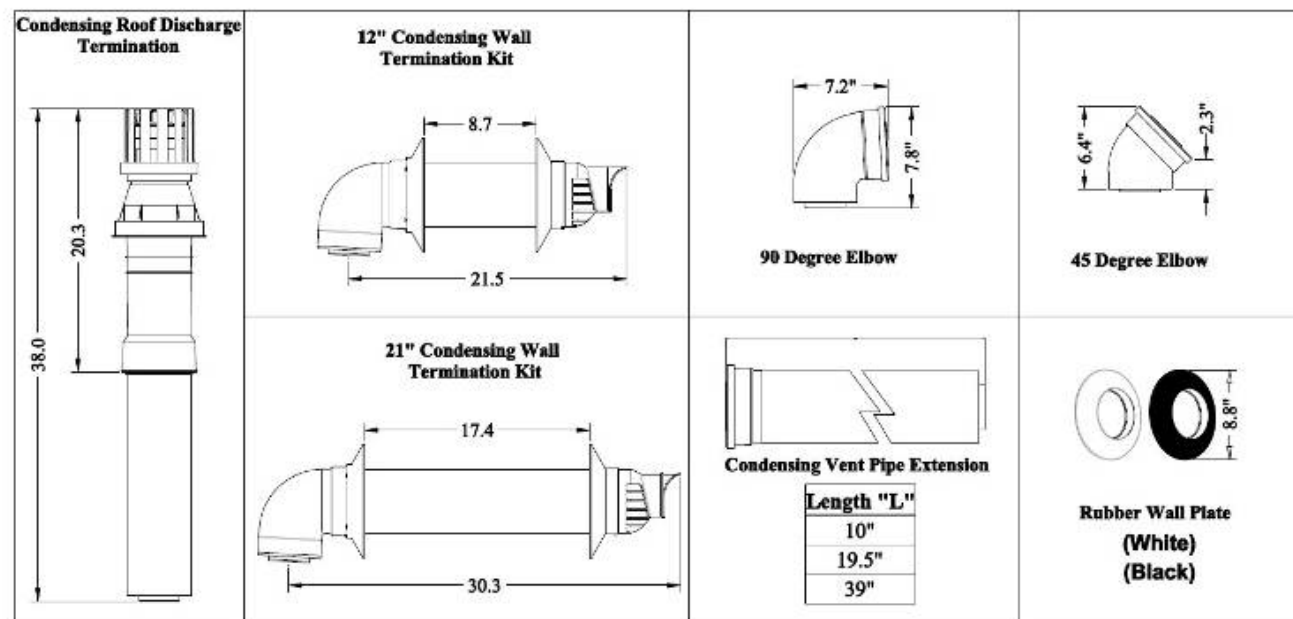
Total equivalency cannot exceed 41 feet.

Add the total length of all vent pipe and the equivalency of all bends.

In this example:

3' (termination)  
+3' (bend)  
+2' (extension)  
+3' (bend)  
+2' (extension)  
**13-foot equivalency**

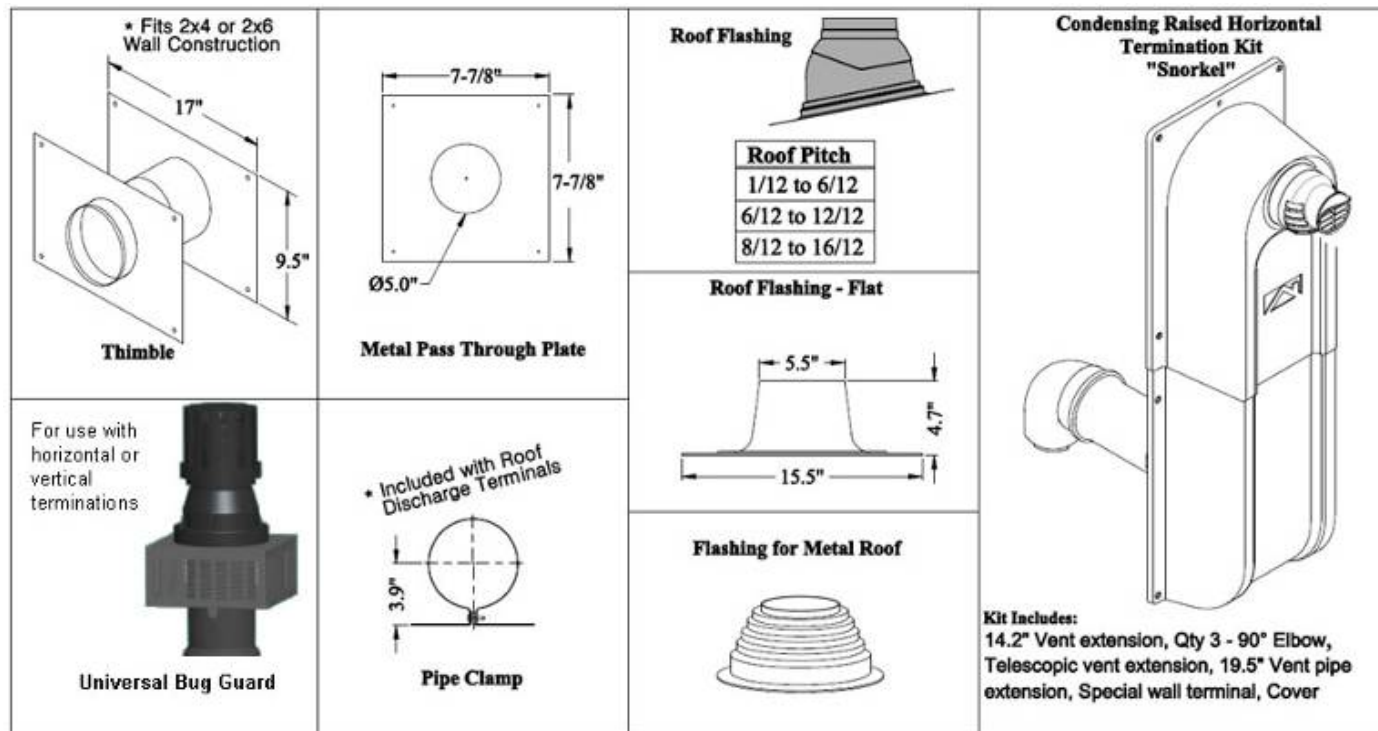
# Condensing Concentric Venting Parts



The above vent component examples contain a polypropylene exhaust, and although they are compatible with aluminum exhaust venting, they should never be interchanged.

Note: Check manufacturer's recommendations as using incorrect or unapproved venting can void the manufacturer's warranty.

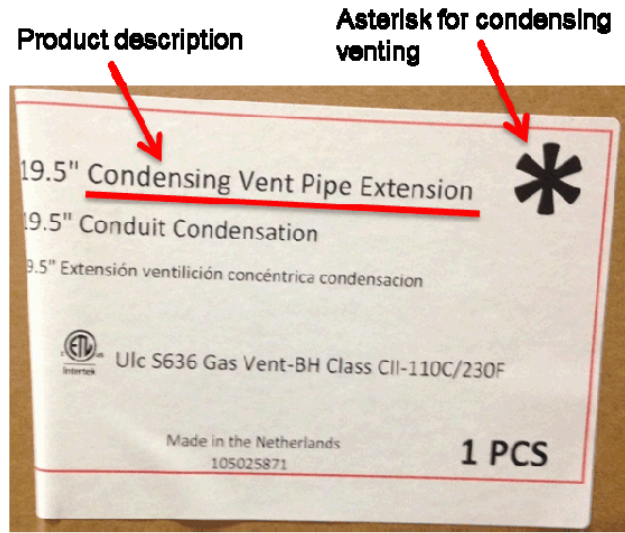
# Condensing Concentric Venting Parts



# Labeling

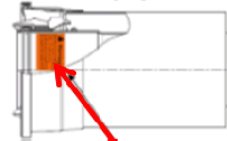
When purchasing or using venting, ensure the proper type is used. Polypropylene venting will have a green “Condensing” label on the package. Each polypropylene condensing vent component will have an orange “Warning” label on every inside and outside piece.

## Labeling on shipping box.



## Warning label on each individual vent piece.

### Inside pipe



### Outside pipe





# Water Line Connection

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Some manufacturers recommend the use of a “kit” that includes components used to connect the water lines to the water heater.

Use of this kit will assist in flushing the heat exchanger in areas where water quality issues exist, as well as improve overall product serviceability.

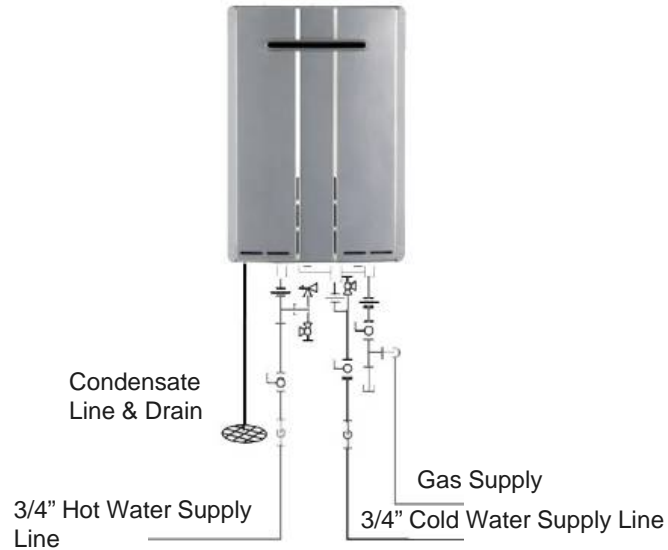
A standard size kit (with a PRV rated to 200K Btu) is acceptable for condensing tankless water heaters having a maximum input of 199,000 Btu.



# Tankless Technologies

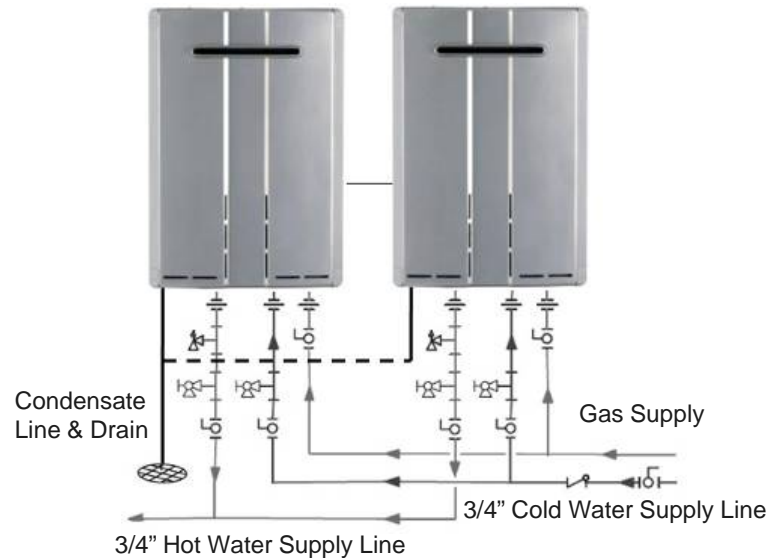
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## Single Unit Installation

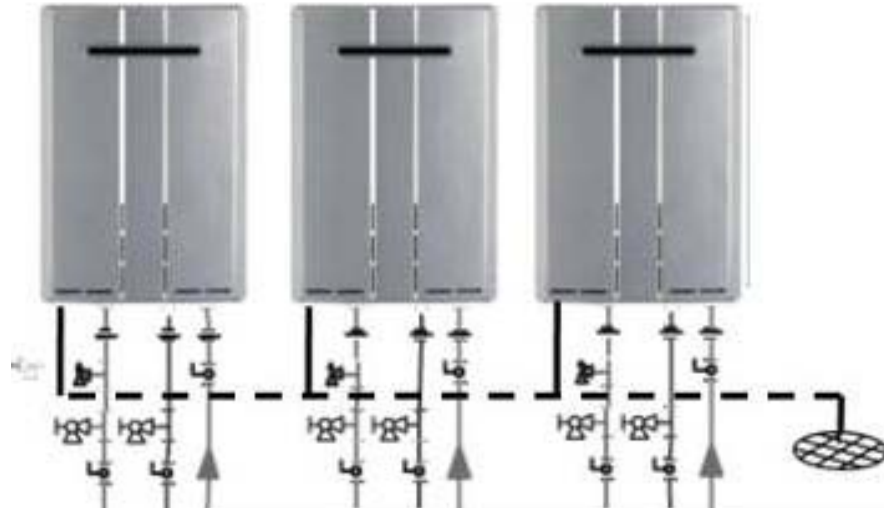


Standard Installation: Single unit based on structure's hot water demand (bathrooms/fixtures)

## Multi Unit Application



Two Unit Standard Installation: Will require a multiple system configuration of mechanical and electrical components to enable the units to work together.



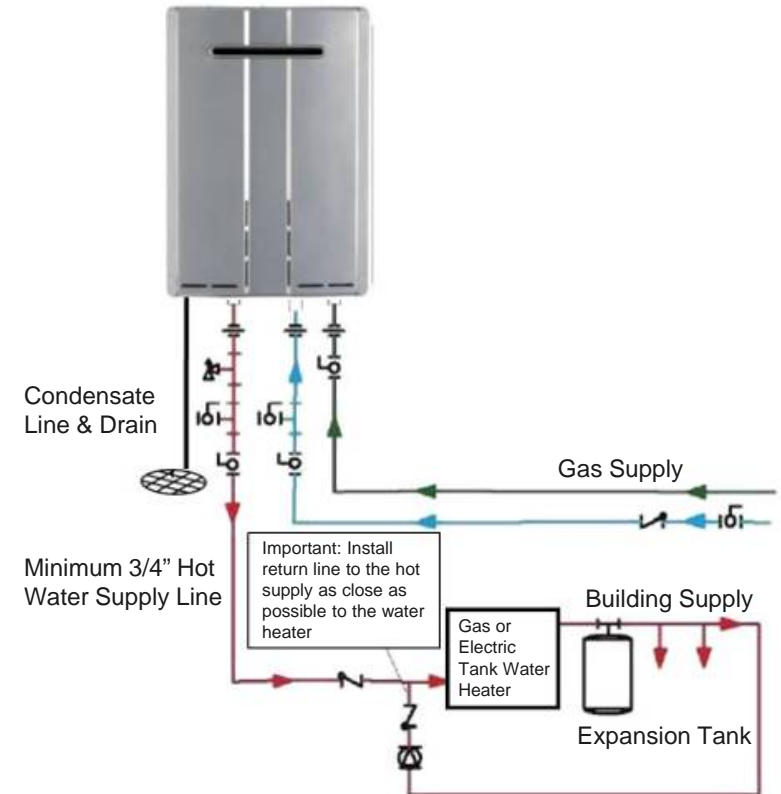
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## Tankless Water Heaters with Recirculation

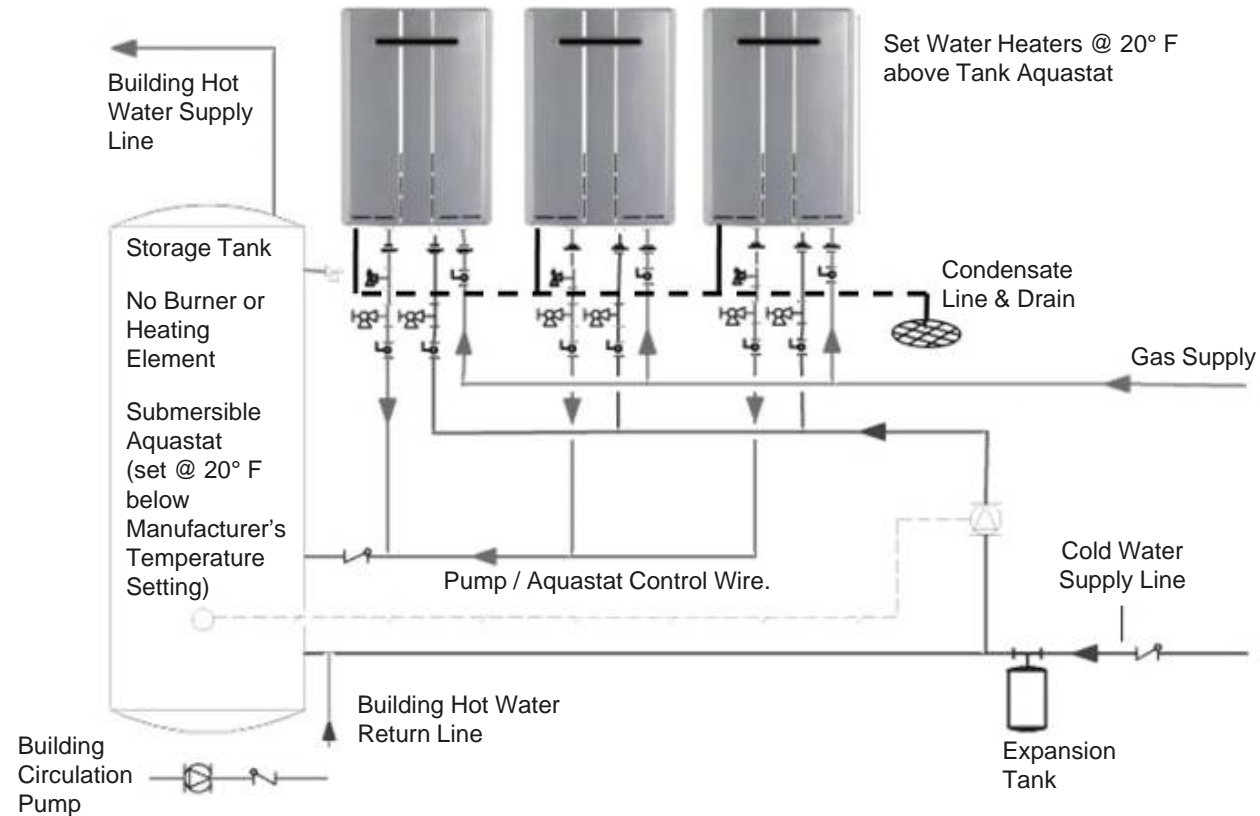
## Recommended Piping – Recirculation

For this application:

- Pump should be of bronze or stainless construction and controlled by an aquastat or timer, or combination of both.
- Pump to be sized to maintain circulation loop temperature.
- The pump should be sized to overcome the pressure loss through the tank water heater, and supply and return plumbing in the circulation loop.



# Backup Storage / Circulation Example





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## Residential Applications

# Introduction

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There are many opportunities in which to use tankless water heaters in residential applications, including:

- single family homes
- attached housing
- condominiums, and
- apartments.



# Residential Requirements

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Typically, an average three-bath home requires only one tankless water heater. Consider zoning the plumbing for larger homes.

For homes with custom fixtures, multiple units can be manifolded together to provide the necessary amount of hot water.

For installations that require two water heaters, connecting cables are required. Installations that require three or more water heaters in one location will require a multiple system configuration of mechanical and electrical components to enable the units to work together.





# Single Family Homes

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## San Clemente, CA

Homes ranging in size from 4,719 – 5,399 square feet, having five to seven bedrooms and five-and-a-half to seven-and-a-half bathrooms, use internal tankless water heater units vented to the outside with an on-demand recirculating pump.



# Attached Homes

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## Torrance, CA

Each attached home, ranging from 1,839 – 1,960 square feet, with three bedrooms and two-and-a-half bathrooms, uses one tankless water unit, located in the attic, to provide hot water.



# Condominiums

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Anaheim, CA

This 60-unit condominium complex includes two- and three-bedroom units.

Water heaters are providing both domestic and space heating.



# Apartments

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## Marina Del Rey, CA

In each of the 400 apartments in this building, interior tankless water heaters were installed in custom enclosures with the vent termination above the enclosures.



# Residential/ Business

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Aliso Viejo, CA

These 41 townhomes include one tankless water heater for each living unit.

Some plans include an interior model in the balcony closet, while others include a recessed box with an exterior model.





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## Commercial Applications

# Introduction

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There are many opportunities in which to use tankless water heaters in commercial applications, including:

- car washes
- hotels and motels
- detention centers
- fitness centers and spas
- schools and daycare facilities
- dormitories/locker rooms
- stadiums
- cafeterias and restaurants
- laundry facilities
- government facilities
- nursing/retirement homes
- churches, and
- industrial facilities.





# Car Washes

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This car wash has ten standard bays, two large truck bays, and two automatic car wash bays.

Eight units with 320 gallons of storage replaced four 560,000-Btu units with six hundred gallons of storage.





# Hotels and Motels

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This 75-room Ramada Inn operates with eight tankless units.

According to the CFO, they realized savings of 50 percent per room occupied in 2007 as compared to 2006.

Also, the hotel qualified for a \$900 rebate from the natural gas utility.



# Detention Centers

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Twelve tankless water heating units are being used to handle the needs of the 600-inmate jail, including 72 showers and kitchen.



# Fitness Centers

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Ten tankless units replaced two 2,000,000-Btu boilers and 1,800 gallons of storage.

The tankless units run 42 showers and 10 lavatories and can deliver 3,900 gallons of unmixed hot water an hour.

Use of the tankless units freed up 20 x 40 square feet of space in a room that can now be repurposed.

Also, the fitness center qualified for a \$6,000 rebate and reduced the annual operating costs by \$5,000.



# Schools and Daycare Facilities

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## Middle School in Charlotte, NC

Five tankless water heaters with 200 gallons of storage replaced a 800,000-Btu boiler and handle all of the hot water demands at a middle school in Charlotte, NC.

The school states that they saved \$6,387.93 (5,057.74 therms) in the first five months of operation from November 2007 to March 2008.



# Locker Rooms

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Middle School in Birmingham, AL

Student Population: 590

Six tankless units handle the athletic locker rooms containing ten showers, fourteen lavatories, and two mop sinks.

Note that the tankless system saved more than 50% on therms per gallon of water consumed when compared to a similar application in another middle school in the same region.



# Stadiums

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Three tankless units replaced a 2,000,000-Btu boiler with a 200-gallon storage tank.



Please remember the **exam password RECESS**. You will be required to enter it in order to proceed with the online examination.





# Restaurants

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Four tankless systems were installed, replacing the existing tank system (70-gallon, 360,000-Btu) in a restaurant in San Antonio, TX.

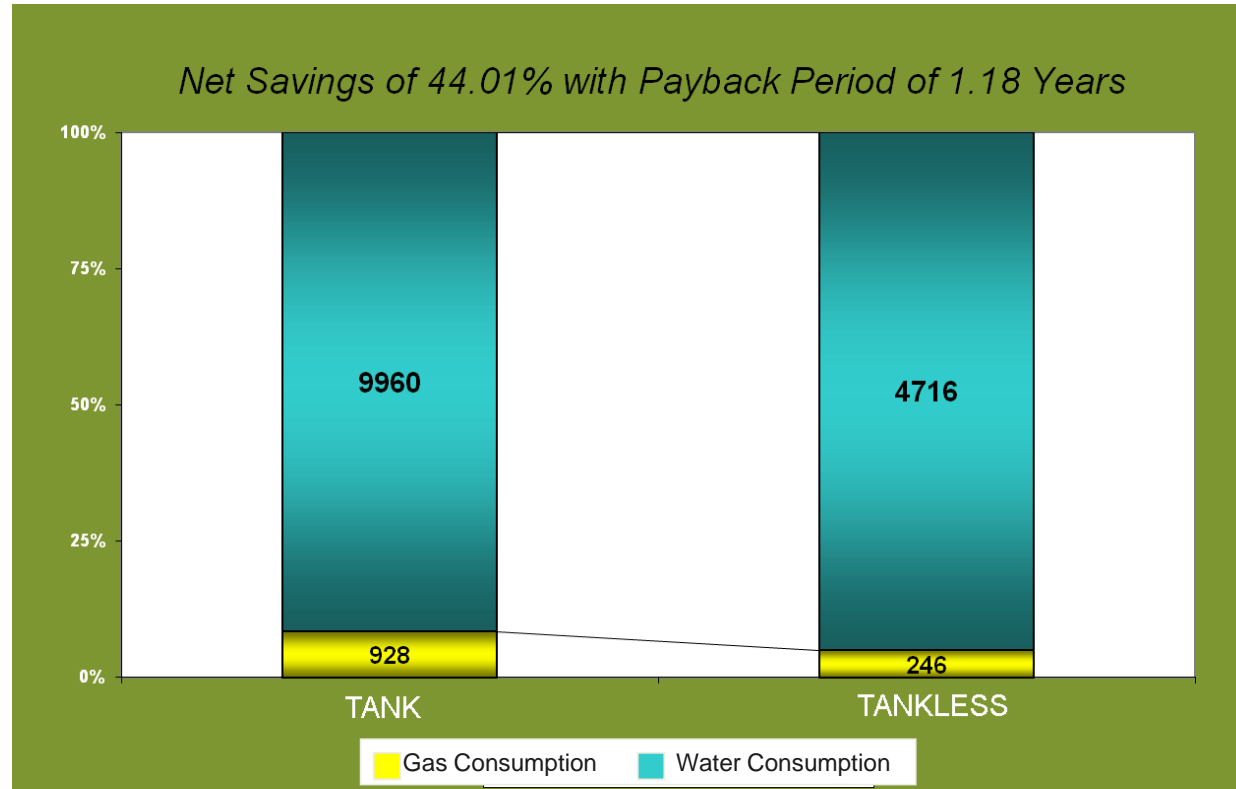
By installing the units on the roof, substantial space was freed up in a 20 x 20 mechanical room.

Results of tests measuring therms/gallon consumption proved natural gas savings (refer to the table on subsequent slide).



## Second Restaurant: Net Savings 44.01%

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## Summary

# Summary

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- Tankless water heaters are environmentally sound appliances as they produce very low NO<sub>x</sub> and CO<sub>2</sub> emissions.
- Components of some tankless systems are replaceable, unlike standard tank water heaters that are typically replaced when they fail or leak.
- 95% of the components of some tankless units are recyclable.
- With a life expectancy of up to twenty years, tankless systems offer twice the service life over a standard tank type water heater.
- Tankless systems provide space savings, energy savings, and lower operating costs.
- As part of a green design strategy, specifying tankless systems is a viable solution for a wide range of residential and commercial applications.

# Conclusion

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