Note: The following example only provides a small portion of the course created for Certus. The information has been placed in a knowledge and learning management system for instructors to use. Visuals and practice example were also provided and placed in the system for classes.

2-Hour Water Heater Course

Water heaters are an essential appliance people rely on every day. When a person turns on a faucet they expect to receive hot water. But making this happen is not as simple as buying a water heater, setting it up, connecting water lines, and turning the appliance on. In the United States (U.S.), each individual water heater's installation, operation, and maintenance must be done within federal, state, and local government regulations, rules, and guidelines. Plus, it must comply with plumbing industry and related organizations codes and standards. For example, codes require every water heater have a Temperature & Pressure (T&P) Relief Valve (T&P Valve) as a safety device to prevent problems from pressure like leaks, damage, and hazards.

A. Sources of Requirements

The main developers and publishers of regulatory requirements, codes, and standards for plumbing are in the following list:

- **U.S. Department of Energy (DOE), Energy Efficiency and Renewable Energy Office**
  Title: 2023-06-21 Energy Conservation Program: Test Procedure for Consumer Water Heaters and Residential-Duty Commercial Water Heaters; Final Rule
  Description: This final rule incorporates the latest version of the industry testing standards for consumer water heaters and residential-duty commercial water heaters and adopts relevant portions of those standards into the Federal test procedures.

  Title: Appliance & Equipment Standards
  Description: Minimum energy conservation standards for more than 60 categories of appliances and equipment.

- **International Association of Plumbing and Mechanical Officials** (IAPMO) & **American National Standards Institute** (ANSI)
  Title: Universal Plumbing Code (UPC)
  Description: A set of minimum standards and requirements for plumbing systems that aims to protect public health, safety, and welfare.

  Title: A40 Safety Requirement for Plumbing (2024)
  Description: Codes that address the installation of all pipes so that they do not leak or break under normal use conditions, including allowing enough room for expansion when a pipe freezes during cold weather.
- **International Code Council (ICC)**
  Title: International Plumbing Code (IPC)
  Description: Set of rules and guidelines that establish minimum requirements for plumbing systems and components in commercial buildings.

  Title: International Residential Code (IRC)
  Description: Code for residential buildings that creates minimum regulations for one- and two-family dwellings of three stories or less, bringing together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.
- **Council of American Building Officials**
  Title: I-Codes
  Description: Complete set of comprehensive, coordinated building safety and fire prevention codes.
- **The American Society of Mechanical Engineers (ASME)**
  Title: B31 Piping, Boiler and Pressure Vessel Code
  Description: A set of codes and standards on the design, construction, inspection, and preservation of piping systems.
- **State and Local Administrative Codes**
  Most states use the IPC, UPC, or a combination of both. There are a few that have their own set of plumbing codes and most are based on the IPC or UPC. The states that do are listed below.

- Louisiana State Plumbing Code
- New Mexico Plumbing Code
- Oregon Specialty Plumbing Code
- Wisconsin Statues, Comm 81-87, and Plumbing Code
- Washington State Building Code, Uniform Plumbing Code

Other individual applicable codes come from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), National Fire Protection Association (NFPA), American National Standards Institute (ANSI), National Electrical Code (NEC) National Electrical Safety Code (NESC), and ICC International Mechanical Code (IMC).

The requirements change frequently as new legislation, laws, and code amendments are passed. Therefore, you need to monitor these organizations and make adjust in what you design, select, and install as well as how it's done.

B. Water Heater Classifications, Categories or Types

There are laws, regulations, rules, codes, and standards for nearly everything that makes up a water heater system. However, finding the pertinent requirements for a specific model of water heater can be difficult. Below is a chart that illustrates this with some of the different ways water heater systems are classified and termed.

:

Department of Energy (DOE)	International Code Council (ICC)	ConsumerReporrts.org	Manufacturers	Wikipedia
Storage Water Heaters	Electric, Household Storage	Storage Tank Water Heate	Tank	Storage Water Heaters (tank-type)
Demand-Response	Oil-Fired Storage Tank	Tankless (On-Demand) Water Heater	Tankless	Instantaneous wate heaters
Residential-Duty Commercial	Gas-Fired, 75 000 Btu/h or less, Storage	Heat Pump (Hybrid) Water Heater	Combination Boil (building heat & hot water)	Point-of-use (POU)
Heat Pump	Electric, Commercial Storage	Condensing Water Heater	Heat Pump	Geothermal Heatin

Solar Water Heaters	Electric Instantaneous	Solar Water Heater	Solar Water Heaters	Solar Water Heaters
Tankless Coil & Indirect Water Heaters	Solid Fuel-Fired			Gravity-fed System
Specialty	Gas-Fired, above 75 000 Btu/h, Storage and Instantaneous			Centralized Hot Water Heaters

The lack of established standard types termed the same way and consistent use can make finding relevant rules, codes and standards for water heater systems challenging. Regardless of how think about water heater terms and types, be prepared to work with how the DOE does it for government regulations and ICC in industry codes and standards.

C. Government Regulatory Requirements

- **Residential Consumer Water Heaters**

  A new DOE "Final Rule" went into effective on July 5, 2024, for residential consumer water heaters. Compliance is required on or after May 6, 2029. Changes that have been made include:

  - Requires the flow rate during the FHR test to be 1.5 ± 0.25 gpm (5.7 ± 0.95 L/min) for water heaters with a rated storage volume less than 20 gallons.
  - Specifies that the first required measurement for each draw of the 24-hour simulated-use test is 15 seconds after the draw is initiated.
  - Requires maintaining the ambient temperature for non-heat pump water heaters within a range of 67.5 °F ± 5 °F, and with an average of 67.5 °F ± 2.5 °F.
  - Flow rate requirements are to be modified during the first-hour rating (FHR) test for water heaters with a rated storage volume less than 20 gallons.
  - Standard temperature is 60 °F (15.6 °C) and the standard pressure is 30 inches of mercury column (101.6 kPa).

- Clarifies that the manifold pressure tolerance applies only to water heaters with a pressure regulator that can be adjusted. The manifold pressure must be within the greater of ±10 percent of the manufacturer recommended value or a ±0.2 inches water column.
- Gas-fired circulating water heaters must now be tested using an unfired hot water storage tank (UFHWST) with a storage volume between 80 and 120 gallons.
- A mixing valve should be installed when the water heater is designed to operate with one.

An overview summary with all the changes can be found at https://www.regulations.gov/document/EERE-2019-BT-TP-0032-0058)

- **Permits**

  Most states and cities have local rules that must be followed in addition to government regulations and national codes. Many require you obtain a permit and pay the related fees before installing a new or replacement and old water heater.

D. Construction & Plumbing Industry Requirements

- **Temperature Safety Devices**

  If you're installing a storage-type water heater or hot water boiler that draw energy from a source other than gas, you will need to add an over-temperature safety protection device.

- **Draft Hoods and Regulators**

  When you plan to mount a draft hood or a barometric draft regulator for a water heater, it needs to be installed in the same room as the water heater or appliance it serves.

- **Vents & Ducts**

  The ducts you install need to be made of galvanized steel or a material having equivalent corrosion resistance, strength, and rigidity. Those you

install in dwelling units, need to end in unobstructed studs and joist spaces. If the duct goes into an attic, it should not have a screen on top.

When installing ducts for systems with two combustion openings, you need to put in one for the upper combustion air opening, and a second that is separate for the lower opening.

- **Single-Wall Heat Exchangers**
  If you install an indirect-fired water heater it must have potable water or contain a fluid recognized as safe by the Food and Drug Administration (FDA) and classified as food grade. The unit must also have on it the following labels:
  - ***Caution***
  - ***The heat-transfer medium shall be potable water or other nontoxic fluid recognized as safe by the FDA.***
  - ***The maximum operating pressure of the heat exchanger shall not exceed the maximum operating pressure of the potable water supply.***
- **Catch Pans**
  When a catch pan becomes necessary, the pan you select must be composed of number 24 galvanized steel or plastic materials and meet the minimum .9 mm thickness requirement. For gas water heaters, any plastic catch pans need a material with a flame spread index of less than 25.
- **Shut Down Valve**
  When you install water heater, it must have an automatic gas shutoff valve.
- **Sediment Traps**
  Water heaters need a sediment trap to prevent the sediment and natural gases from entering the system through a gas valve.
- **Temperature Ranges**
  When you set the temperature for a water heater system, the safe range is between 120°F to 160°F. The standard temperature for most water

heaters is 140°F, but the Department of Energy recommends turning down the temperature to 120°F to save energy.

- **Louvers, Grilles, & Screens**
  The size of openings for combustion, ventilation, and dilution air should be based on the net free area of each opening—wood louvers 25%; metal louvers and grilles 75%.
- **Piping Capacity**
  Before you connect additional appliances to a gas piping system, you need to first check if there is adequate capacity. If capacity is inadequate, you need to enlarge the existing system.
- **Installation**
  - **Combined Spaces**
    If you're combining spaces on the same story, they must become one area with an opening of at least 1 square inch per 1000 Btu/h (0.002 m2/kW) of the total input rating for all appliances in that space. For an air opening, it needs to be at least 3 inches (76 mm).
  - **Closets**
    You can install fuel-burning water heaters in a closet located in a bedroom or bathroom if it is a direct-vent type. It also needs to be equipped with a listed gasketed door assembly and self-closing device. The door assembly needs to be installed with a threshold and bottom door seal. The closet must be exclusively used for the water heater. Exceptions can be made by the local authority that has jurisdiction.
  - **Residential Garages**
    Water heater can be installed in residential garages or adjacent spaces that open to the garage as long as it's not a living space of a dwelling unit. The burners and burner-ignition devices need to be located at least 18 inches (457 mm) above the floor unless listed as flammable vapor ignition resistant.

- **Self-Closing Doors**
  When installing self-closing doors, they must swing easily and freely, and have a self-closing device that cause the door to close and latch after each opening. The closing mechanism cannot have a hold-open feature.
- **Appliance Clearance**
  Water heaters there must be installed so there is enough clearance between the water heater and any object or part of the structure. Nothing can interfere with combustion air or the draft hood. There also needs to be adequate open space in front of the water heater for easy access and servicing. Plus, the open areas size must comply with the manufacturer's installation instructions.
- **Seismic Straps**
  Some local codes in earthquake-prone areas require seismic straps on the top and bottom of the water heater. These straps secure the heater to the wall, keep it upright and stable in the occurrence of an earthquake. Check the local codes to determine if your area requires these straps before installation.
- **Shutoff & Check Valves**
  All water heaters must have a shut off valve on the cold water supply pipe to the water heater. There should be no shutoff valve between the valve and the tank. The valve can be a lever-handle ball valve or a round-handle gate valve. When the valve is closed, it should also shut off water to all hot water pipes.
- **Appliance Protection**
  A water heater includes many components that need protection from dents and damage. Typically, you will need to build a barrier surrounding a water heater. The exception

is when the water heater system is in an isolated location with a low risk of damage or contact from outside sources.

Additionally, when considering the installation of a water heater, it's important to factor in how long it takes for the water heater to recover after heavy use. This recovery time can vary depending on factors such as the size and type of water heater, as well as the demand level for hot water in the building.

- **Discharge Pipes**

  Discharge pipes need to be installed and attached to a TPR valve to reduce leaks and potential water damage when the TPR valve releases steam or drains extra water. This pipe should direct water to outside the building or into an indoor catch pan or floor drain. The water heater installation codes specify that the water needs to easily drain to a safe area that won't cause damage or flooding inside the home.

  Additional requirements for water heat discharge pipes include:

  - ✓ An air gap is required between the pipe and drain to prevent backflow and Backsiphonage.
  - ✓ Pipes need to be installed so they drain away by gravity and the size needs to be no less than the size of the TPR valve. Plus, be at least as large as the valve outlet's diameter.
  - ✓ Each discharge pipe you install should only serve one water heater system. The same rule applies for relief devices, and they cannot be connected to other piping to prevent cross-connections and backflow.
  - ✓ Pipes need to end six inches or less above the floor and cannot be connected directly to the drainage system

- ✓ For water heaters, you must create an air gap in the same room for discharge to flow through. After the air gap, discharge must go into either a drain on the floor, waste receptor, pan serving the water heater, or outdoors.
- ✓ Pipe or tube to valves need to be installed as short and straight to avoid stressing the valve.
- ✓ The water heater needs to be installed in a way that ensures no water can be trapped around the appliance and become standing water that can become contaminated.