



Residential Hot Water Distribution Options

Compliance Options – 2021 IRC/IECC

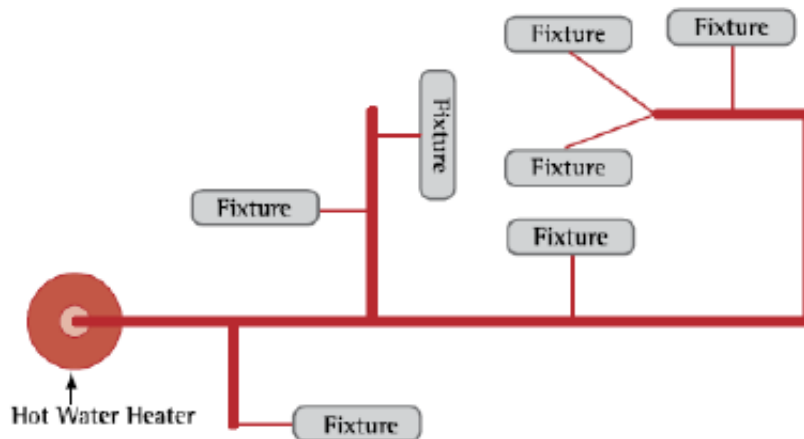
Efficient hot water delivery not only conserves water but reduces the energy needed to heat and deliver hot water. It also minimizes pipe run lengths. For builders, an efficient hot water delivery system can reduce material and installation costs. For homeowners, the benefits include reduced energy and water costs and the convenience of drawing hot water from fixtures quickly.

Scottsdale amended energy code (IRC N1103.5.1.1.1/IECC R403.5.1.1.1) requires a demand-initiated hot water circulation system when the developed length of hot water piping from the source of hot water to the furthest fixture exceeds the maximum length in Table N1103.5.1.1.1 below. For the purpose of this provision, the source of hot water shall be the water heater, boiler, circulation loop, distribution manifold, or heat-traced piping. Hot water pipe insulation shall be provided per IRC N1103.5.2 (IECC R403.5.2).

IRC TABLE N1103.5.1.1.1 (IECC R403.5.1.1.1) – DEMAND HOT WATER RECIRCULATION SYSTEM REQUIREMENT BASED ON PIPE SIZE AND LENGTH

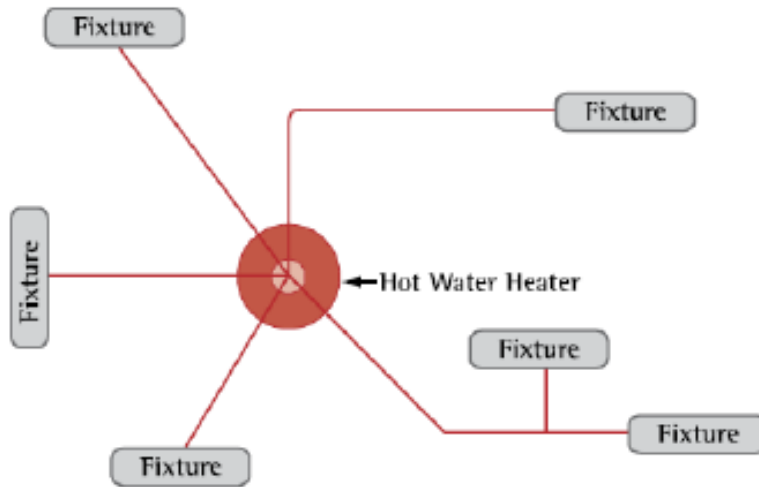
Nominal Pipe Size (inches)	Maximum Piping Length (feet)
3/8 or less	50
1/2	43
5/8	32
3/4	21

OPTION 1 - Traditional Trunk and Branch System



Trunk and branch systems are characterized by one long, large diameter main line (trunk) that runs from the water heater to the furthest fixture in the house. Along the way, “branches” from the main trunk supply hot water to various areas of the home, and smaller “twigs” branch off to supply hot water to individual fixtures. In terms of maximizing hot water delivery efficiency, trunk and branch systems are most suitable for smaller homes or in homes with relatively few fixtures, It is be difficult to design an efficient trunk and branch system in larger homes with spacious layouts and a large number of fixtures without a centralized plumbing core or demand-initiated recirculation system. The length of piping between the water heater and fixtures is limited by Table N1103.5.1.1.1 above.

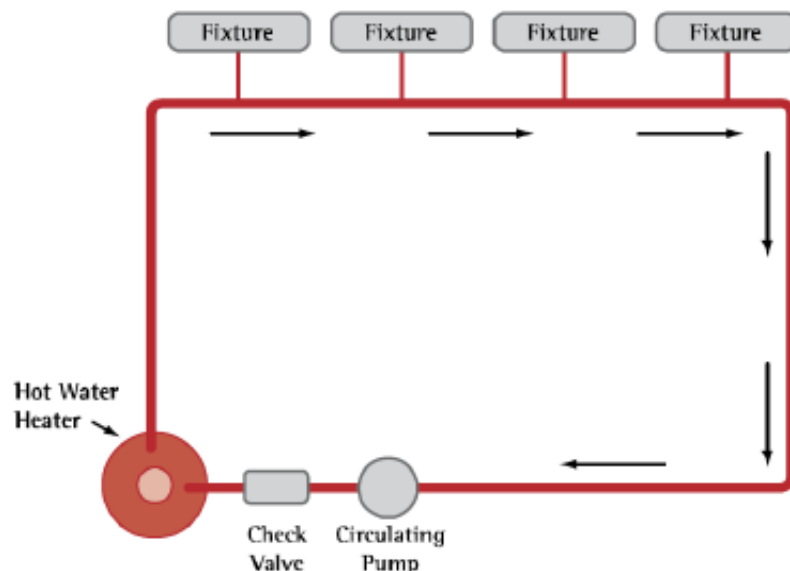
OPTION 2 – Centralized Plumbing Core



Core systems utilize a central plumbing core, where plumbing areas (i.e., kitchens, bathrooms, laundry rooms) are placed in close proximity to the water heater. Hot water is piped directly to each fixture or group of fixtures using smaller diameter piping when appropriate and as direct as possible. The relative proximity of the fixtures and direct horizontal runs minimizes the length of piping and the amount of time required for hot water to reach each fixture. The length of piping between the water heater and fixtures is limited by Table N1103.5.1.1.1 on page 1.

Because core systems use less and smaller diameter piping, they can significantly reduce conductive heat loss and the amount of water that users waste while waiting for hot water. As a result, core systems provide greater flexibility and can be less expensive and quicker to install relative to other system types. Core systems are most suitable for smaller homes or large homes with multiple plumbing cores.

OPTION 3 - Demand-Initiated Recirculation System with Dedicated Return Line

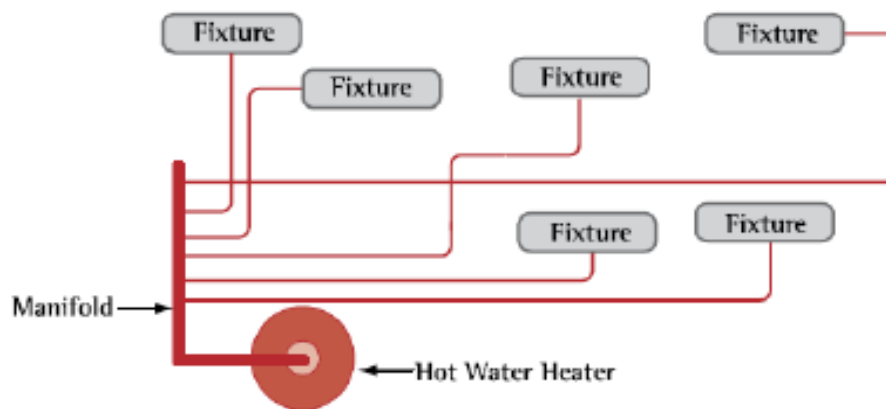


Recirculation systems consist of one continuous hot water supply loop that recirculates water throughout the house. A circulation pump draws hot water through the recirculation loop and returns any ambient-temperature water residing within the loop to the water heater. For best efficiency, the recirculation loop should be located within 10 feet of each fixture. For existing buildings, the pump may use the cold water line to return the water while simultaneously drawing hot water from the water heater.

A demand-initiated control switch is required to activate the circulation pump by means of a push button or motion sensor located near hot water fixtures in bathrooms and kitchens. The pump shall automatically turn off when the water in the circulation loop reaches the set temperature (thermo-sensor) and there is no hot water demand. Timer- and temperature-activated recirculation systems are not permitted (research indicates that these systems use a significant amount of energy to maintain water temperature in the recirculation loop). Smart controllers are also available that automatically adjust to hot water demand based on time of day, week and season without the use manual switches. Smart controllers have the ability to learn, store and adapt operation time to the consumption pattern of the users.

While the cost of the circulation pump and controls represent incremental costs, recirculation systems can be quicker to install and utilize less piping than traditional distribution systems, which in turn reduces overall costs.

OPTION 4 - Whole-House Manifold Distribution System



Whole-house manifold systems, also called parallel pipe or home run systems, use small diameter, flexible piping (such as PEX) that run directly to each individual fixture from a central manifold. The central manifold is typically kept in close proximity to the water heater. The length of piping between the manifold and each fixture is limited by Table N1103.5.1.1.1 on page 1.

Whole-house manifold systems equalize pressure, and therefore several fixtures can be used simultaneously without dramatic changes in pressure or temperature. The elimination of inline fittings also reduces pressure losses, allowing for the use of smaller 3/8 inch diameter piping. Reduced pipe diameters in turn deliver hot water to fixtures faster and with less water and energy waste than conventional piping systems.

Sources:

1. 2021 IRC, IECC and IPC Code Commentaries
2. WaterSense Guide for Efficient Hot Water Delivery Systems (v1.2, 7-24-2014)