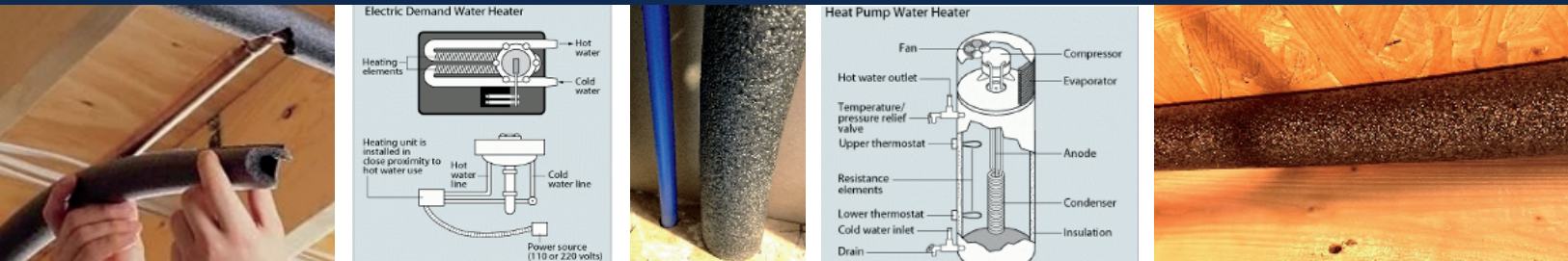


Hot Water Pipe Insulation

2021 VRC/VECC Code Guide



Hot Water Pipe Insulation:

Summary: While the plumbing code (P2603.5) has long required freeze protection of water pipes as needed, the 2012 edition of Virginia's residential energy code began requiring specific insulation performance on some domestic hot water pipes for homes following the prescriptive path. That language has changed only slightly from the 2012 to 2021 editions. Per N1103.5.2 (R403.5.2), pipe insulation of not less than R-3 should be installed on:

1. piping $\frac{3}{4}$ inch and larger in nominal diameter (Virginia's 2012 energy code only required piping larger than $\frac{3}{4}$ inch to be insulated)
2. piping serving more than one dwelling unit
3. piping located outside conditioned space
4. piping from the water heater to a distribution manifold
5. piping located under a floor slab
6. buried piping
7. supply and return piping in circulation and recirculation systems other than cold water pipe return demand recirculation systems

Best practices for effective installation:

- Insulating pipes is quick and easy with typical hand tools after leakage tests and inspections but prior to cover-up by cavity insulation, drywall, and/or other coverings.
- Cut insulation to fit tightly around corners and nearby building components.
- Secure insulation as needed with tape, wire, clips, etc.
- For storage water heaters, also insulate the first foot of incoming cold water pipe adjacent to the water heater. Heat migrates up that pipe during times of no draw.



- Foam sleeves – from R-3 to R-5 – designed for insulating pipes are widely available for less than \$.35 per linear foot (November 2024 pricing).
- Safety tip from the US Dept. of Energy: “On [atmospherically-vented] gas water heaters, insulation should be kept at least 6 inches from the flue. If pipes are within 8 inches of the flue, your safest choice is to use fiberglass pipe-wrap (at least 1-inch thick) without a facing. You can use either wire or aluminum foil tape to secure it to the pipe.”ⁱ

Why: Uninsulated piping increases risk of pipe failure, increases water and water heating costs, and can contribute to resident dissatisfaction with wait times for hot water. Risk of pipes freezing is reduced when they are insulated. PEX, a commonly used material, can suffer from long-term performance problems when degraded by UV exposure. Insulation helps to minimize UV exposure. Insulated hot water piping maintains the temperature in the pipes for longer, reducing wait time at fixtures and minimizing water waste.

How much energy does it save? In September 2022, conservation programs managed by electric utilities in Virginia calculatedⁱⁱ that pipe insulation reduced energy use by 17 kWh/year on ½” pipes and 26 kWh/year on ¾” pipe, per foot of pipe. In September 2022, much of Virginia was paying \$.14 per kWh (prices vary by utility jurisdiction and for other fuel sources). The table below calculates the potential savings over 30 years as achieved by insulating pipes in a typical home – based on unchanging electricity rates.

Pipe diameter (inches)	Annual kWh savings per foot	kWh cost	Savings per foot per year	Sample # feet of pipe in home	Savings per year for home	Mortgage term in years	Total savings over mortgage term
0.5	17	\$ 0.14	\$ 2.38	30	\$ 71.40	30	\$ 2,142.00
0.75	26	\$ 0.14	\$ 3.64	20	\$ 72.80	30	\$ 2,184.00
				Annual savings	\$ 144.20	Lifetime savings	\$ 4,326.00

2021 VRC/VECC Code References:

N1103.5.2 (R403.5.2) Hot water pipe insulation. Insulation for service hot water piping with a thermal resistance, R-value, of not less than R-3 shall be applied to the following:

1. Piping 3/4 inch (19 mm) and larger in nominal diameter located inside the conditioned space.
2. Piping serving more than one dwelling unit.
3. Piping located outside the conditioned space.
4. Piping from the water heater to a distribution manifold.
5. Piping located under a floor slab.
6. Buried piping.
7. Supply and return piping in circulation and recirculation systems other than cold water pipe return demand recirculation systems.

P2603.5 Freezing. In localities having a winter design temperature of 32°F (0°C) or lower as shown in Table R301.2 of this code, a water, soil or waste pipe shall not be installed outside of a building, in exterior walls, in attics or crawl spaces, or in any other place subjected to freezing temperature unless adequate provision is made to protect it from freezing by insulation or heat or both. Water service pipe shall be installed not less than 12 inches (305 mm) deep and not less than 6 inches (152 mm) below the frost line.

Definitions:

CIRCULATING HOT WATER SYSTEM: A specifically designed water distribution system where one or more pumps are operated in the service hot water piping to circulate heated water from the water-heating equipment to fixtures and back to the water-heating equipment.

DEMAND RECIRCULATION WATER SYSTEM: A water distribution system where one or more pumps prime the service hot water piping with heated water on demand for hot water.

MANUAL: Capable of being operated by personal intervention (see “Automatic”).

OCCUPANT SENSOR CONTROL: An automatic control device that detects the presence or absence of people within an area and causes lighting, equipment or appliances to be regulated accordingly.

R-VALUE (THERMAL RESISTANCE): The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area ($h \times ft^2 \times ^\circ F/Btu$) [$(m^2 \times K)/W$].

SERVICE WATER HEATING: Supply of hot water for purposes other than comfort heating.

ⁱ <https://www.energy.gov/energysaver/do-it-yourself-savings-project-insulate-hot-water-pipes>.

Banner graphics from <https://www.energy.gov/energysaver/water-heating>; photos from Viridiant.

ⁱⁱ Energy savings calculations are presented in the Mid-Atlantic Technical Reference Manual (TRM) V9 at <https://neep.org/mid-atlantic-technical-reference-manual-trm-v9>

