

# Mechanical System Piping Insulation and Service Hot Water Systems - Code Compliance Brief

## Overview:

*The intent of this brief is to provide code-related information about mechanical system piping insulation and service hot water systems to help ensure that what is proposed regarding insulating these systems will be accepted as being in compliance with the code. Providing consistent information to document compliance with codes and standards to all relevant parties responsible for verifying with those codes and standards (e.g., code officials, builders, contractors, designers, etc.) is expected to result in increased compliance and timely, less challenging, and more uniform plan review and field inspections.*

Pipe insulation reduces temperature changes while fluids are being transported through piping associated with heating, cooling or service hot water systems, thereby saving energy and reducing operating costs. Other measures that can save energy and water include designing a compact plumbing distribution system, and using plumbing fixtures certified by the WaterSense Program. The U.S. Department of Energy (DOE) [Zero Energy Ready Home National Program Requirements](#) [1][1] includes mandatory water-efficiency requirements that all homes must meet the efficient design requirements found in Section 3.3 of the [EPA WaterSense Single-Family New Home Specification](#) [2], which requires builders to minimize water wasted while waiting for hot water to arrive at plumbing fixtures. The WaterSense website includes tools to properly size pipe runs and to design and install landscape irrigation systems.

The following sections list the applicable code and standard requirements and details helpful for Plan Review. The Field Inspection section then provides details for inspecting "...mechanical system piping insulation and service hot water systems." For resources on technical validation, best practices, and measure guidelines, refer to the Technical Validation/Reference Materials section of this brief.

The lists and provisions provided below in each section are intended to target the primary code sections and provisions. There may be other references, code sections, standards, testing methods, etc., that affect the technology or other assemblies or functions of the building.

[1] DOE Solar Energy Ready Program Requirements, [http://www.energy.gov/sites/prod/files/2014/04/f15/doe\\_zero\\_energy\\_ready...](http://www.energy.gov/sites/prod/files/2014/04/f15/doe_zero_energy_ready...)[1]

## Plan Review:

This section lists applicable code requirements and details helpful for plan review regarding the provisions to meet the requirements for mechanical and service hot water piping insulation.

### **2015 IRC, Section R104 Duties and Powers of the Building Official**

**2015 IECC/IRC, Section R104.1 General.** The building official has authority to render interpretations of this code and to adopt policies and procedures in order to clarify the application of its provisions. Such interpretations, policies and procedures shall be in conformance with the intent and purpose of this code.

**R102.1/R104.11 Alternative Materials, Design and Method of Construction and Equipment.** The provisions of this code are not intended to prevent the installation of any material or prohibit any design or method of construction not specifically prescribed in the 2015 IECC/IRC, provided that any such alternative has been approved. The building official is permitted to approve an alternative material, design, or method of construction where the building official finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and the material, method, or work offered is for the purpose intended, not less than the equivalent of that prescribed in the code. Compliance with specific performance-based provisions of the International Codes is an alternative to the specific requirements of this code.

**R104.11.1 Tests.** Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the building official has authority to require tests as evidence of compliance to be made at no expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the building official shall approve the testing procedures. Tests shall be performed by an approved agency. Reports of such tests shall be retained by the building official for the period required for retention of public records.

Per the **2015 IECC/IRC, Section R103.3/R106.3 Examination of documents**, the code official/building official must examine or cause to be examined construction documents for code compliance.

**Construction Documentation.** Review the construction documents for details describing piping size, length of runs, fluid temperatures, controls, insulation, and installation.

- **2015 IECC/IRC, Section R103.2/N1101.5 Information on construction documents.** Construction documents should include:
  - Insulation material(s) and their R-value(s)
  - Mechanical and service hot water piping design and installation specifications

- Operating temperature of fluids to be transported connected to mechanical system and service hot water system
- Protection of piping exposed to outdoor elements
- Controls.

**2015 IECC/IRC, Section R403.4/N1103.4 Mechanical system piping insulation (Mandatory).** Mechanical system piping capable of carrying fluids above 105°F (41°C) or below 55°F (13°C) shall be insulated to a minimum of R-3.

**R403.4.1/N1103.4.1 Protection of piping insulation.** Piping insulation exposed to weather shall be protected from damage, including that caused by sunlight, moisture, equipment maintenance, and wind, and shall provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be permitted.

Mandatory means the provisions are required regardless of what compliance path is chosen to demonstrate compliance (e.g., prescriptive, performance based, or Energy Rating Index).

**R403.5/N1103.5 Service hot water systems.** Energy conservation measures for service hot water systems shall be in accordance with Section NR403.5.1/N1103.5.1 and R403.5.2/N1103.5.4.

**R403.5.1/N1103.5.1 Heated water circulation and temperature maintenance systems (mandatory).** Heated water circulation systems shall be in accordance with Section R403.5.1.1/N1103.5.1.1. Heat trace temperature maintenance systems shall be in accordance with Section R403.5.1.2/N1103.5.1.2. Automatic controls, temperature sensors, and pumps shall be accessible. Manual controls shall be readily accessible.

**R403.5.1.1/N1103.5.1.1 Circulation systems.** Heated water circulation systems shall be provided with a circulation pump. The system return pipe shall be dedicated return pipe or a cold water supply pipe. Gravity and thermos-syphon circulation systems shall be prohibited. Controls for circulating hot water system pumps shall start the pump based on the identification of a demand for hot water within the occupancy. The controls shall automatically turn off the pump when the water in the circulation loop is at the desired temperature and when there is no demand for hot water.

**R403.5.1.2/N1103.5.1.2 Heat trace systems.** Electric heat trace systems shall comply with IEEE [2] 515.1 or Underwriters Laboratory UL 515. Controls for such systems shall automatically adjust the energy input to the heat tracing to maintain the desired water temperature in the piping in accordance with the times when heated water is used in the occupancy.

**R403.5.2/N1103.5.2 Demand recirculation systems.** A water distribution system having one or more recirculation pumps that pump water from a heated water supply pipe back to the heated water source through a cold water supply pipe shall be a demand recirculation water system. Pumps shall have controls that comply with both of the following:

1. The control shall start the pump upon receiving a signal from the action of a user of a fixture or appliance, sensing the presence of a user of a fixture or sensing the flow of hot or tempered water to a fixture fitting or appliance.
2. The control shall limit the temperature of the water entering the cold water piping to 104°F (40°C).

[2] Institute of Electronics and Electrical Engineers, Standards Association, <https://standards.ieee.org/> [3]

### Field Inspection:

Per the **2015 IECC, Section R104 Inspections**, construction or work for which a permit is required is subject to inspection.

Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footings and the foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

Per the **2015 IRC, Section R109 Inspections**, for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding the foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and the final inspection. Any additional inspections are at the discretion of the building official.

This section of the 2015 IECC/IRC provides details for inspecting to the specific provisions for construction of mechanical system piping insulation and service hot water heating systems, piping design, and insulation and controls where one or more specific types of inspection called for by the IECC or IRC may be necessary to confirm compliance. To confirm code compliance, plumbing and mechanical rough-in would be the typical types of inspection performed.

- Verify the mechanical system piping carrying fluids are insulated to a minimum R-3
- Verify piping protection has been installed properly to prevent damage from sunlight and extreme weather conditions
- Verify piping diameter and run lengths per approved construction documents
- Verify proper controls have been installed properly.

### Technical Validation(s):

This section provides additional related information and references to materials that are applicable to the provision.

- [2015 IECC—International Energy Conservation Code](#) [4]

Author(s): ICC

Organization(s): ICC

Publication Date: May 2014

This code establishes a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems, and service water heating systems in homes and commercial businesses.

- [2015 IRC—International Residential Code for One- and Two-Family Dwellings](#) [5]

Author(s): ICC

Organization(s): ICC

Publication Date: May 2014

This code for residential buildings creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy, and electrical provisions for one- and two-family residences.

#### **Related BASC Guides:**

- Core Plumbing, <https://basc.pnnl.gov/resource-guides/core-plumbing#quicktabs-guides=0> [6]
- Demand Plumbing, <https://basc.pnnl.gov/resource-guides/demand-plumbing> [7]