



**Proposed 2021 Seattle Energy Code (Mechanical Code) Changes**

**C403.1 Clarification regarding compliance with ASHRAE 90.4. (staff request)**

**C403.1 General.** Mechanical systems and equipment serving heating, cooling, ventilating, and other needs shall comply with this section.

- EXCEPTIONS:1. Energy using equipment used by a manufacturing, industrial or commercial process other than for conditioning spaces or maintaining comfort and amenities for the occupants are exempt from all Section C403 subsections except for Section C403.3.2, Tables C403.3.2 (1) through (16) inclusive, Sections C403.3.4.1, C403.3.4.2, C403.3.4.3, C403.7.7, C403.9.2.1, C403.10.3, C403.11.2, and C403.11.3, as applicable. Data center and computer room HVAC equipment is not covered by this exception.
2. Data center systems are exempt from Sections C403.4 and C403.5, but shall comply with ASHRAE 90.4 Sections 6 and 8 according to Section C403.1.3.

**C403.1.1 Table listing TSPR occupancies.** Easier to understand scope of the requirement in a table than in a list within a paragraph. Also clarification to exception #5.

**C403.1.1 HVAC total system performance ratio (HVAC TSPR).** For systems serving ((office (including medical office), retail, library, and education occupancies and buildings, which are subject to the requirements of Section C403.3.5 without exceptions, and the dwelling units and residential common areas within Group R-2 multi-family buildings)) occupancies included in Table C403.1.1, the HVAC total system performance ratio (HVAC TSPR) of the proposed design HVAC system shall be greater than or equal to the HVAC TSPR of the standard reference design as calculated according to Appendix D, Calculation of HVAC Total System Performance Ratio.

**Table C403.1.1  
Occupancy Classifications Requiring TSPR**

<b>Occupancy Classification</b>	<b>Inclusions</b>	<b>Excluded</b>
<b>A</b>	Library	All other Group A uses
<b>B</b>	Office, medical office, library	All other Group B uses
<b>E</b>	All occupancies included	
<b>M</b>	All occupancies included	
<b>R</b>	Dwelling units and common areas within Group R-2 areas of buildings	R-1, R-3
<b>F, H, I, S, U</b>		All occupancies

EXCEPTIONS 1. Buildings in which the sum of the *conditioned floor area* of office, retail, education, library, and multifamily spaces is less than 5,000 square feet. Areas that are eligible for any of the exceptions below do not count towards the 5,000 square feet.

2. HVAC systems using district heating water, chilled water or steam.

3. HVAC systems connected to a *low-carbon district energy exchange system*.

4. HVAC systems not included in Table D601.10.1.

5. HVAC systems with chilled water supplied by absorption chillers, heat recovery chillers, water to water heat pumps, air to water heat pumps, or a combination of air and water cooled chillers on the same chilled water loop with no more than 10 percent of the cooling capacity of the combination being supplied by air cooled chillers.

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#### **C403.1.4 Exceptions to the heat pump heating rule.**

- Exception 2: Permits electric resistance wattage to be averaged over all the rooms in a single apartment.
- Exception 11: Requires hydronic systems using district heating coils to be sized large enough to work with 120°F water, to accommodate future change to heat pump heating.
- Exception 16: Clarification for Seattle climate
- Exception 18: Clarification requested by staff that electric resistance “standby equipment” is permissible.

**C403.1.4 Use of electric resistance and fossil fuel-fired HVAC heating equipment.** HVAC heating energy shall not be provided by electric resistance or fossil fuel combustion appliances. For the purposes of this section, electric resistance HVAC heating appliances include, but are not limited to, electric baseboard, electric resistance fan coil and VAV electric resistance terminal reheat units and electric resistance boilers. For the purposes of this section, fossil fuel combustion HVAC heating appliances include, but are not limited to, appliances burning natural gas, heating oil, propane, or other fossil fuels.

EXCEPTIONS:...

2. **Dwelling and sleeping units.** Dwelling or sleeping units are permitted to be heated using electric resistance appliances as long as the installed HVAC heating capacity in any separate space is not greater than specified in 2.1 through 2.3. Where a single dwelling unit includes multiple habitable spaces that are all heated with electric resistance heat, individual spaces are permitted have more electric resistance heating capacity than specified in 2.1 through 2.3, where the total electric resistance heating capacity for the dwelling unit is less than or equal to the total allowed.

2.1. Seven hundred fifty watts in Climate Zone 4, and 1000 watts in Climate Zone 5 in each habitable space with fenestration.

2.2. One thousand watts in Climate Zone 4, and 1300 watts in Climate Zone 5 for each habitable space that has two primary walls facing different cardinal directions, each with

exterior fenestration. Bay windows and other minor offsets are not considered primary walls.

2.3. Two hundred fifty watts in spaces adjoining the *building thermal envelope* but without fenestration.

For the purposes of this section, habitable space is as defined in the International Building Code. For buildings in locations with exterior design conditions below 4°F (-16°C), an additional 250 watts above that allowed for Climate Zone 5 is permitted in each space with fenestration.

11. **District energy.** Steam or hot water district energy systems that utilize fossil fuels as their primary source of heat energy, that serve multiple buildings, and that were already in existence prior to the effective date of this code, including more energy-efficient upgrades to such existing systems, are permitted to serve as the primary heating energy source. Any hydronic system served by fossil fuel-fired district energy shall be sized to provide all required space heating at Seattle design low outdoor temperature with maximum 120°F fluid, to permit future conversion to heat pump heating.

16. **DOAS ERV auxiliary heat.** Dedicated outdoor air systems with energy recovery ventilation are permitted to utilize ((fossil fuel for Climate Zone 5 or)) electric resistance ((in Climate Zone 4 or 5)) for auxiliary heating to preheat outdoor air for defrost or as auxiliary supplemental heat to temper supply air to 55°F (13°C) or lower for buildings or portions of buildings that do not have hydronic heating systems.

18. Standby equipment. Heating equipment provided in addition to that needed to maintain comfort temperatures, and controlled such that it will only be used when the primary heating equipment is not in use, is permitted to be electric resistance.

#### **C403.3.2. Clarification of how to reference new DOE equipment testing procedures.**

**C403.3.2 HVAC equipment performance requirements.** Equipment shall meet the minimum efficiency requirements of Tables C403.3.2(1) through C403.3.2 (16) when tested and rated in accordance with the applicable test procedure. After new equipment efficiency values including HSPF2, EER2, and SEER2 have been published by the US Department of Energy, equipment is permitted to meet those values in lieu of the table values. Plate-type liquid-to-liquid heat exchangers shall meet the minimum requirements of AHRI 400. The efficiency shall be verified through certification and listed under an *approved* certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

**Table C403.3.5.** Add clarification for R-2 dwelling units. From David Reddy: Dwelling & sleeping units are already required to have balanced ventilation with heat recovery, essentially meaning that they have a kind of DOAS. This change applies the DOAS rules to those buildings that use central or rooftop systems.

**Table C403.3.5**  
**Occupancy Classifications Requiring DOAS**

Occupancy Classification <sup>a</sup>	Inclusions	Exempted
A-1	All occupancies not specifically exempted	Television and radio studios
A-2	Casinos (gaming area)	All other A-2 occupancies
A-3	Lecture halls, community halls, exhibition halls, gymnasiums, courtrooms, libraries, places of religious worship	All other A-3 occupancies
A-4, A-5		All occupancies excluded
B	All occupancies not specifically exempted	Food processing establishments including commercial kitchens, restaurants, cafeterias; laboratories for testing and research; data processing facilities and telephone exchanges; air traffic control towers; animal hospitals, kennels, pounds; ambulatory care facilities
F, H, I, R, S, U		All occupancies excluded
R	R-occupancy spaces that are required to include energy recovery ventilation systems by Section C403.7.6	Dwelling and sleeping units served by energy recovery ventilation systems that serve only one dwelling or sleeping unit
E, M	All occupancies included	

a. Occupancy classification from the *International Building Code* Chapter 3.

**C403.3.5.2 DOAS fan power.** David Reddy proposal to reduce fan power.

**C403.3.5.2 DOAS fan power.** For a DOAS that does not have at least one fan or fan array with fan electrical input power  $\geq 1$  kW, the total combined fan power shall not exceed ~~((4)) 0.8~~ watts per cfm of outdoor air as calculated in accordance with Equation 4-10 using design maximum airflows and external static pressures. For a DOAS with at least one fan or fan array with fan electrical input power  $\geq 1$  kW, the DOAS shall comply with the fan power limitations of Section C403.8.1. DOAS total combined fan power shall include all supply, exhaust and other fans utilized for the purpose of ventilation. This fan power restriction applies to each DOAS in the permitted project, but does not include the fan power associated with the zonal heating and cooling equipment.

**(Equation 4-10)**

$$\text{DOAS Total Combined Fan Power} = \sum \left( \frac{\text{Fan bhp}}{\eta_m} \right) \times \frac{746}{\text{CFM}_{\text{supply}}}$$

Where:

Fan bhp	≡	Brake horsepower for each supply, exhaust and other fan in the system at design maximum airflow rate.
$\eta_m$	≡	Fan motor efficiency including all motor, drive and other losses for each fan in the system.
CFM <sub>supply</sub>	≡	Design maximum airflow rate of outdoor (supply) air.

**C403.7.6.1 HRV efficiency** (From CA code)

**C403.7.6.1 Ventilation for Group R-2 occupancy.** For all Group R-2 dwelling and sleeping units, a balanced ventilation system with heat recovery system with minimum ~~((60)) 67~~ percent sensible recovery effectiveness shall provide outdoor air directly to each habitable space in accordance with the *International Mechanical Code*. The ventilation system shall allow for the design flow rates to be tested and verified at each habitable space as part of the commissioning process in accordance with Section C408.2.2. The return/exhaust air stream temperature for heat recovery device selection shall be 70°F (21°C), or as calculated by the *registered design professional*.

**C403.8.4 Fractional HP fan efficiency.** With input from Mike Moore and David Reddy. HRV efficacy is latest CA code standard. Question: Is section highlighted in aqua still relevant? Also includes some related adjustments to **C405.8 Electric motor efficiency**.

**Fractional fan efficiency code language**

**C403.8.4 Low-capacity ventilation fans.** Mechanical ventilation system fans with motors less than 1/12-hp (0.062 kW) in capacity shall meet the efficacy requirements of Table C403.8.4 at one or more rating points. Airflow shall be tested in accordance with the test procedure referenced in Table C403.8.5 and listed. The airflow shall be reported in the product listing or shall be derived from the input power and airflow values reported in the product listing or on the label.

Commented [DJ1]: Question: Should this 1/12 hp cap be expanded to 1/2 hp to cover most equipment listed in HVI and Energy Star.

Commented [DJ2]: Is this still relevant?

EXCEPTIONS: 1. Where ventilation fans are a component of a listed heating or cooling appliance.

2. Dryer exhaust duct power ventilators and domestic range booster fans that operate intermittently.

3. Fans in radon mitigation systems.

4. Fans not covered within the scope of the test methods referenced in Table C403.8.5

5. Ceiling fans regulated under 10 CFR 430 Appendix U.

**Table C403.8.4  
Low-Capacity Ventilation Fan Efficacy**

<b>Fan Location System Type</b>	<b>Airflow Rate Minimum (cfm)</b>	<b>Minimum Efficacy (cfm/watt)</b>	<b>Minimum Static Pressure for Testing</b>	<b>Test Procedure</b>
Balanced ventilation system without heat or energy recovery	Any	1.2 <sup>a</sup>	0.2 inch w.c.	ASHRAE Standard 51 (ANSI/AMCA Standard 210)
HRV or ERV	Any	<del>(1.2)</del> 1.7 <sup>a</sup> cfm/watt	0.2 inch w.c.	CAN/CSA 439-18
Range hood	Any	2.8	0.1 inch w.c.	ASHRAE 51 (ANSI/AMCA Standard 210)
In-line supply or exhaust fan	Any	3.8	0.2 inch w.c.	
((Bathroom, utility room)) Other exhaust fan	<90	2.8	0.1 inch w.c.	
	>90 and <200	3.5	0.1 inch w.c.	
	>200	4.0	0.1 inch w.c.	

Commented [D33]: From CA code

For SI: 1 cfm/ft = 47.82 W.

<sup>a</sup> For balanced systems, HRVs, and ERVs, the efficacy shall be determined as the total airflow divided by the total fan power. ((Airflow shall be tested in accordance with HVI 916 and listed. Efficacy shall be listed or shall be derived from listed power and airflow. Fan efficacy for fully ducted HRV, ERV, balanced and in-line fans shall be determined at a static pressure not less than 0.2 inch w.c. Fan efficacy for ducted range hoods, bathroom, and utility room fans shall be determined at a static pressure not less than 0.1 inch w.c.))

Commented [D34]: Rather than "outdoor" airflow

**C405.8 Electric motor efficiency.** All electric motors, fractional or otherwise, shall meet the minimum efficiency requirements of Tables C405.8(1) through C405.8(4) when tested and rated in accordance with DOE 10 CFR. The efficiency shall be verified through certification under an approved certification program, or, where no certification program exists, the equipment efficiency rating shall be supported by data furnished by the motor manufacturer.

**Exception:** The standards in this section shall not apply to the following exempt electric motors:

1. Air-over electric motors.
2. Component sets of an electric motor.
3. Liquid-cooled electric motors.
4. Submersible electric motors.
5. Inverter-only electric motors.
6. Fan motors that are less than 1 hp and that comply with the efficacy requirements of Section C403.8.4.

**C405.8.1 Fractional horsepower fan motors.** Fractional hp fan motors that are 1/12 hp or greater and less than 1 hp (based on output power) which are not covered by Tables C405.8(3) and C405.8(4) shall be electronically commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with DOE 10 CFR 431. These motors shall also have the means to adjust motor speed for either

balancing or remote control. Belt-driven fans may use sheave adjustment for airflow balancing in lieu of a varying motor speed.

**Exceptions:**

1. Motors that are an integral part of specialized process equipment.
2. Where the motor is integral to a listed piece of equipment for which no complying motor has been approved.
3. Motors used as a component of the equipment meeting the minimum efficiency requirements of Section C403.3.2 and Tables C403.3.2(1) through ((C403.3.2(12))) C403.3.2(13), provided that the motor input is included when determining the equipment efficiency.
4. Motors in the airstream within fan coils and terminal units that operate only when providing heating to the space served.
5. Fan **motors that are less than 1 hp and that comply with the requirements of Section C403.8.4**, ~~not covered by Tables C405.8(1) through C405.8(4) and are used to power heat recovery ventilators, energy recovery ventilators, or local exhaust fans in Group R subject to the efficacy requirements of Section C403.8.4.~~
6. Domestic clothes dryer booster fans, range hood exhaust fans, and domestic range booster fans that operate intermittently.
7. Radon and contaminated soil exhaust fans.
8. ~~Group R heat recovery ventilator and energy recovery ventilator fans that are less than 400 cfm.~~

**Add new standards as follows:**

CSA  
CSA Group  
8501 East Pleasant Valley Road  
Cleveland OH 44131-5516  
CAN/CSA-C439-18. Laboratory methods of test for rating the performance of heat/energy-recovery ventilators

ASHRAE  
180 Technology Parkway NW  
Peachtree Corners, GA 30092  
ASHRAE Standard 51 (ANSI/AMCA Standard 210). Laboratory Methods of Testing Fans For Certified Aerodynamic Performance Rating

**C403.8.7 Occupied Standby Controls** Originally from 2024 IECC proposal CEPI 108, modified extensively for Seattle code with input from Rushing and AEI.

**Add new definition:**

**OCCUPIED-STANDBY MODE.** Mode of operation when an HVAC zone is scheduled to be occupied and an occupant sensor indicates no occupants are within the zone.

**Revise as follows:**

**C403.7 Ventilation and exhaust systems.**

In addition to other requirements of Section C403 applicable to the provision of ventilation air or the exhaust of air, ventilation and exhaust systems shall be in accordance with Sections C403.7.1 through C403.7.8. **and Section C403.8.7.**

**Add new text as follows:**

**C403.8.7 Occupied standby controls.**

Occupied standby controls in compliance with C403.8.7.1 and C403.8.7.2 are required for zones and systems serving zones where no less than 90 percent of the floor area of the zone consists of use types including those listed below and other space types with similar use and occupancy, and none of the spaces within the zone are required by the International Mechanical Code to have ventilation airflow greater than zero when unoccupied.

1. Classroom/lecture/training rooms
2. Conference/meeting/multipurpose rooms
3. Lounges and breakrooms
4. Enclosed offices/open office areas/reception areas/lobbies
5. Assembly areas
6. Library stacks
7. Restrooms, storage rooms, locker rooms serving the above spaces
6. Corridors, stairways, and circulation spaces serving the above spaces

**C403.8.7.1 Occupied standby zone controls.** For zones required to provide occupied-standby controls, within 5 minutes of all spaces in that zone entering *occupied-standby mode*, the zone control shall operate as follows:

1. Active heating set point shall be setback at least 1°F (0.5°C).
2. Active cooling set point shall be setup at least 1°F (0.5°C).
3. Airflow supplied to the zone shall be controlled as follows, depending on system type:
  - 3.1 Spaces that are required to have occupancy sensors in accordance with Section C403.7.2 are required to shut off the outdoor airflow in accordance with that section.
  - 3.2 Small dedicated outdoor air systems (DOAS) that serve multiple heating and cooling system zones without automatic zone control dampers are not required to shut off the DOAS supply airflow by zone. A system is considered a small DOAS when:
    - a. the area served is no greater than 25,000 square feet (2323 m<sup>2</sup>) of conditioned floor area, and;
    - b. the DOAS does not serve more than one floor.
  - 3.3 Other dedicated outdoor air systems (DOAS) that serve multiple heating and cooling system zones without automatic zone control dampers are required to shut off the DOAS supply airflow when all the zones on any one floor or in any one area up to 25,000 square feet enter *occupied-standby mode*. The maximum zone sizes for DOAS supply airflow shutoff are as follows:
    - a. 25,000 square feet (2323 m<sup>2</sup>) of conditioned floor area, or;
    - b. not more than one floor.
  - 3.4 For systems other than those identified in 3.2 and 3.3 above, all airflow (outdoor airflow and supply airflow) supplied to the zone shall be shut off whenever the space temperature is between the active heating and cooling set points.



**Exception:** Airflow (outdoor airflow and supply airflow) for *replacement air* or makeup air is permitted to be supplied during *occupied-standby mode* for any of the space types identified in 3.1 through 3.4 above.

**C403.8.7.2 Occupied standby system controls.** Multiple zone systems that are capable of *automatically resetting or that are required in accordance with Section C403.6.10 to reset the effective minimum outdoor air setpoint and that serve zones with occupied-standby zone controls shall reset the effective minimum outdoor air setpoint based on a zone outdoor air requirement of zero for all zones in occupied-standby mode. Sequences of operation for system outside air reset shall comply with an approved method.*

**Exception:** Airflow (outdoor airflow and supply airflow) for *replacement air* or makeup air is permitted to be supplied during *occupied-standby mode*.

**C403.12 Single zone VAV Remove reference to gas boilers for clarity.**

7. Single-zone VAV systems shall comply with one of the following options:

7.1. Single-zone VAV air handling units with a hydronic heating coil connected to systems with hot water generation equipment limited to the following types of equipment: ((Gas-fired hydronic boilers with a thermal efficiency,  $E_{th}$ , of not less than 92 percent,)) air-to-water heat pumps or heat recovery chillers. Hydronic heating coils shall be sized for a maximum entering hot water temperature of 120°F for peak anticipated heating load conditions.

**C403.15 Clean water pumps.** Pump efficiency standard from 2024 IECC proposal CEPI-83. Also, new Hydraulic Institute ER rating, suggested by NEEA, Kevin Rose & Nicole Dunbar.

**C403.15 Clean water pumps.**

*Clean water pumps* meeting all the following criteria shall achieve a ((PEI)) *Pump Energy Index (PEI)* rating not greater than 1.0 and a *Hydraulic Institute Energy Rating (ER)* greater than zero:

1. Shaft input power is greater than or equal to 1.0 hp (0.75 kW) and less than or equal to 200 hp (149.1 kW) at its BEP.
2. Designated as either an End Suction Close-coupled, End Suction Frame Mounted, In-line, Radially Split Vertical, or Submersible Turbine pump.
3. A flow rate of 25 gal/min (1.58 L/s) or greater at its best efficiency point (BEP) at full impeller diameter
4. Maximum head of 459 ft at its BEP at full impeller diameter and the number of stages required for testing
5. Design temperature range from 14°F (-10°C) to 248°F (120°C)

6. Designed to operate with either:
  - 6.1. a 2- or 4-pole induction motor, or
  - 6.2. a non-induction motor with a speed of rotation operating range that includes speeds of rotation between 2880 and 4320 rpm and/or 1440 and 2160 rpm, and
  - 6.3. in either (1) or (2), the driver and impeller must rotate at the same speed
7. For submersible turbine pumps, a 6 inch (152 mm) or smaller bowl diameter
8. For end-suction close-coupled pumps and end-suction frame-mounted/own bearings pumps, specific speed less than or equal to 5000 rpm when calculated using U.S. customary units

**Exceptions:** The following pumps are exempt from these requirements:

1. Fire pumps
2. Self-priming pumps
3. Prime-assisted pumps
4. Magnet-driven pumps
5. Pumps designed to be used in a nuclear facility subject to 10 CFR 50, "Domestic Licensing of Production and Utilization Facilities."
6. Pumps meeting the design and construction requirements set forth in U.S. Military Specification MIL P 17639F, "Pumps, Centrifugal, Miscellaneous Service, Naval Shipboard Use" (as amended); MIL P 17881D, "Pumps, Centrifugal, Boiler Feed, (Multi-Stage)" (as amended); MIL P 17840C, "Pumps, Centrifugal, Close-Coupled, Navy Standard (For Surface Ship Application)" (as amended); MIL P 18682D, "Pump, Centrifugal, Main Condenser Circulating, Naval Shipboard" (as amended); MIL P 18472G, "Pumps, Centrifugal, Condensate, Feed Booster, Waste Heat Boiler, And Distilling Plant" (as amended).

**Commented [DJ5]:** We can eliminate these, right? We're not building nuclear facilities and military work is not subject to Seattle code

**BEST EFFICIENCY POINT (BEP).** The pump hydraulic power operating point (consisting of both flow and head conditions) that results in the maximum efficiency.

**CLEAN WATER PUMP.** A device that is designed for use in pumping water with a maximum nonabsorbent free solid content of 0.016 lb/ft<sup>3</sup> (0.256 kg/m<sup>3</sup>) and with a maximum dissolved solid content of 3.1 lb/ft<sup>3</sup> (49.66 kg/m<sup>3</sup>), provided that the total gas content of the water does not exceed the saturation volume, and disregarding any additives necessary to prevent the water from freezing at a minimum of 14°F (-10°C).

**PUMP ENERGY INDEX (PEI).** The ratio of a pump's energy rating divided by the energy rating of a minimally compliant pump. For pumps with the constant load operating mode, the relevant PEI is PEI<sub>CL</sub>. For pumps with the variable load operating mode, the relevant PEI is PEI<sub>VL</sub>.

**Table C404.3.1 Piping Volume and Maximum Piping Lengths.** We currently allow ½" and 5/8" pipe between the circulating loop and a "public lavatory" to be 8 feet long. Should we extend that to include 3/8" pipe? (I believe that 3/8" is permitted if serving only a single fixture.)

**Table C404.3.1**  
**Piping Volume and Maximum Piping Lengths**

Nominal Pipe Size (inches)	Volume (liquid ounces per foot length)	Maximum Piping Length (feet)	
		Public lavatory faucets	Other fixtures and appliances
1/4	0.33	6	50
5/16	0.5	4	50
<b>3/8</b>	<b>0.75</b>	<b>3 (8)</b>	50
1/2	1.5	((2)) 8	43
5/8	2	((4)) 8	32
3/4	3	0.5	21
7/8	4	0.5	16
1	5	0.5	13
1 1/4	8	0.5	8
1 1/2	11	0.5	6
2 or larger	18	0.5	4

**C404.6 Pipe insulation.** Remove some irrelevant information, clarify “vertical support” exception, and clarify for tubular insulation that you can’t get out of our pipe insulation requirements just because a manufacturer recommends thinner insulation. New Table C404.6 to make more readable, consolidating hot water pipe insulation thickness requirements in one place, instead of having to go back to a table in C403 and its footnotes.

**C404.6 Insulation of piping.** Piping from a water heater to the termination of the heated water fixture supply pipe shall be insulated in accordance with Table ~~((C403.10.3))~~ C404.6. On both the inlet and outlet piping of a storage water heater or heated water storage tank, the piping to a heat trap or the first 8 feet (2438 mm) of piping, whichever is less, shall be insulated. Piping that is heat traced shall be insulated in accordance with Table ~~((C403.10.3))~~ C404.6 or the heat trace manufacturer's instructions. Tubular pipe insulation shall be installed in accordance with the insulation manufacturer's instructions, **whichever results in thicker insulation.**

EXCEPTION: Tubular pipe insulation shall not be required on the following:

1. The tubing from the connection at the termination of the fixture supply piping to a plumbing fixture or plumbing appliance.
2. Valves, pumps, strainers and threaded unions in piping that is 1 inch (25 mm) or less in nominal diameter.
3. Piping from user-controlled shower and bath mixing valves to the water outlets.
4. ~~((Cold water piping of a demand recirculation water system.))~~
5. Tubing from a hot drinking-water heating unit to the water outlet.
6. ~~((Piping at))~~ **Vertical pipe riser** locations where a vertical support of the piping is installed.
7. ~~((Piping surrounded by building insulation with a thermal resistance (R-value) of not less than R-3.))~~
8. Hot water piping that is part of the final pipe run to the plumbing fixture and is not part of the heated-water circulation system circulation path is not required to meet the minimum insulation requirements of Section C404.6.

**Table C404.6**

**Required Pipe Insulation Thickness for Service Water Heating**

Location	Water Temp	Nominal Pipe or Tube Size					Insulation Conductivity	
		< 1"	1 to < 1-1/2	1-1/2 to < 4	4 to < 8	8 or larger	Conductivity Btu • in. / (h • ft <sup>2</sup> • °F) <sup>b</sup>	Mean Rating Temp. °F
Circulation	105 – 140°F	2.0	2.0	2.5	2.5	2.5	0.21 - 0.28	100
Loop Piping not in-partition	141 – 200°F	2.5	2.5	3.0	3.0	3.0	0.25 - 0.29	125
All other piping not in-partition	105 – 140°F	1.0	1.0	1.5	1.5	1.5	0.21 - 0.28	100
	141 – 200°F	1.5	1.5	2.0	2.0	2.0	0.25 - 0.29	125
In-partition <sup>a</sup>	105 – 140°F	1.0	1.0	1.5	1.5	1.5	0.21 - 0.28	100
Circulation	141 – 200°F	1.5	1.5	2.0	2.0	2.0	0.25 - 0.29	125
Loop Piping < 1-1/2 inch								
In-partition <sup>a</sup>	105 – 140°F	1.0	1.0	1.0	1.0	1.0	0.21 - 0.28	100
All other piping < 1-1/2 inch	141 – 200°F	1.0	1.0	1.0	1.0	1.0	0.25 - 0.29	125

- a. In a partition within a conditioned space, for piping smaller than 1-1/2 inch
- b. For insulation outside the stated conductivity range, conform to requirements of Table C403.10.1

**C404.7.1.2 Multiple riser SHW circulation.** Clarifies the phrase “extended periods” and exempts Group R and Group I occupancies from the automatic shutdown requirement. Improved wording on item #4 and exception from David Reddy.

**C404.7.1.2 Multiple riser systems.** Where the circulation system serves multiple domestic hot water risers or piping zones, the following **equipment and** controls shall be provided:

1. Controls shall be configured to automatically turn off the circulation pump during **((extended))** periods **of time exceeding 4 hours** when hot water is not required.

2. System shall include means for balancing the flow rate through each individual hot water supply riser or piping zone.

3. ~~For circulation systems that use a variable flow circulation pump, each~~ **Each** riser and piping zone shall have a self-actuating thermostatic balancing valve.

4. **A variable speed circulation pump that automatically adjusts speed to reduce flow to maintain a constant pressure or recirculation return temperature.**

**EXCEPTION:** Multiple riser systems serving Group R and Group I occupancies are not required to have controls that automatically turn off the circulation pump.