[Note: New definitions to add]

TEMPERATURE MAINTENANCE: The system used to maintain the temperature of the building domestic hot water delivery system, typically by circulation and reheating or by a heat trace system.

SINGLE-PASS: A heat pump water heater control strategy using variable flow or variable capacity to deliver water from the heat pump at the final target storage water temperature in a single pass through the heat exchanger with variable incoming water temperatures.

MULTI-PASS: A heat pump water heater control strategy requiring multiple passes of water through the heat pump to reach the final target storage water temperature.

[Note: Strike all of Section C404.2.1 and C404.2.2 and replace with the new language below.]

C404.2.1 Service water heating system type. Service water heating equipment shall not use fossil fuel combustion or electric resistance. Service hot water shall be provided by an air-source heat pump water heating (HPWH) system meeting the requirements of this section, or a ground-source heat pump water heating (GSHP) system. Supplemental service water heating equipment is permitted to use electric resistance in compliance with Section C404.2.1.4.

Exceptions:

1. 24kW plus 0.1W/SF of building area of stand-alone electric resistance water heating capacity is allowed per building.

2. Solar thermal, wastewater heat recovery, other *approved* waste heat recovery, ground source heat pumps, water-source heat pump systems utilizing waste heat, and combinations thereof, are permitted to offset all or any portion of the required HPWH capacity where such systems comply with this code and the Uniform Plumbing Code.

3. Systems meeting the requirements of the Northwest Energy Efficiency Alliance (NEEA) Commercial Electric “Advanced Water Heating Specification” v8.0 or more recent.

4. Unitary heat pump water heaters located in conditioned space are permitted, where they are sized to meet all calculated service water heating demand using the heat pump compressor, and not supplementary heat.

5. Steam or hot water district energy systems that utilize fossil fuels as their primary source of heating 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. Hydronic equipment installed must be sized for a supply water temperature of 120°F or less.

6. Commercial dishwashers, commercial food service equipment, and other approved process equipment are permitted to utilize electric booster heaters for supply water temperatures 120°F or higher.

C404.2.1.1 Primary heat pump system sizing. The system shall include a primary service minimum output at 40°F dry bulb or wet bulb outdoor air temperature for air-source heat pumps, or 40°F ground temperature for ground-source heat pumps that provides sufficient hot water as calculated using the equipment manufacturer's selection criteria or another *approved* methodology. Air source heat pumps shall be sized to deliver no less than 50 percent of the calculated demand for hot water production during the peak demand period when entering air temperature is 24°F.

Exception: 50 percent sizing at 24°F is not required for heat pumps located in a below-grade enclosed parking structure or other ventilated and unconditioned space that is not anticipated to fall below 40°F at any time.

C404.2.1.2 Primary hot water storage sizing. The system shall provide sufficient hot water to satisfy peak demand period requirements.

C404.2.1.3 System design. The service water heating system shall be configured to conform to one of the following provisions:

1. For *single-pass* HPWHs, *temperature maintenance* heating provided for reheating return water from the building's heated water circulation system shall be physically decoupled from the primary service water heating system storage tank(s) in a manner that prevents destratification of the primary system storage tanks. *Temperature maintenance* heating is permitted to be provided by electric resistance or a separate dedicated heat pump system.

2. For *multi-pass* HPWHs, *recirculated temperature* maintenance water is permitted to be returned to the primary water storage tanks for reheating.

C404.2.1.3.1 Mixing valve. A thermostatic mixing valve capable of supplying hot water to the building at the user temperature set point shall be provided, in compliance with requirements of the Uniform Plumbing Code and the HPWH manufacturer's installation guidelines. The mixing valve shall be sized and rated to deliver tempered water in a range from the minimum flow of the *temperature maintenance* recirculation system up to the maximum demand for the fixtures served.

C404.2.1.4 Supplemental water heating. Total supplemental electric resistance water heating equipment shall not have an output capacity greater than the primary water heating equipment at 40°F entering air temperature. Supplemental electric resistance heating is permitted for the following uses:

1. *Temperature maintenance* of heated-water circulation systems, physically separate from the primary service water heating system. *Temperature maintenance* heating capacity shall be no greater than the primary water heating capacity at 40°F.

2. Defrost of compressor coils.

3. Heat tracing of piping for freeze protection or for *temperature maintenance* in lieu of recirculation of hot water.

4. Backup or low ambient temperature conditions, where all of the following are true:

a. The supplemental heating capacity is no greater than the primary service water heating capacity at 40°F.

b. During normal operations the supplemental heating is controlled to operate only when the entering air temperature at the air-source HPWH is below 40°F, and the primary HPWH compressor continues to operate together with the supplemental heating when the entering air temperature is between 17°F and 40°F.

c. The primary water heating equipment cannot satisfy the system load due to equipment failure or entering air temperature below 40°F.

C404.2.1.5 Alarms. The control system shall be capable of and configured to send automatic error alarms to building or maintenance personnel upon detection of equipment faults, low leaving water temperature from primary storage tanks, or low hot water supply delivery temperature to building distribution system.

TABLE C406.1

EFFICIENCY PACKAGE CREDITS

Code Section	Commercial Building Occupancy					
	Group R-1	Group R-2	Group B	Group E	Group M	All Other
	Additional Efficiency Credits					
~~8. High-efficiency service water heating in accordance with Sections C406.8.1 and C406.8.2~~	~~4.0~~	~~5.0~~	~~NA~~	~~NA~~	~~NA~~	~~8.0~~

9. High performance service water heating in ((~~multi-family~~)) buildings in accordance with Section C406.9	~~7.0~~ 5.0	~~8.0~~ 5.0	~~NA~~ 3.0[7] Lab Only	~~NA~~ ??	~~NA~~ ??	~~NA~~ 3.0[6]

[…additional footnotes 6 & 7 for Group B and "All Other"]

6. Buildings, building additions, building areas, occupancy types, or tenant spaces with a service hot water load of 10 percent or more of total building energy loads, as demonstrated through an energy analysis complying with Section C407, or a minimum service water energy use of 15,000 Btu per square foot per year, as demonstrated through an alternate service hot water load calculation method approved by the code official, are permitted to apply this credit.

7. In Group B occupancies, the high-performance service water heating credit applies only to research and production laboratory spaces, and adjacent circulation serving those laboratory spaces, but not to associated office or other space uses.

C406.8.2 Load fraction. Not less than 60 percent of the annual service hot water heating energy use, or not less than 100 percent of the annual service hot water heating energy use in buildings with water-cooled systems subject to the requirements of Section C403.9.5 or qualifying for one of its exceptions, shall be provided by one or more of the following:

~~1. Service hot water system delivering heating requirements using heat pump technology with a minimum COP of 3.0. For air-source equipment, the COP rating will be reported at the design leaving heat pump water temperature with an entering air temperature of 60°F (15.6°C) or lower. For water-source equipment, the COP rating will be reported at the design leaving load water temperature with an entering water temperature of 74°F (23.3°C) or lower.~~

1.~~2.~~ Waste heat recovery from service hot water, heat recovery chillers, building equipment, process equipment, or other approved system. Qualifying heat recovery must be above and beyond heat recovery required by other sections of this code.

2.~~3.~~ On site renewable energy water-heating systems.

C406.9 High performance service water heating ~~in multifamily buildings~~. For a whole building, building addition, or tenant space ~~with not less than 90 percent of the conditioned floor area being Group R-2 occupancy~~, not less than 90 percent of the annual building service hot water energy use shall be provided by a heat pump system ~~with a minimum COP of 3.0. This efficiency package is allowed be taken in addition to Section C406.8.2.~~ meeting the requirements of Section C404.2.1 plus the following:

1. The refrigerant used in the heat pump system shall have a global warming potential (GWP) no greater than 675.

2. No electric resistance primary or supplementary heating capacity shall be provided.

Exceptions to item 2.

1. Electric resistance heating is permitted for circulating system *temperature maintenance* and heat tracing of service hot water supply and return piping.

C404.7 Heated-water circulating and heat trace temperature maintenance systems. Heated-water circulation systems for *temperature maintenance* shall be in accordance with Section C404.7.1. Electric resistance heat trace ~~*temperature maintenance*~~ systems for *temperature maintenance* shall be in accordance with Section C404.7.2. Controls for hot water storage shall be in accordance with Section C404.7.3. Automatic controls, temperature sensors and pumps shall be in a location with access. Manual controls shall be in a location with ready access.

C503.5 Service ~~hot~~ water heating systems. New service ~~hot~~ water heating systems and equipment, or existing systems and equipment that are altered or replaced, ((~~that are part of the alteration~~)) shall comply with Section C404.

Exceptions:

1. Like-for-like replacement of a single electric resistance or fuel-fired service water heating appliance with the same or higher efficiency is permitted where the existing appliance is failing, requires immediate replacement, and where no other alterations are made to the service water heating system.

2. Alternate service water heating system designs that are not in full compliance with this code may be approved when the code official determines that existing building constraints including, but not limited to, available floor space or ceiling height, limitations of the existing structure, or electrical service capacity make full compliance impractical. Alternate designs shall include additional energy saving strategies not prescriptively required by this code for the scope of the project.

Add reference to Chapter 6:

NEEA

Northwest Energy Efficiency Alliance
700 NE Multnomah Street
Suite 1300
Portland, Oregon 97232

Standard reference number	Title	Referenced in code section number
Version 8.0 or later	Commercial Electric Advanced Water Heating Specification	C404.2.3