PPI RECOMMENDATION E

Recommendation Against Mixing Hydronic Heating Water with Potable Water in Combined Systems

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Hydronic radiant heating is a comfortable and efficient technology for a wide range of buildings, from residential applications to large commercial and industrial facilities. In most projects, it is possible to meet the heat loss of buildings through a heated floor using relatively low-temperature heated fluid, often under 120˚F (48˚C), even at design load (i.e., peak demand).

This gives radiant heating systems the flexibility to work with a wide variety of high-efficiency heat sources, such as low-temperature condensing boilers, geothermal water-to-water heat pumps, air-to-water heat pumps, and solar thermal collection systems.

In certain cases, especially with low-load hydronic radiant heating distribution systems, domestic water heaters have been used as the source of warm water, subject to local code requirements. Typical applications of this type of heat source include special dual-purpose water heaters which are intended to supply both hydronic space heating and hot domestic water and designed so that the heating water and the domestic water do not mix. These domestic hot water (DHW) heaters are sometimes described as "combi" or "segregated" and they typically utilize an internal heat exchanger to prevent mixing of the potable water with the hydronic heating water.

When combined hydronic and potable systems are constructed whereby the potable water travels through hydronic heating distribution units (e.g., fan coils, radiators, radiant piping layouts) and components such as valves, circulators, or manifolds, potential health and safety issues may be created. These potential issues include:

- Drinking water safety
- *Legionella* and biofilms
- Corrosion and equipment life

It is the recommendation of the Plastics Pipe Institute that combined potable-hydronic systems, where the mixing of hydronic water with potable water may occur, should be avoided. See below for details.

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1. **Drinking Water Safety**

The US *Reduction of Lead in Drinking Water Act (RLDWA)*[1] took effect in 2014, greatly restricting the amount of lead allowed in alloys which contact potable water. Now, components which contact potable water must be certified to standards such as NSF/ANSI Standard 372 *Drinking Water System Components – Lead Content.*

Similarly, plumbing components must be tested and certified to NSF/ANSI/CAN Standard 61 *Drinking Water Components - Health Effects*[2] to ensure they are safe for drinking water. See www.nsf.org for more information on these standards.

Some hydronic heating components are not intended or certified to be used for potable water. Examples include certain radiators, pipes, fan coils, fittings, balancing or mixing valves, and distribution manifolds. Such items aren't necessarily marked as "Non-Potable"; the **absence** of a "Potable Water" or "PW" mark may be the only clue that these components are not suitable for contact with potable water.

Therefore, if these components are installed so that domestic water flows through them and then returns to a potable water outlet, this type of installation may violate regulations regarding the approval of components for drinking water safety, or regulations requiring so-called lead-free components intended to contact potable water, or both, and may contaminate drinking water.

2. **Legionella and Biofilms**

According to the CDC, Legionnaire's Disease[3], a type of severe pneumonia, is caused by breathing in small droplets of water that contain *Legionella*[4].

Legionella has been a topic of much research in recent years, with experts in the public health and plumbing fields focusing on piping designs that eliminate dead-legs and stagnant water.

[1] Congress enacted the Reduction of Lead in Drinking Water Act on January 4, 2011, to amend Section 1417 of the Safe Drinking Water Act (SDWA) regarding the use and introduction into commerce of lead pipes, plumbing fittings or fixtures, solder and flux. The Act became effective on January 4, 2014.
[2] Water treatment or distribution products in North America are required to comply with NSF/ANSI/CAN Standard 61: Drinking Water System Components – Health Effects by most government agencies that regulate drinking water supplies. Developed by a team of scientists, industry experts, and key industry stakeholders, NSF/ANSI/CAN 61 sets health effects criteria for many water system components.
[3] Legionnaires' disease is a severe, often lethal, form of pneumonia. It's caused by the bacterium *Legionella* pneumophila found in both potable and non-potable water systems. The disease was named in 1976, when American Legion members who attended a Philadelphia convention, suffered from an unusual pneumonia (lung infection)
[4] https://www.cdc.gov/legionella/downloads/fs-legionnaires.pdf CDC "Legionnaires Disease"

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Research indicates that bacterium *Legionella* pneumophila can grow in water between 68°F and 120°F (20°C to 48°C), with an ideal growth range of 85°F to 110°F (29°C to 43°C).

In a typical residential plumbing system, with 200 to 300 feet of hot-water piping, disinfectants in treated water can control the growth of *Legionella*. Hot water is normally delivered to outlets quickly, and the age of the water is not a concern, even though drinking water disinfectants can dissipate quickly after being exposed to heat, such as in a water heater. Some level of disinfectant normally remains until water is delivered to a fixture.

However, if the plumbing system is connected to a hydronic distribution system, such as a radiant heating system, this can lead to a large volume of water. Over time, this water could contain little to no disinfectant at the ideal temperature range for *Legionella* growth. When the heating system turns off, there could be a significant volume of warm stagnant water sitting in pipes, fan coils, and other hydronic components. When the heating system turns on due to a call for heat, that stagnant water will re-enter the domestic hot water heater, and then travel through the plumbing distribution system to an outlet.

Water becomes aerosolized (i.e., droplets and vapor) in a shower or near an aerated faucet and is easy to inhale. This is a potentially dangerous situation for people who are susceptible to this type of bacteria, as this can allow *Legionella* to enter the lungs.

During periods of inactivity (e.g., summer), the water in heating components might be stagnant for weeks or months. Although the water is at or near ambient room temperature, and *Legionella* will grow more slowly, it does not die. Further, stagnant water has been shown to allow the growth of biofilms inside piping components and appurtenances.

To help prevent this, some codes require a means to prevent the stagnation of hydronic water by cycling or flushing the contents at least every 24 hours, such as with a timed circulator. However, if the timer used to activate this circulator fails or is deactivated, or if certain zone valves remain closed, complete flushing doesn't occur.

Studies show that flushing with hot water to effectively kill *Legionella* requires a temperature above 160°F (71°C)[5] throughout an entire piping network; at lower temperatures, some bacteria can remain protected inside biofilms. However, supplying water at this temperature through radiant tubing embedded in concrete

[5] https://www.epa.gov/sites/default/files/2016-09/documents/legionella_document_master_september_2016_final.pdf EPA 2016 "Technologies for Legionella control in Premise Plumbing Systems: Scientific Literature Review"

may damage both concrete and flooring, so this is not a recommended procedure. Also, setting a water heater to a temperature above 130°F (54°C), even during short time periods, can create very hazardous conditions to building occupants due to the risk of scalding[6].

In recognition of the potential risk of creating an environment promoting the growth of pathogens in a combined potable-hydronic system, the 2021 edition of CSA B214 *Installation Code for Hydronic Heating Systems*[7] added new restrictions on the use of combined systems, limiting the total length of the hydronic piping network to 50 ft (15 m), the total volume of water in the hydronic system to 13.1 US Gallons (50 l), and the minimum supply temperature to the hydronic system of 140°F (60°C).

3. **Corrosion and Equipment Life**

   Fresh potable water typically contains dissolved oxygen and disinfectants such as chlorine or chloramines. Some hydronic components can be corroded or otherwise damaged by contact with these substances.

   For example, an iron-body circulator that is intended for a closed-loop hydronic system, but is actually installed in an open-loop combined system, could rust when exposed to fresh water; an elastomeric valve seal or gasket could be attacked by chloramines in the water, and eventually leak; or plastic tubing that is certified for hydronics but not for potable water might not be compatible with hot chlorinated water and might fail prematurely.

Therefore, it is the recommendation of the Plastics Pipe Institute that combined potable-hydronic systems, where the mixing of hydronic water with potable water may occur, should be avoided. Potential heat sources for small hydronic heating systems include segregated dual-purpose water heaters with internal heat exchangers, or the use of external heat exchangers to separate the potable water from the hydronic water.

[6] https://scaldprevention.org/ Information Provided by Ron George, CPD
[7] https://www.csagroup.org/store/product/CSA%20B214%3A21/ CSA B214:21 "Installation code for hydronic heating systems"

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