Getting the Pressure Right

Proper PRV Settings and Expansion Tank Pre-Charge in Hydronic Systems

George R. Carey, Jr.
VP, Fluid Industrial Associates
gcarey@fiainc.com
@Ask_GCarey

In closed-loop hydronic heating systems, pressure stability is everything. It affects heat delivery, system efficiency, component life and overall reliability. Two components sit at the heart of this balance: the pressure reducing valve (PRV) and the diaphragm expansion tank. While both are simple devices in concept, their proper setup is often overlooked, leading to many of the common issues seen in the field. When correctly matched and adjusted, however, they provide a stable, quiet and trouble-free system.

The pressure reducing valve serves as the system's automatic fill regulator. It takes incoming domestic water-typically at pressures higher than the heating system requires—and reduces it to a controlled level. This establishes the system's cold fill pressure, which is the baseline pressure when the system is not actively heating. For most residential applications, this setting is typically 12 psi, a value that has become a standard because it satisfies the needs of a typical two-story home.

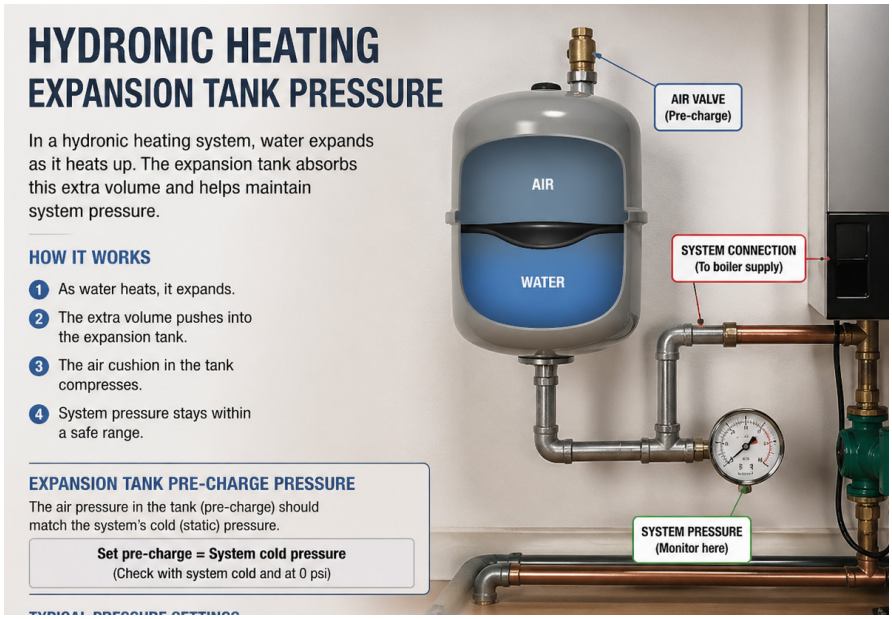
The reasoning behind this number is grounded in basic physics. Water requires approximately 0.433 psi per foot of vertical lift. In a system where the highest heat emitter sits 20 feet above the boiler, it takes just under 9 psi to reach that point. Adding a safety margin of several pounds ensures positive pressure throughout the system and helps prevent air from being drawn in. This brings the ideal cold fill pressure into the 12 to 14 psi range. Taller structures or systems with greater elevation differences will require higher settings, often between 18 to 20 psi.

Improper PRV settings can quickly create operational problems. If the pressure is set too low, water may not reach the upper portions of the system, resulting in poor heat delivery and the potential for air accumulation. Circulators operating under these conditions may become noisy due to cavitation. Conversely, if the pressure is set too high, the system will experience excessive pressure as it heats, often leading to discharge from the relief valve. This not only wastes water but also introduces fresh oxygen into the system, accelerating corrosion and component wear.

Complementing the PRV is the diaphragm expansion tank, which manages the natural expansion of water as it is heated. In a closed system, water has no place to expand unless space is provided. The expansion tank creates this space using a flexible diaphragm that separates system water from a pocket of compressed air. As the water temperature rises and its volume increases, it pushes against the diaphragm, compressing the air and absorbing the expansion. This action keeps the system pressure within a safe and predictable range.

The effectiveness of the expansion tank depends heavily on its pre-charge pressure. This is the air pressure inside the tank before it is subjected to system pressure, and it must be set correctly for the tank to function as intended. The key principle is simple but critical: The expansion tank pre-charge should match the system's cold fill pressure as set by the PRV. For example, a system filled to 12 psi should have the expansion tank pre-charged to 12 psi.

When these pressures are matched, the diaphragm remains in a neutral position at startup, allowing the tank to immediately accept expanded water as the system heats. If the pre-charge is too low, the tank begins partially filled with water, leaving less room for



expansion and causing pressure to rise rapidly during operation. This often results in relief valve discharge and unnecessary system stress. If the pre-charge is too high, water has difficulty entering the tank, effectively rendering it inactive. In this case, the system behaves as though no expansion tank is present, leading to erratic pressure swings and potential damage.

Properly setting the expansion tank pre-charge requires isolating the tank or reducing the system to zero before making adjustments. The air pressure is then measured at the Schrader valve using a standard gauge and adjusted as needed. Once the pre-charge matches the desired cold fill pressure, the tank can be returned to service and the system refilled.

When both the PRV and expansion tank are correctly set, the system operates smoothly and predictably. The cold fill pressure establishes a stable baseline, and as the system heats, pressure rises gradually-typically remaining below the relief valve setting. The expansion tank absorbs the increased volume without sharp pressure fluctuations, ensuring consistent performance and long-term reliability.

Ultimately, proper pressure management is one of the simplest yet most impactful aspects of hydronic system design and maintenance. Taking the time to correctly set both the pressure reducing valve and the expansion tank pre-charge eliminates a wide range of common problems before they start. For technicians, it represents a small step that delivers significant returns in performance, reliability and customer satisfaction.

Questions or comments, e-mail me at *gcarey@fiainc.com*, call me at (800) 423-7187 or follow me on Twitter at @Ask_Gcarey. **ICM**

Dear Readers,

I would like to take a moment to announce that I will be retiring after 32 years from Fluid Industrial Associates (FIA) at the end of June.

I want to thank publisher Don Farrell for providing me the opportunity to contribute to Indoor Comfort Marketing *magazine for the last 26 years. It has truly been an honor and a privilege to be a part of this community of industry professionals who care deeply for independent energy providers.*

When Dan Holohan decided it was time to step down from writing his monthly column for Oilheating *(the name of the magazine at the time), he suggested to then-editor Paul Geiger to give me a chance.*

My first column appeared in the May 2000 issue and it has been a great journey over the past 26 years. A special Thank You *to all who took the time to read my column over the years, I have appreciated that very much!*

Thank you,
George R Carey Jr. .

Publishers Note: It has been a great pleasure to share George's expertise with the industry for all these years. His knowledge and professionalism will be sorely missed. *D. Farrell*