Expansion Vessels — Precharge, Acceptance Volume and Sizing That Prevents Dripping Relief Valves

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What a diaphragm expansion vessel actually does in a closed loop, the precharge rule (just below cold fill pressure) that most installations get wrong, sizing from water content and temperature swing, membrane styles and replaceability, and the annual check that takes two minutes.

The physics in one paragraph

Water is incompressible and grows ~4 % from 10 °C to 90 °C; in a closed loop that growth must go somewhere or pressure spikes to the relief valve's set point every heat-up. The expansion vessel is a gas spring plumbed into the loop: a membrane separates system water from a nitrogen/air cushion, and the cushion compresses as water expands. Stocked sizes run from the 12 L Termix/Cimm through 50 L utility vessels to the Reflex N 500 L half-membrane class — about 60 rows.

Precharge: the two-minute setting that decides everything

Rule: gas precharge "H 0.2–0.3 bar below the system's cold-fill pressure, measured with the vessel isolated or the system drained at the vessel (a connected vessel always reads system pressure — the classic false "it's fine").

Precharge too LOW !’ the vessel sits part-full of water when cold and runs out of acceptance on heating !’ relief valve weeps every evening.

Precharge too HIGH !’ the membrane stays bottomed until pressure exceeds the charge !’ the loop behaves as if no vessel exists at low loads, banging and cycling.

Annual check: isolate/depressurise the water side, gauge the gas valve, top with nitrogen or dry air to spec. Water at the gas valve = membrane holed = replacement time (or a new membrane where the design allows).

Sizing and construction honestly

Size from three numbers: total water content, temperature swing (expansion coefficient), and the pressure window between cold fill and relief set. The vessel's acceptance volume — the water it can actually take within that window — is a fraction of its shell litres: a "25 L" vessel may accept 8; makers' tables do this in one lookup, and glycol mixes expand more (glycol guide).

Membrane style: fixed diaphragm (half-membrane, like the stocked Reflex N pattern) for standard heating duty; full replaceable bladders where the water never should touch steel (potable, chilled with inhibitors) and where membrane renewal beats vessel replacement.

Placement: on the suction side of the circulator near the boiler/chiller return, connected without isolation in normal operation — a service valve with a lockable handle satisfies both maintenance and safety.

Undersized or dead vessels announce themselves as pressure swinging bar-wide across the day and a relief valve that "needs replacing" every year — the valve is the witness, not the culprit.

Quoted within 24 hours from system volume, temperatures, fill and relief pressures — or simply the failed vessel's label — with nitrogen-charged commissioning data on the papers.

Frequently asked questions
What should the precharge pressure of an expansion vessel be?About 0.2–0.3 bar below cold-fill pressure, measured with the water side isolated or drained — a vessel checked while connected just reads system pressure and always looks 'correct'.Why does my relief valve drip every evening?The loop has nowhere to put thermal expansion: vessel undersized, precharge lost, or membrane holed. Check the gas valve — water there ends the diagnosis — then precharge; the relief valve itself is almost never the fault.How big an expansion vessel does my system need?From water content, temperature swing and the pressure window: expansion volume "H content × expansion coefficient, then divided by the vessel's acceptance factor between fill and relief pressures. Shell litres overstate capacity several-fold — use the maker's table.Diaphragm or bladder vessel?Fixed-diaphragm vessels are the economical heating standard; replaceable-bladder designs keep water off the steel entirely and renew with a membrane instead of a vessel — chosen for potable duty, inhibited chilled loops and larger plant where maintenance wins.Can I use compressed air to recharge the gas side?Dry air works for standard heating vessels (nitrogen is better — no oxygen diffusion, no moisture); charge to specification with the water side depressurised. If the vessel needs recharging often, the membrane is leaking and recharge is a bandage.

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