

System bypass

The system bypass valve performs several functions, when correctly set, it maintains a minimum flow to satisfy the minimum flow requirements of the boiler, and provides a cooling flow for fixed speed glandless circulator pumps.

Heating boiler manufacturers may specify a minimum flow rate in order to satisfy the boiler operating requirements under low heat load conditions when radiator thermostatic radiator valves are closing down. The bypass flow ensures correct operation of the boiler, to prevent kettling in the boiler heat exchanger (formation of steam bubbles), which can be heard as sizzling or popping noises, similar to a scaled up kettle. The minimum flow also helps prevent the high temperature cut-out from operating due to residual heat stored in the heat exchanger. The bypass flow controls the rate at which the temperature rises in the boiler heat exchanger to allow sufficient time for the boiler controls to react.

The boiler minimum flow requirement is stated by the boiler manufacturer. The bypass flow requirement varies according to the specific requirements of the boiler. In some cases the bypass flow may be small, or in some exceptional cases even up to the rated flow rate of the boiler.

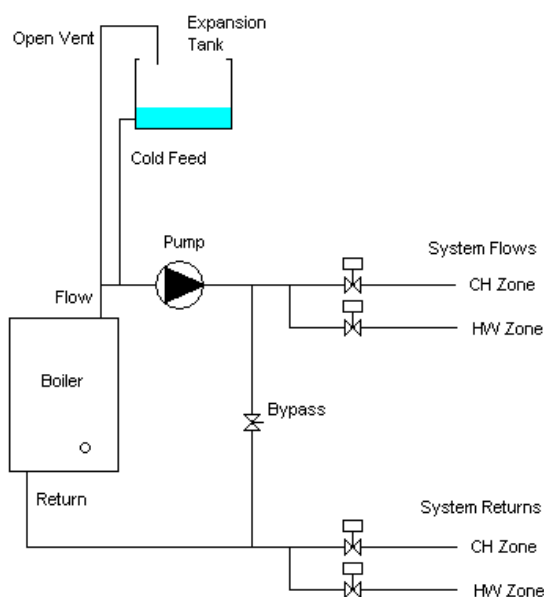
For cast iron boilers the bypass flow helps prevent stress cracking of the heat exchanger, the temperature difference across the boiler should be no greater than 11 °C. Generally an automatic bypass valve is recommended for cast iron boilers. The automatic bypass valve works in conjunction with the characteristics of the pump. As the system flow reduces the pump pressure increases causing the bypass valve to open to maintain boiler flow.

The residual heat stored in a cast iron boiler is high, the flow temperature will continue to rise after the burner has shut off. The high thermal mass of the heat exchanger does have the advantage that temperature changes do happen relatively slowly.

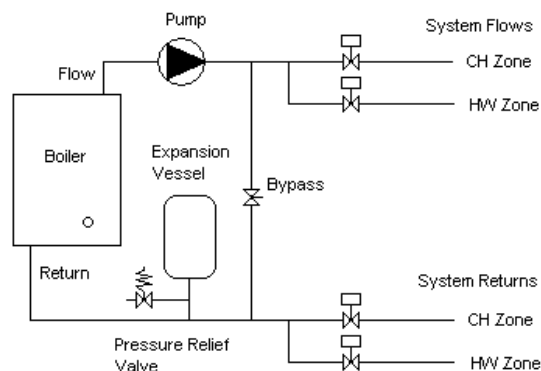
Condensing boilers generally have a modulating burner with a low water content, low mass stainless steel heat exchanger. The low thermal mass of the heat exchanger means that temperature changes can happen very quickly. The boiler controls must therefore respond much faster than those of a cast iron boiler. However, the modulating burner of a condensing boiler allows the heat output to match the heat demand of the system reducing risk of high temperature cut-out, and allowing time for the controls to respond.

General bypass arrangement

Open vented system



Pressurised system



For small bypass flow rates, a bypass circuit can be formed back to the boiler return after the system pump, as shown above.