

pumps is established by adding the flow capacity of one pump to the flow capacity of the other at identical heads. If two pumps are placed in series, the relationship of flow to head due to operation of both pumps is established by adding the pump heads at identical flows. When using pumps in series, they must be identical or similar since the maximum flow will be limited by the smaller pump. Gate valves should be provided to enable isolation of either pump when only one is in operation.

The Heat Source or Boiler

The most frequently used source of heat is the 30 psi hot water heating boiler, constructed of cast iron or steel in accordance with the ASME boiler construction code for low-pressure heating boilers. See Chapter 16, Heating Boilers, Furnaces, Space Heaters. Boilers, classed as low pressure

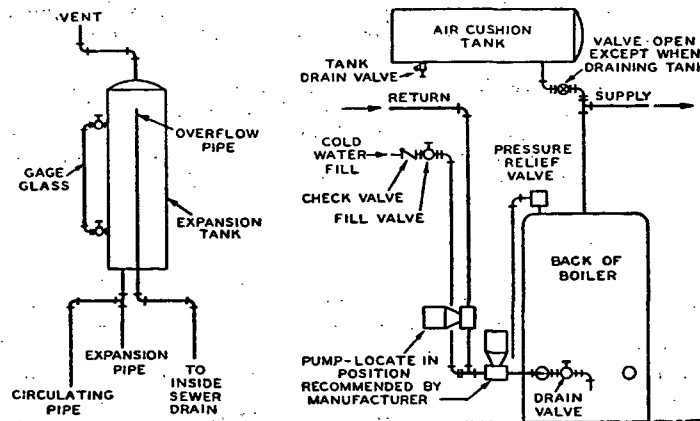


FIG. 14. AN OPEN EXPANSION TANK

FIG. 15. A CLOSED EXPANSION TANK

heating boilers, may be used for hot water with pressures as high as 160 psi if the temperature of the water does not exceed 250 F and if they are constructed according to the ASME code for the pressure at which they are operated.¹⁴

The ASME code requires installation of a relief valve on each hot water heating boiler to limit the pressure exerted on that boiler to the value for which it was designed and tested.¹⁴ Similar requirements exist for converters and electric water heaters. This operating pressure limit for the boiler is an important factor in the design of the hot water heating system. Together with the size and characteristics of the expansion tank, it determines the permissible height from the boiler to the top element or pipe of the distribution system, as discussed under Expansion Tanks. In addition to the pressure relief valve required by the ASME code, a hot water heating boiler should be equipped with a thermometer, located toward the top of the boiler, and a reliable pressure or altitude gauge with a range at least twice that of the maximum operating pressure or altitude allowable for the boiler.

EXPANSION TANKS AND SYSTEM PRESSURE CONTROL

The objectives of system pressure control are to: maintain maximum pressure at all equipment in the system below the working pressure of such

equipment; maintain minimum pressure for all normal operating temperatures in order that air can be vented and cavitation at the pump suction and boiling of system water prevented; and accomplish these objectives with as little addition of new water to the system as possible.

An expansion tank is the primary device used to accomplish system pressure control. The excess water volume in the system resulting from increased temperature is stored in the expansion tank during periods of high operating temperatures and returned to the system when the system water temperature is lower. The expansion tank must be designed to store the required volume of water during maximum design operating temperatures

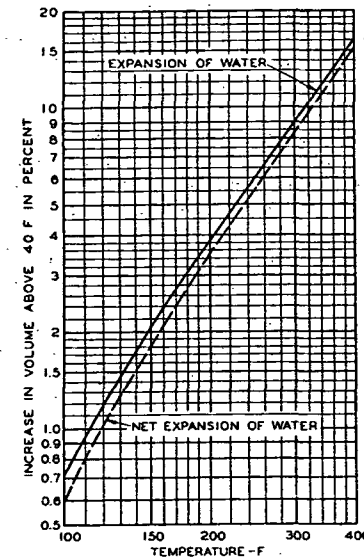


FIG. 16. EXPANSION OF WATER ABOVE 40 F

Note: Net expansion of water equals actual expansion of water less volumetric expansion of metal system.¹⁷

without exceeding the maximum operating pressure allowable, and to maintain required minimum pressure when the system is cold. Some designers provide an automatic fill valve to maintain the minimum pressure in the system by supplying water to make up for losses due to leakage. Others prefer that any water added to the system should be supplied by a manual valve.

The relief valve installed on hot water boilers in accordance with the ASME code performs the function of limiting the maximum pressure at the boiler. Since it is a safety device, it should not be considered an operating control.

Systems are designated as open, Fig. 14, or closed, Fig. 15.

The open tank system is vented to atmosphere and is generally limited to installations having operating temperatures of 180 F or less because of system boiling and tank water evaporation problems. The tank should be at least 3 ft above the high point of the system and should be connected to the suction side of the pump to prevent sub-atmospheric system pressures