SPENCE ENGINEERING COMPANY PIPELINE
Applications Newsletter August 2000

Condensate Chambers

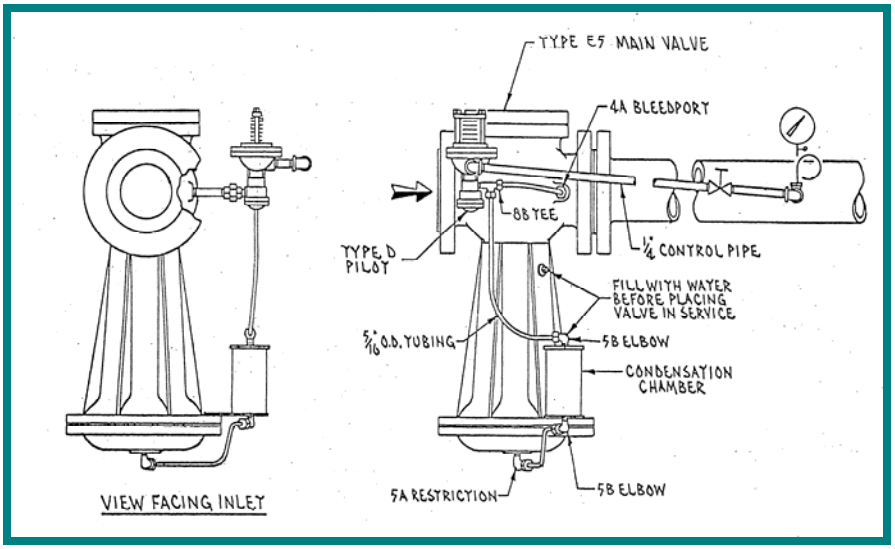
10" Spence Type ED120 Steam Pressure Regulator with Condensate Chamber

A Condensation Chamber is standard on Spence Type E5 Main Valves and on all cast steel, Type E Main Valves when steam temperatures exceed 600°F. The function of the Condensate Chamber is to ensure condensate, and not steam, is transmitted to the main valve hood by providing an external reservoir of water to accommodate the requirements of main valves with large hood volumes.

Main valves are designed to operate with the base and hood flooded with condensate. Under normal operation conditions, the copper or steel tubing and large base and hood surface area radiate enough heat to turn the pilot's steam output into condensate. Condensate collects in the restriction tubing and above and below the diaphragm in the base and hood. This allows the pilot to move the diaphragm hydraulically and protects the diaphragm from the higher heat content of live steam. Main valves with large internal volumes, or valves used in relatively high pressure or superheat, may require more water than can be condensed from radiation alone. Live steam will rapidly degrade the rubber diaphragm of an E5 and generally yield poor control in other main valves. To prevent this from happening, the Condensation Chamber is primed with water before start-up. As the pilot opens, medium pressure steam flows to the Condensation Chamber condensing the vapor in the presence of the prime and larger radiational area. The condensate exits the chamber through a 5B Open Elbow directed to the 5A Restriction Elbow in the hood. This condensate collecting under the diaphragm creates a loading pressure which forces the valve open **(See Figure 1)**.

Our Type E5 Main Valves are designed to provide exceptionally accurate regulation at relatively low pressure drops in service as high as 300 PSI at 600°F. The Condensation Chamber acts as a reservoir, protecting the valve's rubber diaphragm from degrading were it to come in contact with raw steam. Additionally, when an E5 Main Valve is put into superheat service, the Condensation Chamber prevents super heated steam from boiling off condensate around the diaphragm.

It is also important to note that any main valve discharging steam into a vacuum environment, such as condensers in a power plant, should include a Condensation chamber. Under these operating conditions, the down stream vacuum may cause condensate in the base to boil. Should this happen, regulation performance is severely degraded as flashing condensate creates pressure imbalances which prevents the diaphragm from responding to the pilot. Specifying the Condensate Chamber will solve this problem by preventing the condensate from turning into steam.



(Figure 1) Connection Diagram for Spence Type E5D Pressure Regulator With Condensate Chamber

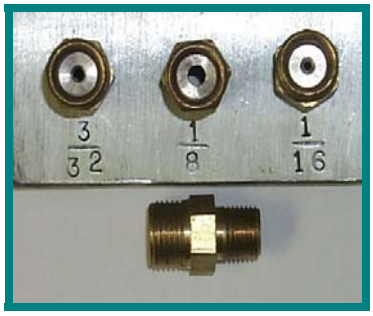
See Reverse Side

Bleedports

Spence Type E Main Valves are normally closed. The valve is held closed by the initial pressure on the disc and by an internal main spring. When the pilot is opened, initial pressure flows through the pilot creating an intermediate pressure that flows out the No. 8B tee and through a Bleedport Bend to a No. 4A Bleedport fitting. The purpose of the 4A Bleedport is to restrict the flow, allowing pressure to build from the Pilot to the No. 5A Restriction Elbow and under the diaphragm of the Main Valve. As the Pilot opens, the loading pressure under the Main Valve's diaphragm is increased which forces the Main Valve open. When the Pilot closes, the loading pressure under the Main Valve's diaphragm exhausts or bleeds off through the 4A Bleedport allowing the Main Valve to close.

Under normal conditions, a 3/32" 4A Bleedport is used on a Type E Main Valve, with a standard heavy main spring, on a pressure drop in excess of 50 PSI (30 PSIG minimum). Likewise, the same 3/32" 4A Bleedport is used on a Type E Main Valve, with optional, light main spring, on a pressure drop in excess of 15 PSI. When the pressure drop across the Main Valve is less than 15 PSI, the optional Light Main Spring is substituted; the orifice in the 4A Bleedport is reduced to 1/16" **(See Figure 2)**.

In some applications it is desirable to make the Main Valve close faster and open slower (e.g. the Primary Valve of a Two-Stage Reduction). In these applications the standard 4A Bleedport, with a 3/32" orifice is replaced with a 4A Bleedport with a 1/8" orifice. In the case of 10" and 12" Main Valves, which use the larger D120 or A54 Pilots, the standard orifice in the 4A Bleedport is already 1/8".



(Figure 2) No. 4A Bleedports with 3/32", 1/8" and 1/16" Bleedports

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Restriction Elbows

The No. 5A Restriction Elbow serves as a "snubber' by restricting the flow of the condensate loading pressure to and from a Main Valve's diaphragm. This "snubbing" action stabilizes the Main Valve and permits it to hold a position where it throttles or modulates. As the Main Valve's size increases, the size of the diaphragm and the size of the orifice, of the 5A Restriction Elbow also increases **(See Figure 3)**.

(Figure 3) No. 5A Restriction Elbow

In applications where the pressure drop across the Main Valve is less than 15 PSIG, the "snubbing action of a 5A Restriction Elbow becomes too effective, making the Main Valve operate slowly and lethargically. To prevent this from occurring, a No. 5B Open Elbow is utilized.

The 5B Open Elbow is a No. 5A Restriction Elbow with the orifice removed. The 5B Open Elbow is also standard on all Type E2 Main valves and E5 Main valves on 15 PSI or less differential service **(See Figure 4)**.

(Figure 4) No. 5B Open Elbow

For additional information on Auxiliary Fittings and the Operating Cycles of Pressure Regulators, see S.E.M. 8B in the Instructions and Parts Manual - SC IP, Temperature and Pressure Regulators Handbook - CM 998, SD 3001E and SD 3002A.

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