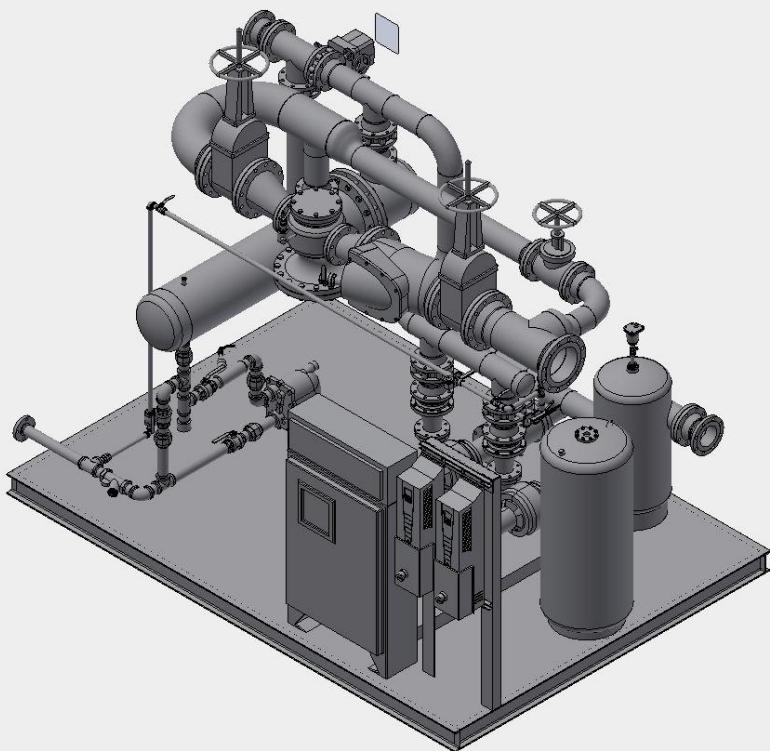


# Systecon HST Heating System

## The proven, reliable design in heat exchanger pumping systems.

The Power Piping Code B31.1 defines any heating hydronic system that exceeds 250°F or 160 psig, as a high temperature/high pressure system. In common heating systems, which may be designed for a maximum temperature of 200°F, the possibility of the valve failing open and the water temperature exceeding 250°F exists. Therefore, the code may limit maximum steam pressure of a, steam-to-water heating system to 15 psig. The Systecon HST Heating System eliminates this possibility and many other disadvantages common to standard steam-to-water heat exchanger systems.



### HST Overview

- Eliminates problems inherent in standard steam heating systems.
- Reduces first cost and improves system temperature accuracy.
- Assures proper design of system such as location of pumps, air eliminators, and expansion tanks.
- Provides complete communication with any building management system.

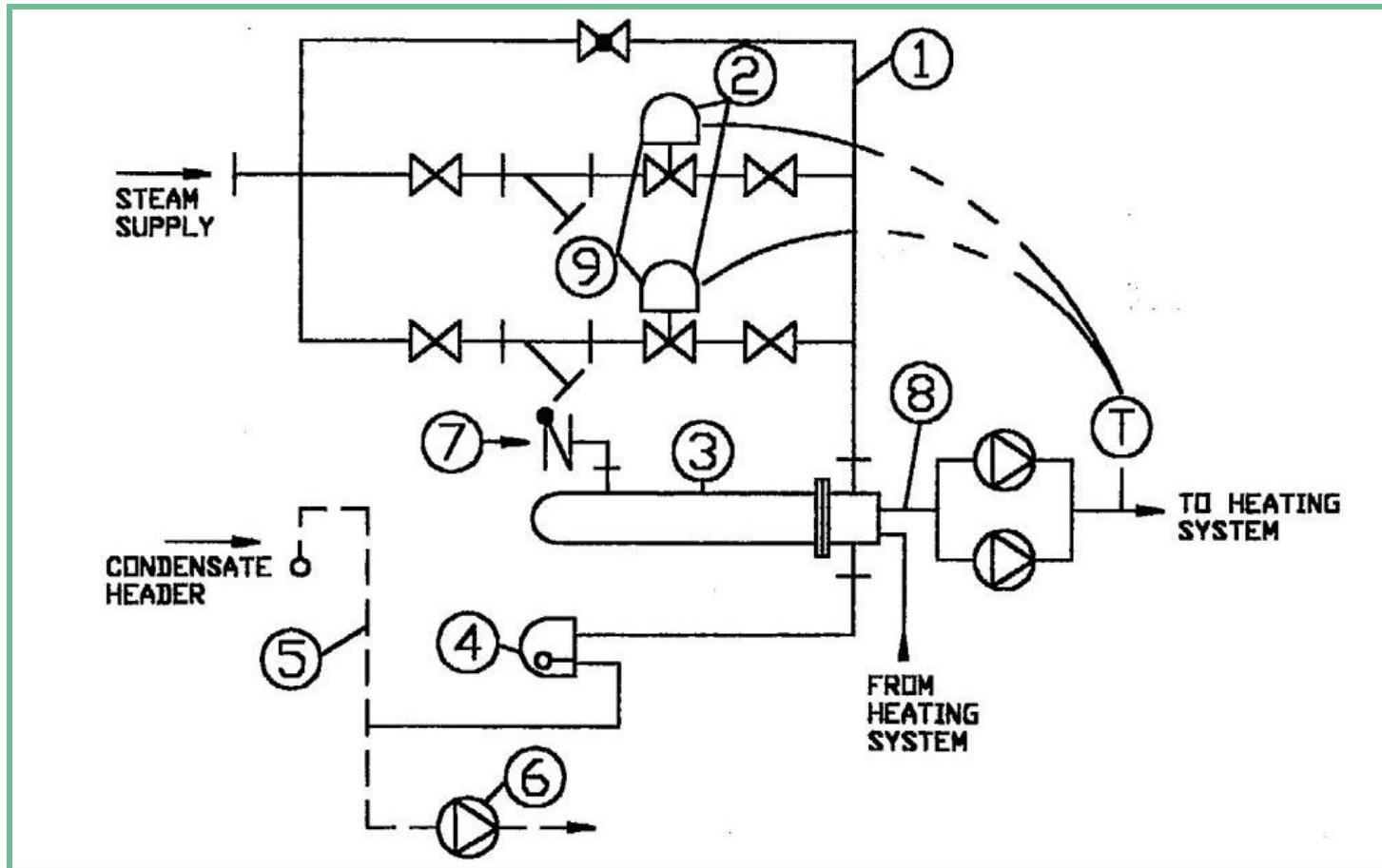
### Systecon Features

All Systecon Packaged Systems comply with ETL listing and in-plant labeling for complete systems that bear the ETL Label of Certification.

The HST Heating System can be provided with constant or variable speed pumps. Systecon can conduct a wire-to-water efficiency evaluation for the system designer and assist them in determining the optimal combination of variable speed pumps.

Systecon can provide technical data, footprint drawings, and suggested specifications on the Type HST heating system.

**Figure 1 - 1/3 – 2/3 Capacity Steam Control Valve Train for Heating Supply Water**



### THE PROBLEMS: Standard 1/3 – 2/3 Capacity Steam Control Systems

Most steam heating systems use two steam temperature regulators - one for one-third capacity and the other for two-thirds capacity. Figure 1 shows the standard 1/3 – 2/3 steam control valve train for heating supply water temperature control. In this system, the water flow through the heat exchanger varies with the load on the hot water system. The steam to the heat exchanger is controlled by the temperature transmitter T.

**There are several concerns/disadvantages to the operation of the standard systems:**

1. A complete 1/3 – 2/3 valve train with all normal accessories (Figure 1) costs more than the components for the comparable Systecon system (Figure 2).
2. On a light heating load, the water flow through the heat exchanger will be very small, causing the steam valves to close. This causes the steam pressure in the heat exchanger to collapse, resulting in a vacuum in the heat exchanger. Also, valve modulation contributes to pressure fluctuations in the heat exchanger shell. Because of this, it is difficult to maintain accurate temperature control at very low loads or loads just above one-third capacity.
3. Steam control valve modulation and the mass flow of heating water through the tubes causes pressure changes and varying rates of steam condensation. This can have an appreciable effect on the temperature control accuracy for the heated water system.

4. Since the trap sees differential pressure fluctuations, as noted in #3 above, its capacity varies greatly, and the trap can be heard to cycle frequently and slam closed if a vacuum is formed.
5. With a design flow pressure drop of 2 psi for the steam control valve and a pressure drop of 2 psi for the trap, many systems have been designed to lift the condensate to an overhead return, assuming 15 psig steam. The assumed pressure leaving the trap is:

$$[15 - 2 (\text{cv}) - 2 (\text{trap})] \text{ psig} = 11 \text{ psig}, \text{ with lift capacity } [11 \text{ psig} \times 2.31 \text{ ft/psi}] = 25.4'$$

However, the pressure in the shell may generally be lower than expected or in a vacuum due to steam condensation. Under these conditions, condensate backs up and floods the shell, reducing heat transfer capacity. When the supply temperature falls sufficiently, the temperature control valve opens, the shell pressure increases, and the condensate is blown out of the shell exposing the tubes to live steam. This causes the supply temperature to exceed the setpoint, the control valve modulates close, and the cycle starts all over again. This cycling also reduces the life of the trap.

6. Unless the condensate drains to a lower floor, this system requires a condensate pump for proper operation. However, due to the flash steam or valve failure conditions, this pump can see water temperatures higher than design. If this occurs, water can boil in the pump suction and the pump must be throttled back to avoid cavitation or waterhammer. This will erode the pump and seals and eventually destroy them.
7. To break the vacuum that occurs, most designers install a vacuum breaking check valve. This allows air to enter the system which can promote corrosion in the shell and condensate system and allows non-condensing air to cover some tubes at the top of the shell affecting capacity.
8. Some manufacturers locate hot water pumps downstream from the heat exchanger. This exposes the pump seals to higher temperatures and shortens their useful life.
9. If normally open valves are selected and they fail open, the leaving water temperature may easily exceed the standard mechanical seal rating of the pump, which may be 225°F. Also, since available NPSH decreases with an increase in fluid temperature, this location provides the lowest available NPSH in the system. Depending on the pump selected, cavitation could become a problem, especially if the control valve fails open. Also, if there is a loss of control air pressure, the supply temperature of the water will approach the saturated steam temperature causing overheating, pump seal failure and other system problems.

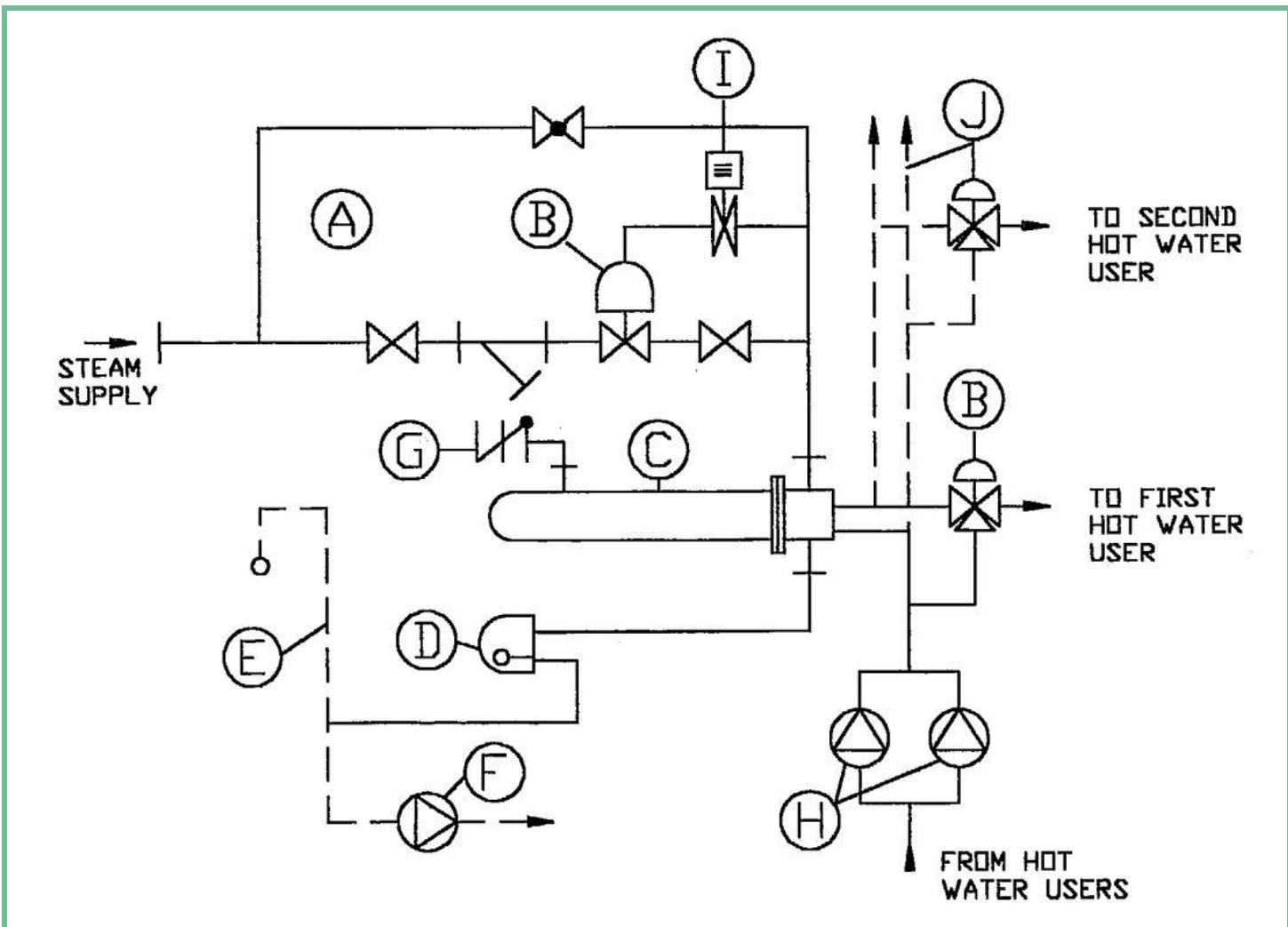
## THE SOLUTION: Systecon Constant Steam Pressure/Variable Temperature and/or Flow Heating Supply Water Temperature Control System

Figure 2 shows the Systecon constant stream pressure control with variable flow and temperature control for heating supply water. In this system, the water flow through the heat exchanger and output water temperature is modulated via a three-way mixing valve.

**There are several major advantages to the operation of the Systecon HST heating system:**

- A. For a capacity of 4500 MBH, the constant pressure/variable flow system costs about 5-15% less than the cost of the 1/3 – 2/3 steam control valve system.
- B. By using a self-contained, normally closed, pressure-reducing valve and carefully selected 3-Way mixing valve with low flow heating water-to-shut off capacity, very accurate leaving water temperatures can be maintained, even at low loads. At a midwestern university where this type of system was installed, a leaving temperature setpoint of  $\pm 0.5^{\circ}\text{F}$  was maintained at a 1% load.

**Figure 2 - Constant Steam Pressure/Variable Temperature and/or Flow Heating Supply Water Temperature Control**



- C. The PRV maintains a fairly constant shell pressure and temperature. This eliminates the flash steam and associated problems caused by these thermal and pressure changes.
- D. Since the trap sees constant pressure differentials, it does not cycle much during operation. Basically, the flow simply varies depending on the rate of stream condensing. With regular, simple maintenance, the life of the trap is increased.
- E. Since it is possible to maintain a constant pressure on the shell for the heat exchanger, condensate can be lifted successfully to an overhead condensate return line.
- F. A condensate pump is not required with this system unless the condensate is being returned over great distances or is injected into a return system over 15 psi.
- G. A vacuum breaker and thermostatic air vent are installed in the top of the shell. A vacuum is produced only on system shut-down. When initiated, the air vent eliminates any air covering the upper tubes. This increases efficiency and reduces corrosion.

- H. The pumps are installed in the system return before the heat exchanger. This allows the pump to always see the highest possible NPSH and the lowest system temperature which saves the pump seals and allows the use of standard temperature seals.
- I. The self-contained, normally closed, PRV is equipped with a solenoid activated sensing line. On system start-up, the solenoid opens allowing the PRV to open and maintain the constant steam pressure required by the system.

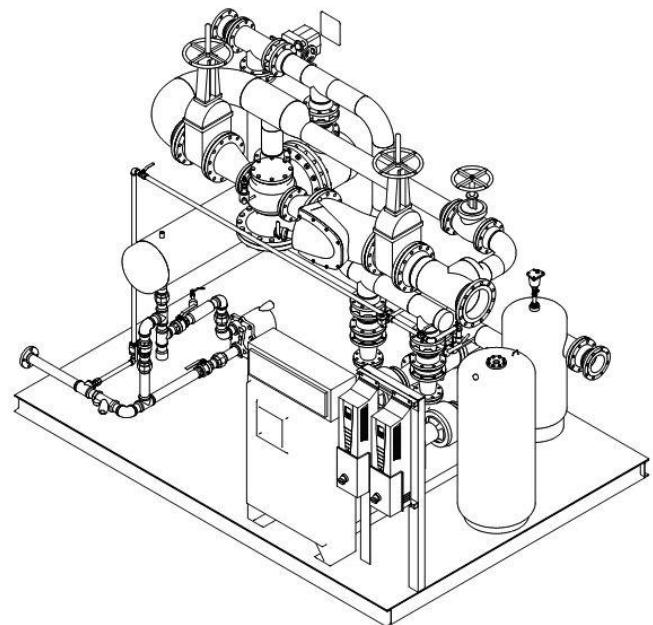
If control air pressure is lost, the 3-Way mixing valve will open full to heat and the supply temperature will climb out of control. In this case, a high temperature mode is initiated. For example, if the design temperature is 180°F, then at 185°F, the system will revert to high temperature mode. An alarm will be sent, and the sensing line solenoid will be deactivated causing the PRV to close. The supply temperature will fall until a preset low temperature is reached, say 175°F. At this temperature, the sensing line solenoid will be reactivated and the PRV will again open. This cycle will continue, maintaining supply temperature between 185°F and 175°F, with no control air required until the error is reset and the system can again maintain an accurate set-point. The set-point may be reset from outside air temperature and/or from system MBH load.

- J. Another advantage is the capability of this system to serve several zones of different temperature requirements with totally independent control. For example, the main system may be a dehumidification reheat zone which operates year-round, and the second zone may serve the exterior radiation system which operates only in winter. One may be reset by outside air temperature and the other by zone MBH load. NOTE: If zone is reset by MBH, it must have a dedicated return for temperature sensing.

## Systecon's Design Advantages

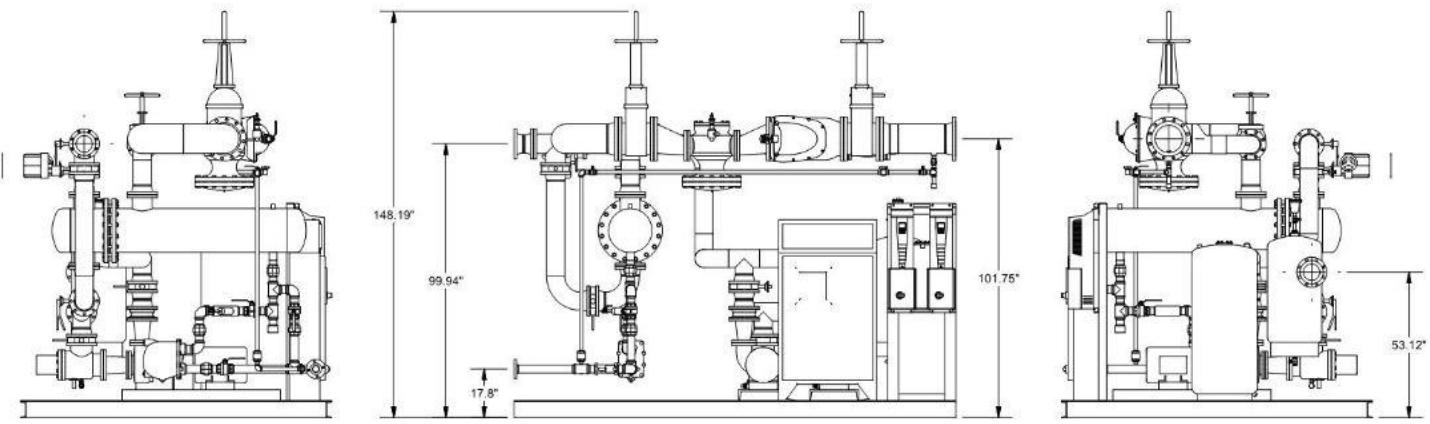
Systecon's experience and innovative approach through five decades of manufacturing pumping systems has enabled us to perfect the design layout of the components for a heating system to achieve the longest system life with a minimum of service.

- The pumps are located on the return side of the heat exchanger to achieve operation at lower temperatures. This extends the useful life of the pump seals.
- Makeup water is connected to the return side of the system.
- The system strainers are located on the system return to mix makeup water with the return water before entering the air separator.



The HST System demonstrates Systecon's total system capability and responsibility to assure the engineer and their client that hot water will be provided in the proper volume and temperature for the heating system.

# Systecon HST Heating System 600 GPM



LEFT VIEW

ELEVATION FRONT VIEW

RIGHT VIEW

