Pressure and/or Temperature Pilot Operated Steam Regulators (continued)

How To Size Series 2000 Main Valves

1. Determine the available steam inlet pressure.
2. Determine the reduced steam outlet pressure.
3. Determine the available steam temperature based on the boiler's steam output.
4. Determine the capacity required by referring to the manufacturer's specifications for your equipment.
5. Apply the specifications (as determined in steps 1-4) to the Full Port Steam Capacity Table to determine the main valve size. If steam inlet pressure is below 30 psig (2.1 bar) use the Low Pressure Steam Capacity Table.

Select a main valve that will operate between 50-100% of the capacity rating.

If necessary, use the Normal or Reduced Port Steam Capacity Tables.

A normal or reduced port main valve is recommended for systems that will be expanded in the future.

To prevent excessive relief valve popping, the relief valve setting must be at least 5 psi (.35 bar) higher than the no load pressure setting on systems up to 35 psig (2.4 bar).

For systems greater than 35 psig (2.4 bar), the relief valve must be set 10 psi (0.7 bar) higher than the no load pressure setting.

Note: To prevent excessive noise and extend valve life, do not exceed pressure drops greater than 150 psig (10.4 bar) and avoid those greater than 100 psig (6.9 bar).

To prevent seat damage and to maintain control and accuracy, do not oversize. Select regulators that will operate between 50-100% of their capacity rating.

6. Use the Main Valve Body Style Chart to select a model number (based on size and pressure).

7. Use the Ordering Information Chart todetermine the part number (based on the model number).

8. Size inlet and outlet piping for velocity:
   For heating or indoor applications –
   4,000-6,000 ft./min. (1,219-1,828 m/min.)
   For industrial or outdoor applications –
   8,000-12,000 ft./min. (2,438-3,657 m/min.)

   Note: Main valve noise data available through ESP-Plus, or upon request.

9. Install drip traps ahead of regulators to drain condensate from steam lines.

Series 2000
Sizing Examples

Example 1.

Conditions:
In this example, the steam supply to the process equipment in the installation (system) will be regulated by one Series 2000 pressure regulator. Assume all equipment will be operating at the same time at a constant load.

Problem:
Calculate the steam load requirements for all of the equipment in the process system by referring to the equipment name plate. Then select a Series 2000 pressure regulator from the Steam Capacity Tables to determine the specific model pressure regulator and valve size needed.

Known Data
Inlet pressure 75 psi (5.3 bar)

Equipment Identification	Operating Pressure psi (bar)	Maximum Pressure psi (bar)	Equipment Steam Loads Requirements lbs./hr. (kg/hr.)	Pipe Size in. (mm)
A	20 (1.4)	40 (2.8)	300 (136)	½ (15)
B	20 (1.4)	30 (2.1)	600 (272)	¾ (20)
C	20 (1.4)	25 (1.75)	400 (181)	¾ (20)
D	20 (1.4)	25 (1.75)	800 (363)	1 (25)
E	20 (1.4)	25 (1.75)	500 (227)	½ (15)
F	20 (1.4)	50 (2.5)	600 (272)	¾ (20)
Total Capacity 3200 lbs./hr. (1453 kg/hr.)				

Procedure:
The steps to size a Series 2000 pressure regulator are listed on page 39. For this problem assume :

1. An inlet pressure of 75 psi (5.2 bar).
2. An outlet pressure of 20 psi (1.4 bar).
3. The steam load adds up to 3200 lbs./hr. (1453 kg/hr.) as shown to the left.
4. Be sure to review the recommendations for good practice in selecting pressure regulators.
5. Refer to the Full Port Capacity Table first for your selection. The normal and reduced trim capacity tables should be used if there is a possibility the system will be expanded in the future.
6. Select the smallest regulator possible that will handle the steam load requirements. Typically it can be found in the Full Port Capacity Table.
7. When the outlet steam pressure is 50% or less of the inlet pressure, use the lowest outlet pressure shown in the capacity table.

Answer:

1. Referring to the Full Port Capacity Table, with the conditions given above under procedure, the correct valve to select would be a Model 2100 1½" (40mm) Main Valve-Full Port.
2. Since in our example there is no supply of compressed air in the plant nor a need to also control temperature, a spring pilot would be selected to handle the outlet pressure requirements. This would be a Model SSP-50 with an adjustable range of 2 to 50 psi (.14 to 3.5 bar). You would adjust the pilot to 20 psi (1.4 bar).

Example 2.

Conditions:
In this example, a pressure/temperature regulator has to be selected to regulate the steam going into a steam to water heat exchanger. Due to a planned plant addition in the next 5 years, the steam system will be enlarged.

Problem:
The exchanger heats water from 50°F to 150°F (10-65°C) and has an assumed water flow of 50 gpm (189 lpm). The heat exchanger is limited to a 20 psi (1.4 bar) steam pressure. Assume the steam supply pressure is 100 psi (6.9 bar).

Known Data:
Temperature Rise — 150°F - 50°F = 100°F (66 - 10 = 56°C)
Water Flow — 50 gpm (189 lpm) = 3000 gph (11,356 lph)
Steam Inlet — 100 psi (6.9 bar)
Steam Outlet — 20 psi (1.4 bar) (heat exchanger limit)

Procedure:

1. Refer to the following two pages to obtain the steam required to satisfy the above conditions. This would be 2500 lbs./hr. (1134 kg/hr.) according to the tables. Hint: 50 gpm x 60 min. = 3000 gph
2. Next, refer to the steam capacity tables for a normal port to obtain the regulator size since it is planned to enlarge this system at a later date.

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Sizing Examples

Example 2. (continued)

3. When the outlet steam pressure is 50% or less of the inlet pressure, use the lowest outlet pressure shown in the capacity table.

Answer:

1. Using the above data and referring to the normal port capacity table, a 1¼" (32mm) NPT main valve with a normal port that passes 2880 lbs./hr. (1306 kg/hr.) of steam would be the answer.
   The order would be for:

   One, Model 2100, 1¼" (32mm) Main Valve-Normal Port.

2. Since temperature must be controlled, a combination of spring and temperature pilots should be selected. This would be:

   One Model SSP-50 with adjustable range of 2 to 50 psi. (.14 to 3.5 bar). The pilot would be adjusted to the required 20 psi (1.4 bar).

   One Model STPA-200 with a temperature range of 50-200°F (10-93°C) would be selected and adjusted to 150°F (65°C) to maintain the desired temperature of water leaving the heat exchanger.

NOTE: An alternate option is to use a pneumatic temperature pilot with an air pressure pilot and an air regulator. This would be:

One Model 315 PNT with a temperature range of 50-300°F (10-149°C) adjusted to 150°F (65°C) to maintain the desired temperature of water leaving the heat exchanger.

One Model AP-1A Air Pressure pilot to receive the control signal from the pneumatic temperature pilot.

One Air PRV Regulator, adjusted to maintain a maximum 20 psi (1.4 bar) outlet pressure.

Typical Guidelines for Selection of Temperature Regulators

The degree of temperature variation depends on load change. The chart below is based on 0% through 100% load change.

Type of Heater	Application	Type of Regulator
Instantaneous Heater	Domestic Hot Water	Series 2000 with pneumatic pilot for ± 4 deg. F. (must be used with anti-scald protection)
	Process fluids	Series 2000 with pneumatic pilot for ± 4 deg. F. Series 2000 with STPA pilot for ±10 deg. F. (System recirculation is recommended)
	Wash down stations	Same as process fluids (Pneumatic recommended if available)
	Steam to water converters	Series 2000 with either direct or pneumatic operated pilots. ± 10 deg. F. accuracy.
Semi-instantaneous Heater or Storage Heater	Domestic hot water	Series 2000 with pneumatic temperature pilot ± 4 deg. F. accuracy (must be used with anti-scald protection)
	Process fluids	Series 2000 with pneumatic temperature pilot ± 4 deg. F. accuracy. Direct-operated pilots ± 10 deg. F. accuracy.
	Wash down stations	Same as process fluids

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Formulas for Sizing

Heating water with steam	lbs. steam/hr. = $\frac{GPM}{2}$ x temp. rise °F
Heating fuel oil with steam	lbs. steam/hr. = $\frac{GPM}{4}$ x temp. rise °F
Heating air with steam	lbs. steam/hr. = $\frac{CFM}{900}$ x temp. rise °F
Radiation conversion	lbs. steam/hr. = $\frac{\text{sq. ft. EDR}}{4}$
To convert lbs. steam/hr. to kg. steam/hr.	Multiply lbs./hr. x .454 = kg/hr.
For steam P_1 = Inlet psia P_2 = Outlet psia	When P_2 is 1/2 P_1 or less $Cv = \frac{\text{lbs./hr.}}{1.5 \times P_1}$ When P_2 is more than 1/2 P_1 $Cv = \frac{\text{lbs./hr.}}{2.1\sqrt{\Delta P \times (P_1 + P_2)}}$
Corrections	For superheat = 1 + .00065 (°F superheat) Flow at superheat = $\frac{\text{Flow at saturation}}{\text{superheat correction}}$