DEFINITIONS RELATING TO REGULATOR CAPACITY

The capacities contained in this bulletin are based on a specific level of performance by the regulator. The measure of performance is accuracy of regulation, also known as offset or deviation. Each table is appended with a footnote indicating the accuracy of regulation obtainable at the rated capacities listed.

Pertinent terms involved in the determination of accuracy of regulation and rated capacity are defined as follows:

*** REGULATED VARIABLE** is the controlled condition of the fluid either (1) flowing through a regulator or (2) in a process served by a regulator. Reduced pressure, back pressure and differential pressure are the typical regulated variables to be dealt with in this instance. Other cases, such as vapor pressure produced by a steam-heated vapor generator, will be found.

*** MINIMUM CONTROLLED FLOW** is the lowest flow at which a steady condition of fluid pressure can be maintained. Any further reduction of flow produces a noticeable deviation of the regulated pressure toward dead-end shut off. For convenience, minimum controlled flow is often considered as being at 5% of rated capacity.

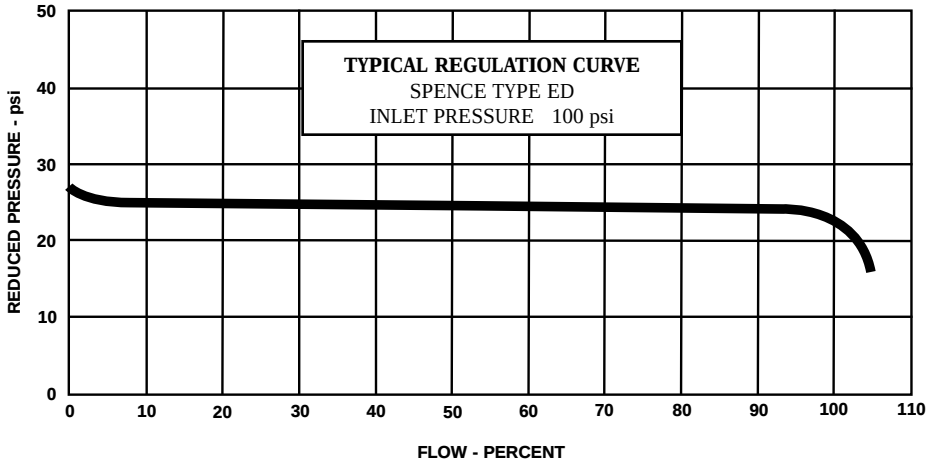
*** SET POINT** is the value of the regulated pressure at minimum controlled flow.

*** RATED CAPACITY** of a pressure regulator pertains to specified inlet and outlet conditions and is the rate of flow through the regulator, guaranteed by the manufacturer, when the regulated pressure deviates no more than a specified number of psi from the set pressure at minimum controlled flow.

*** ACCURACY OF REGULATION** is the amount by which the regulated pressure deviates from set point at minimum controlled flow as the flow through the regulator is gradually increased from minimum to rated capacity.

*** LOCK-UP** is the increase from set value due to dead end shut-off.

* Adapted from "*Definitions of Regulator Capacities*", Standard No. FCI 58-1, published by Fluid Controls Institute, Inc.



TYPICAL REGULATION CURVE

The performance characteristic of a Spence Pressure Regulator is shown above. Using this curve to illustrate several terms of reference, the following facts are evident:

REGULATED VARIABLE	REDUCED PRESSURE
Minimum Controlled Flow	4%
Set Point	25.0
Reduced Pressure at Rated (100%) Flow	22.5 psi
Accuracy of Regulation, psi	2.5 psi
Accuracy of Regulation, % of set pressure	10%

The slight slope of the curve establishes a definite relationship between flow and regulated pressure. Note that 1 psi accuracy of regulation is obtainable at 95% of rated flow.

For back pressure regulation, or differential where the regulator opens on increasing differential, the characteristic curve would lie opposite to that shown. It would slope upward with flow increase because a positive deviation is required to cancel valve opening.

NOTES ON USE OF TABLES

The lowest reduced pressures are approximate critical pressures. No appreciable increase in flow can be obtained at lower pressures.

Downstream pipe size should be enlarged at regulator outlet to approximately equalize pipe velocities before and after the reduction. The Steam Capacity Tables are useful for determining steam pipe sizes and regulator size at any desired lower velocity level.

Reduced Seats—Spence Regulators are available with a choice of seat sizes called Full and Normal Ports. There is a capacity table for each port with standard plugs. The Cv Valve Coefficients shown on the back page, indicate where 75% and 50% parabolic plugs are available. For a given pressure drop, rated flows with various ports and plugs in the same size body may be compared. Thus, valve and port size may be selected to limit velocities entering and leaving the regulator. Lower velocities mean a greater proportion of the pressure drop occurs at the valve seat, where it belongs, rather than in the body outlet and connected piping.

Capacity ratings apply to Spence Regulators with Type D, N and Q Pilots which are spring loaded and have 3½ inch diaphragms. Other pilots having greater or lesser sensitivity will provide proportionally greater or less accuracy of regulation.

PLANNING MAIN VALVE INSTALLATION

A. PLANNING THE INSTALLATION

1. Locate the valve in a straight run of horizontal pipe. See Fig. 1.
2. Allow headroom above the valve for access through the blind flange. Provide clearance for stem withdrawal underneath.
3. Prevent water hammer and erratic operation by installing traps to provide proper drainage before and after the valve, and before secondary PRV or control valve.
4. Avoid damaging affects of scale and dirt in pipe lines by using a strainer as shown in Fig. 1 .
5. Provide a 3-valve by-pass to facilitate inspection without interrupting service.
6. To eliminate excessive noise and erratic regulation with steam and other compressible fluids enlarge the delivery pipe size to effect a reasonable flow velocity at the reduced pressure. A tapered transition is recommended. If possible, avoid a sharp turn close to the regulator outlet and a bull-headed tee connection to the low pressure main.
7. Install initial and delivery pressure gauges to indicate performance. If the pressure rating of the delivery system or connected equipment is less than the initial steam pressure, provide a safety valve.

B. CONTROL PIPE

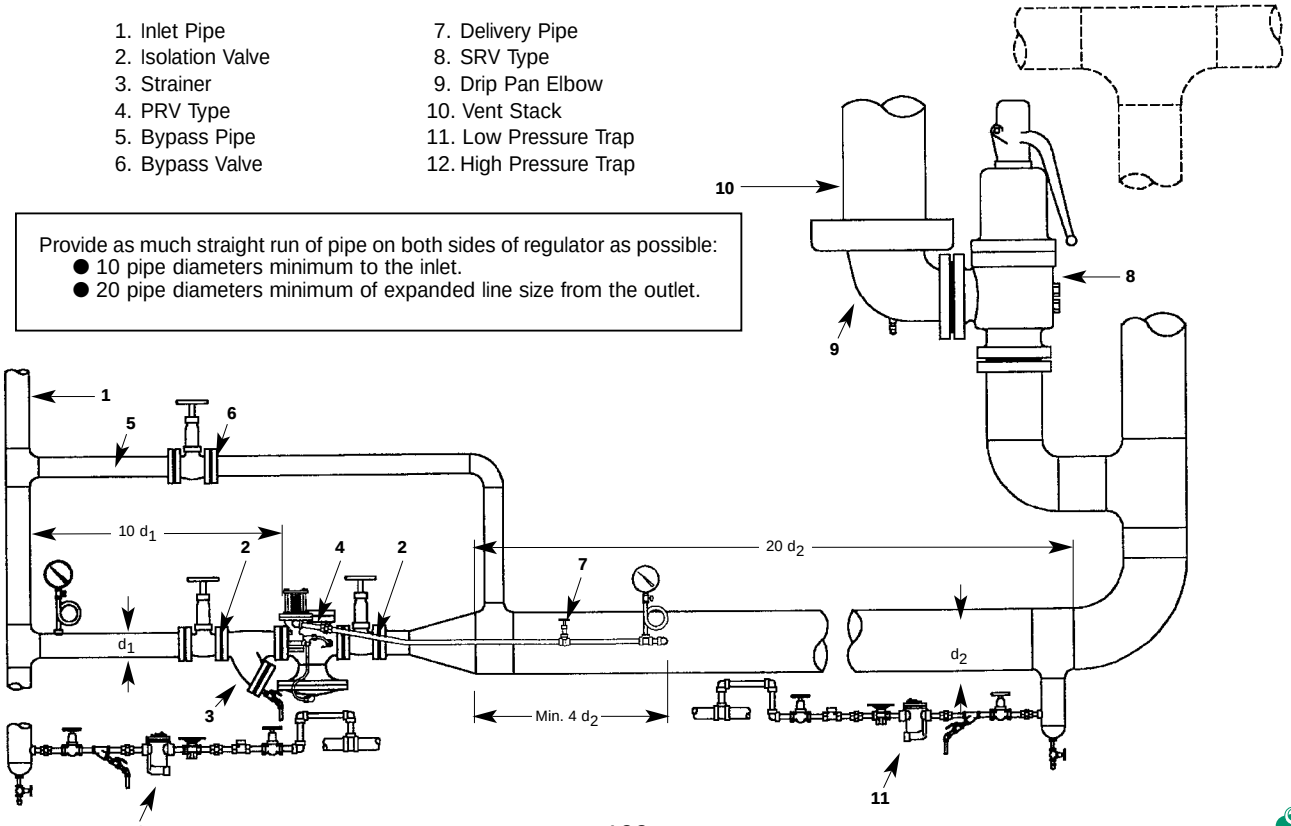
1. Use 1/4” pipe for this line which connects the pilot diaphragm chamber to the desired point of pressure control. See Fig. 1.
2. Take the control at a point of minimum turbulence. Avoid control immediately at the valve outlet or after a turn. When the delivery pipe expands in size select a spot at least 4 pipe diameters beyond the point of enlargement.
3. Pitch away from pilot to avoid erratic operation and fouling. Eliminate water pockets.
4. Locate delivery pressure gauge in control pipe to show pressure actually reaching pilot diaphragm.

C. DESIGN GUIDELINES TO MINIMIZE NOISE

1. Size the regulator to provide a maximum inlet velocity of about 10,000 FPM.
2. Determine the regulator outlet velocity. if it would exceed 30,000 FPM, use a Spence muffling orifice or a second stage regulator.
3 Expand regulator outlet piping to limit discharge line velocity to about 10,000 FPM.
4. Avoid abrupt changes in pipe size. Limit pipe diameter changes to two pipe sizes per stage of expansion. Do not use eccentric reducers.
5. Directional changes in downstream piping should be made only after the line size has been increased. Use long radius fittings; avoid bull-head tee connection.
6. Provide as much straight run of pipe on both sides of regulator as possible:
   a - 10 pipe diameters minimum to the inlet.
   b - 20 pipe diameters minimum of expanded line size from the outlet.
7. Size all piping components, including strainer and stop valves for a maximum flow velocity of about 10,000 FPM (Exception: An outlet stop valve mounted at the regulator outlet should be equal in size to the regulator). In areas where low sound levels are specified, reduce this limit by 25% to 50%.
8. To limit noise transmission through the building’s structure. keep the regulator and piping at least 3 feet away from solid surfaces. Use sound-isolating piping supports.
9. Apply high density insulation to the regulator body, piping and system components. Insulation reduces heat loss significantly and can provide moderate (3-6 dB) local noise attenuation.
10. Use a Spence noise suppressor to reduce the propagation of noise via the downstream piping.

1. Inlet Pipe
2. Isolation Valve
3. Strainer
4. PRV Type
5. Bypass Pipe
6. Bypass Valve
7. Delivery Pipe
8. SRV Type
9. Drip Pan Elbow
10. Vent Stack
11. Low Pressure Trap
12. High Pressure Trap

Provide as much straight run of pipe on both sides of regulator as possible:
- 10 pipe diameters minimum to the inlet.
- 20 pipe diameters minimum of expanded line size from the outlet.



RULES FOR MAIN VALVE SELECTION

When you select a Main Valve, your sizing can be based on one of three methods. They are:

Economical Main Valve

Economical Main Valve Selection is choosing a regulator that has the line size and rough capacity to handle the load. No consideration is given to velocities or noise. If you are interested in an economical selection, select a regulator type for your application, then go to the Capacity Tables and select the size that will provide you with the capacity needed.

Engineered Main Valve

Engineered Main Valve Selection takes into consideration the inlet and outlet velocities of the regulator, It will limit these velocities to acceptable standards. See Pressure Reducing Station Design Guidelines on the following pages for details. If you are interested in an engineered selection, select a regulator type for your application, and then to the Capacity Tables and select the size that will provide you with the capacity needed. Verify that the velocities fall within the guidelines by consulting the Velocity Charts in this Section.

Engineered Main Valve with Noise Suppression

Engineered Main Valve Selection with Noise Suppression considers both velocity and noise suppression in the selection of the regulator. For this selection, it is recommended that you contact your local Spence Technical Sales Representative who can provide you with a computer generated solution.

Selecting a Regulator Type

The following rules should be used to help you to determine the type of regulator that you should use. You should consult the Product Pages, Velocity Tables and Capacity Tables for additional information on your selection.

Rules for Main Valve Selection–Steam Service

Together with the following rules, reference should be made to the Main Valve Specification Table or individual Product Pages for maximum initial pressures and temperatures and “minimum differentials”for the several types of Main Valve. For pressure reduction where fast response time is important, but capacity and accuracy are not critical, select **D50 DIRECT OPERATED REGULATOR**.

Either Dead-end or Continuous Flow Service

RULE 1. For Initial Pressures exceeding 15 psi:

(a) **TYPE E –** Select when the Delivery Pressure is less than 75% of Initial Pressure. For Differential Pressures of 15-50 psi, specify optional LP Spring (10 psi minimum Differential Pressure is attainable by adding optional fittings).

(b) **TYPE E5 –** Select when the Delivery Pressure is 75% to 96%of Initial Pressure.

RULE 2. For Initial Pressures less than 15 psi:

(a) **TYPE E2 –** Select when Initial Pressure is less than 15 psi.

Rules for Main Valve Selection–Air Service

Together with the following rules, reference should be made to the Main Valve Specification Table or individual Product Pages for maximum initial pressures and temperatures and “minimum differentials”for the several types of Main Valve.For pressure reduction where fast response time is important, but capacity and accuracy are not critical, select **D50 DIRECT OPERATED REGULATOR**.

Either Dead-end or Continuous Flow Service

RULE 1. For Initial Pressures exceeding 15 psi:

(a) **TYPE E –** Select when the Delivery Pressure is less than 75% of Initial Pressure. For Differential Pressures of 15-50 psi, specify optional LP Spring (10 psi minimum Differential Pressure is attainable by adding optional fittings).

(b) **TYPE E6 –** Select when the Delivery Pressure is 75% to 93%of Initial Pressure.

(c) **TYPE E5 –** Select when the Delivery Pressure is 93% to 96%of Initial Pressure.

RULE 2. For Initial Pressures less than 15 psi:

(a) **TYPE E2 –** Select when Initial Pressure is less than 15 psi.

Rules for Main Valve Selection–Water Service

Pilot Operated Regulators are not uniformly successful in liquid pressure reducing service unless the delivery system has unusual cushioning such as afforded by an elevated tank or large air chamber.

Water Pressure Reducing Valves

The **TYPE D34 DIRECT OPERATED VALVE** was developed for application on rapidly changing and intermittent flow to an inflexible system.

RULE 1. Select **TYPE D34 DIRECT OPERATED VALVE** for pressure reducing service.

For Pilot Operated Water Regulators

When a pilot operated regulator is required the following rules for the selection of a main valve govern:

RULE 2. When pressure drop across valve exceeds 10 psi:

(a) **TYPE C34 -**Select for all normal requirements.

(b) **TYPE E6** with Dashpot-Select where high lift is desired or special flow requirements encountered.

RULE 3. When pressure drop across valve is between 5 and 10 psi:

(a) TYPE E5 - Select for pressure drops not less than 5 psi.

(b) **TYPE E6** with Dashpot-Select if auxiliary operation is possible.

Together with the above rules, reference should be made to the Main Valve Specification Table for maximum initial pressures and temperatures and “minimum differentials” for the several types of Main Valves.