# SECTION X
# REFERENCE & PIPING DESIGN

# GLOSSARY OF TERMS

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**PRESSURE REGULATOR—**A self-operated device, either pilot or direct operated, in which power to position the valve closure member is provided by the pressure of the controlled variable.

**PRESSURE REDUCING REGULATOR—**A device that controls and responds to changes in its outlet pressure.

**BACK PRESSURE REGULATOR—**A device that controls and responds to change in its inlet pressure.

**DIFFERENTIAL PRESSURE REGULATOR—**A device that maintains a constant differential pressure between a reference pressure and the pressure of the controlled fluid.

**PUMP PRESSURE REGULATOR—**A device that controls the speed of a pump in response to changes in pump discharge pressure.

**TEMPERATURE REGULATOR—**A self operated device in which the energy to position valve closure member(s) is provided by changes of temperature energy of the controlled variable.

**DIRECT OPERATED—**A regulator that uses a temperature thermal system to directly provide the power to move the plug.

**PILOT OPERATED—**A regulator that uses a temperature thermal system to power a pilot mechanism which generates an amplified signal to position the plug of the regulator. The pilot may be internal or external.

**PRESSURE TEMPERATURE—**A dual function piloted regulator combining the control of both temperature and pressure. Control of pressure and temperature may be by a single pilot or multiple pilots. Pilot(s) may be internal or external or these functions in combination may be available.

**DIAPHRAGM ACTUATED REGULATOR—**A regulator utilizing a diaphragm as the position actuator.

**ACCURACY OF REGULATION** is the value of controlled variable (pressure, or differential pressure) expressed as a percentage of the set value (at minimum controllable flow) when with a constant supply pressure the flow through the regulator is increased from the minimum controllable flow to the rated capacity (also equal to 100% minus the offset (droop) %).

**MINIMUM CONTROLLABLE FLOW** is the lowest flow at which a steady regulated condition of the controlled variable can be maintained.

**FLOW COEFFICIENT (Cv)** is the regulator capacity in GPM of H2O at 20 degrees C with one PSI pressure drop at full rated travel. Refer to ISA S75.01 and S75.02 for Testing Procedures and Sizing Equations.

**DEAD BAND—**The range through which the controlled variable can reverse direction without and observable regulator response.

**REPEATABILITY—**Ability to return to any defined point within stated limits of regulation within a specified tolerance.

**DRIFT—**A change in set point over an extended period of time.

**REVERSE ACTION—**A regulator that increases its output as the measured variable increases.

**DIRECT ACTION—**A regulator that decreases its output as the measured variable increases.

**PACKLESS—**A construction that does not employ a dynamic seal isolating internal fluid from ambient or atmosphere.

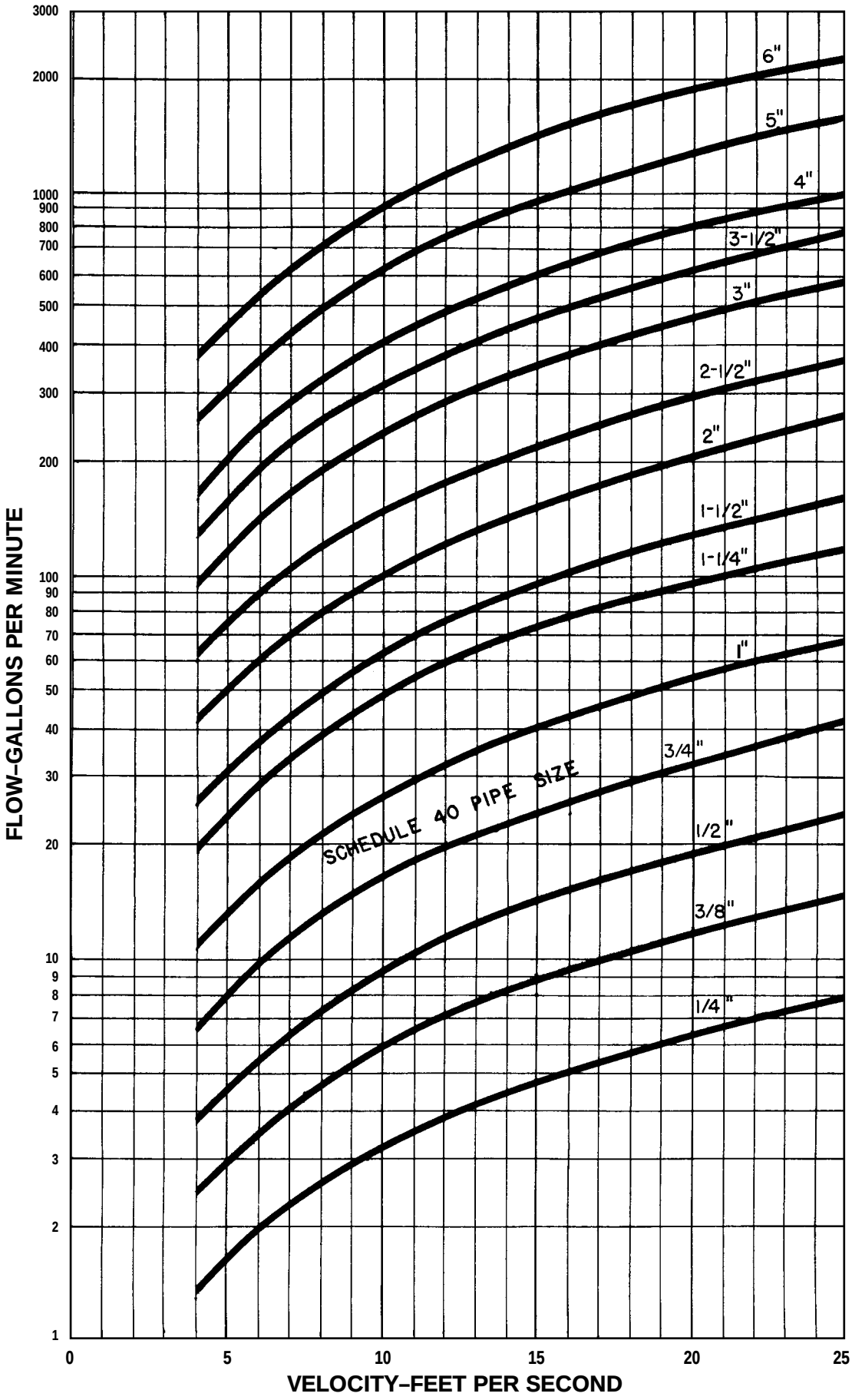
**BALANCED—**A regulator style featuring a pressure balanced plug. May be single or double seated.

**UNBALANCED—**A regulator where the plug closure number is not pressure balanced. Generally a single regulator.

**DROOP—**See accuracy of regulation.

# FLOW VS. VELOCITY CHART

**(Specific Gravity of 1)**



# FLANGE STANDARDS

## 125 lb. CAST IRON — ANSI STANDARD B16.1

| Pipe Size | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Flange | — | — | 4 1/4 | 4 5/8 | 5 | 6 | 7 | 7 1/2 | 8 1/2 | 9 | 10 | 11 | 13 1/2 | 16 | 19 |
| Thickness of Flange (min)[a] | — | — | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 15/16 | 15/16 | 1 | 1 1/8 | 1 3/16 | 1 1/4 |
| Diameter of Bolt Circle | — | — | 3 1/8 | 3 1/2 | 3 7/8 | 4 3/4 | 5 1/2 | 6 | 7 | 7 1/2 | 8 1/2 | 9 1/2 | 11 3/4 | 14 1/4 | 17 |
| Number of Bolts | — | — | 4 | 4 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 12 | 12 |
| Diameter of Bolts | — | — | 1/2 | 1/2 | 1/2 | 5/8 | 5/8 | 5/8 | 5/8 | 5/8 | 3/4 | 3/4 | 3/4 | 7/8 | 7/8 |

[a] 125 lb. cast iron flanges have plain faces.

## 250 lb. CAST IRON — ANSI STANDARD B16.1

| Pipe Size | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Flange | — | — | 4 7/8 | 5 1/4 | 6 1/8 | 6 1/2 | 7 1/2 | 8 1/4 | 9 | 10 | 11 | 12 1/2 | 15 | 17 1/2 | 20 1/2 |
| Thickness of Flange (min)[b] | — | — | 11/16 | 3/4 | 13/16 | 7/8 | 1 | 1 1/8 | 1 3/16 | 1 1/4 | 1 3/8 | 1 7/16 | 1 5/8 | 1 7/8 | 2 |
| Diameter of Raised Face | — | — | 2 11/16 | 3 1/16 | 3 9/16 | 4 3/16 | 4 15/16 | 5 11/16 | 6 5/16 | 6 15/16 | 8 5/16 | 9 11/16 | 11 15/16 | 14 1/16 | 16 7/16 |
| Diameter of Bolt Circle | — | — | 3 1/2 | 3 7/8 | 4 1/2 | 5 | 5 7/8 | 6 5/8 | 7 1/4 | 7 7/8 | 9 1/4 | 10 5/8 | 13 | 15 1/4 | 17 3/4 |
| Number of Bolts | — | — | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 12 | 12 | 16 | 16 |
| Diameter of Bolts | — | — | 5/8 | 5/8 | 3/4 | 5/8 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 7/8 | 1 | 1 1/8 |

[b] 250 lb. cast iron flanges have a 1/16" raised face which is included in the flange thickness dimensions.

## 150 lb. BRONZE — ANSI STANDARD B16.24

| Pipe Size | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Flange | 3 1/2 | 3 7/8 | 4 1/4 | 4 5/8 | 5 | 6 | 7 | 7 1/2 | 8 1/2 | 9 | 10 | 11 | 13 1/2 | 16 | 19 |
| Thickness of Flange (min)[c] | 5/16 | 11/32 | 3/8 | 13/32 | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 11/16 | 3/4 | 13/16 | 15/16 | 1 | 1 1/16 |
| Diameter of Bolt Circle | 2 3/8 | 2 3/4 | 3 1/8 | 3 1/2 | 3 7/8 | 4 3/4 | 5 1/2 | 6 | 7 | 7 1/2 | 8 1/2 | 9 1/2 | 11 3/4 | 14 1/4 | 17 |
| Number of Bolts | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 12 | 12 |
| Diameter of Bolts | 1/2 | 1/2 | 1/2 | 1/2 | 1/2 | 5/8 | 5/8 | 5/8 | 5/8 | 5/8 | 3/4 | 3/4 | 3/4 | 7/8 | 7/8 |

[c] 150 lb. bronze flanges have plain faces with two concentric gasket-retaining grooves between the port and the bolt holes.

## 300 lb. BRONZE — ANSI STANDARD B16.24

| Pipe Size | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Flange | 3 3/4 | 4 5/8 | 4 7/8 | 5 1/4 | 6 1/2 | 6 1/2 | 7 1/2 | 8 1/4 | 9 | 10 | 11 | 12 1/2 | 15 | — | — |
| Thickness of Flange (min)[d] | 1/2 | 17/32 | 19/32 | 5/8 | 11/16 | 3/4 | 13/16 | 29/32 | 31/32 | 1 1/16 | 1 1/8 | 1 3/16 | 1 3/8 | | |
| Diameter of Bolt Circle | 2 5/8 | 3 1/4 | 3 1/2 | 3 7/8 | 4 1/2 | 5 | 5 7/8 | 6 5/8 | 7 1/4 | 7 7/8 | 9 1/4 | 10 5/8 | 13 | | |
| Number of Bolts | 4 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 12 | 12 | | |
| Diameter of Bolts | 1/2 | 5/8 | 5/8 | 5/8 | 3/4 | 5/8 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 7/8 | | |

[d] 300 lb. bronze flanges have plain faces with two concentric gasket-retaining grooves between the port and the bolt holes.

## 150 lb. STEEL — ANSI STANDARD B16.5

| Pipe Size | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Flange | — | — | 4 | 4 5/8 | 5 | 6 | 7 | 7 1/2 | 8 1/2 | 9 | 10 | 11 | 13 1/2 | 16 | 19 |
| Thickness of Flange (min)[e] | — | — | 7/16 | 1/2 | 9/16 | 5/8 | 11/16 | 3/4 | 13/16 | 15/16 | 15/16 | 1 | 1 1/8 | 1 3/16 | 1 1/4 |
| Diameter of Raised Face | — | — | 2 | 2 1/2 | 2 7/8 | 3 5/8 | 4 1/8 | 5 | 5 1/2 | 6 3/16 | 7 5/16 | 8 1/2 | 10 5/8 | 12 3/4 | 15 |
| Diameter of Bolt Circle | — | — | 3 1/8 | 3 1/2 | 3 7/8 | 4 3/4 | 5 1/2 | 6 | 7 | 7 1/2 | 8 1/2 | 9 1/2 | 11 3/4 | 14 1/4 | 17 |
| Number of Bolts | — | — | 4 | 4 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 12 | 12 |
| Diameter of Bolts | — | — | 1/2 | 1/2 | 1/2 | 5/8 | 5/8 | 5/8 | 5/8 | 5/8 | 3/4 | 3/4 | 3/4 | 7/8 | 7/8 |

[e] 150 lb. steel flanges have a 1/16" raised face which is included in the flange thickness dimensions.

## 300 lb. STEEL — ANSI STANDARD B16.5

| Pipe Size | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Flange | — | — | 4 7/8 | 5 1/4 | 6 1/8 | 6 1/2 | 7 1/2 | 8 1/4 | 9 | 10 | 11 | 12 1/2 | 15 | 17 1/2 | 20 1/2 |
| Thickness of Flange (min)[f] | — | — | 11/16 | 3/4 | 13/16 | 7/8 | 1 | 1 1/8 | 1 3/16 | 1 1/4 | 1 3/8 | 1 7/16 | 1 5/8 | 1 7/8 | 2 |
| Diameter of Raised Face | — | — | 2 | 2 1/2 | 2 7/8 | 3 5/8 | 4 1/8 | 5 | 5 1/2 | 6 3/16 | 7 5/16 | 8 1/2 | 10 5/8 | 12 3/4 | 15 |
| Diameter of Bolt Circle | — | — | 3 1/2 | 3 7/8 | 4 1/2 | 5 | 5 7/8 | 6 5/8 | 7 1/4 | 7 7/8 | 9 1/4 | 10 5/8 | 13 | 15 1/4 | 17 3/4 |
| Number of Bolts | — | — | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 12 | 12 | 16 | 16 |
| Diameter of Bolts | — | 5/8 | 5/8 | 3/4 | 5/8 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 3/4 | 7/8 | 1 | 1 1/8 |

[f] 300 lb. steel flanges have a 1/16" raised face which is included in the flange thickness dimensions.

## 400 lb. STEEL — ANSI STANDARD B16.5

| Pipe Size | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Flange | 33/4 | 4 5/8 | 4 7/8 | 5 1/4 | 6 1/8 | 6 1/2 | 7 1/2 | 8 1/4 | 9 | 10 | 11 | 12 1/2 | 15 | 17 1/2 | 20 1/2 |
| Thickness of Flange (min)[g] | 9/16 | 5/8 | 11/16 | 13/16 | 7/8 | 1 | 1 1/8 | 1 1/4 | 1 3/8 | 1 3/8 | 1 1/2 | 1 5/8 | 1 7/8 | 2 1/8 | 2 1/4 |
| Diameter of Raised Face | 1/38 | 1 11/16 | 2 | 2 1/2 | 2 7/8 | 3 5/8 | 4 1/8 | 5 | 5 1/2 | 6 3/16 | 7 5/16 | 8 1/2 | 10 5/8 | 12 3/4 | 15 |
| Diameter of Bolt Circle | 25/8 | 3 1/4 | 3 1/2 | 3 7/8 | 4 1/2 | 5 | 5 7/8 | 6 5/8 | 7 1/4 | 7 7/8 | 9 1/4 | 10 5/8 | 13 | 15 1/4 | 17 3/4 |
| Number of Bolts | 4 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 12 | 12 | 16 | 16 |
| Diameter of Bolts | 1/2 | 5/8 | 5/8 | 5/8 | 3/4 | 5/8 | 3/4 | 3/4 | 7/8 | 7/8 | 7/8 | 7/8 | 1 | 1 1/8 | 1 1/4 |

[g] 400 lb. steel flanges have a 1/4" raised face which is included in the flange thickness dimensions.

## 600 lb. STEEL — ANSI STANDARD B16.5

| Pipe Size | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of Flange | 3 3/4 | 4 5/8 | 4 7/8 | 5 1/4 | 6 1/8 | 6 1/2 | 7 1/2 | 8 1/4 | 9 | 10 3/4 | 13 | 14 | 16 1/2 | 20 | 22 |
| Thickness of Flange (min)[h] | 9/16 | 5/8 | 11/16 | 13/16 | 7/8 | 1 | 1 1/8 | 1 1/4 | 1 3/8 | 1 1/2 | 1 3/4 | 1 7/8 | 2 3/16 | 2 1/2 | 2 5/8 |
| Diameter of Raised Face | 1 3/8 | 1 11/16 | 2 | 2 1/2 | 2 7/8 | 3 5/8 | 4 1/8 | 5 | 5 1/2 | 6 3/16 | 7 5/16 | 8 1/2 | 10 5/8 | 12 3/4 | 15 |
| Diameter of Bolt Circle | 2 5/8 | 3 1/4 | 3 1/2 | 3 7/8 | 4 1/2 | 5 | 5 7/8 | 6 5/8 | 7 1/4 | 8 1/2 | 10 1/2 | 11 1/2 | 13 3/4 | 17 | 19 1/4 |
| Number of Bolts | 4 | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 | 8 | 8 | 12 | 12 | 16 | 20 |
| Diameter of Bolts | 1/2 | 5/8 | 5/8 | 5/8 | 3/4 | 5/8 | 3/4 | 3/4 | 7/8 | 7/8 | 1 | 1 | 1 1/8 | 1 1/4 | 1 1/4 |

[h] 600 lb. steel flanges have a 1/4" raised face which is included in the flange thickness dimensions.

# CONVERSION TABLES

## LIQUID WEIGHTS and MEASURES

| To Convert | To | Multiply By |
|---|---|---|
| Gallons | Liters | 3.7853 |
| Gallons | Cu. Inches | 231 |
| Gallons | Cu. Feet | 0.1337 |
| Gallons | Cu. Meters | 0.00379 |
| Gallons | Lbs. of Water | 8.339 |
| Liters | Gallons | 0.26418 |
| Liters | Cu. Inches | 61.025 |
| Liters | Cu. Feet | 0.0353 |
| Liters | Cu. Meters | 0.001 |
| Liters | Lbs. of Water | 2.202 |
| Cu. Inches | Gallons | 0.00433 |
| Cu. Inches | Liters | 0.01639 |
| Cu. Inches | Cu. Feet | 0.00058 |
| Cu. Inches | Cu. Meters | 0.000016 |
| Cu. Inches | Lbs. of Water | 0.0362 |
| Cu. Feet | Gallons | 7.48052 |
| Cu. Feet | Liters | 28.316 |
| Cu. Feet | Cu. Inches | 1728 |
| Cu. Feet | Cu. Meters | 0.0283 |
| Cu. .Feet | Lbs. of Water | 62.371 |
| Cu. Meters | Gallons | 264.17 |
| Cu. Meters | Liters | 999.972 |
| Cu. Meters | Cu. Inches | 61023.74 |
| Cu. Meters | Cu. Feet | 35.3145 |
| Cu. Meters. | Lbs. of Water | 2202.61 |
| Lbs. of Water | Gallons | 0.11992 |
| Lbs. of Water | Liters | 0.45419 |
| Lbs. of Water | Cu. Inches | 27.643 |
| Lbs. of Water | Cu. Feet | 0.01603 |
| Lbs. of Water | Cu. Meters | 0.000454 |

### LINEAL MEASURES

| | | |
|---|---|---|
| Inches | mm | 25.4 |
| Inches | cm | 2.54 |
| Inches | Meters | 0.0254 |
| Feet | cm | 30.48 |
| Feet | Meters | 0.3048 |
| mm | Inches | 0.03937 |
| mm | Feet | 0.00328 |
| cm | Inches | 0.3937 |
| cm | Feet | 0.03281 |
| Meters | Feet | 3.28 |

### AREA

| | | |
|---|---|---|
| Sq. Inches | Sq. Feet | 0.006944 |
| Sq. Inches | Sq. cm | 6.4516 |
| Sq. Feet | Sq. Inches | 144 |
| Sq. Feet | Sq. cm | 929.03 |
| Sq. Feet | Sq. Meters | 0.0929 |
| Sq. cm | Sq. Inches | 0.155 |
| Sq. cm | Sq. Feet | 0.00108 |
| Sq. cm | Sq. Meters | 0.0001 |
| Sq. Meter | Sq. Inches | 1550 |
| Sq. Meter | Sq. Feet | 10.76 |

## CONVERSIONS of PRESSURE AND HEAD

| To Convert | To | Multiply By |
|---|---|---|
| Lbs .per Sq .In. | Lbs. per Sq. Ft. | 144 |
| Lbs. per Sq. In. | Atmospheres | 0.06805 |
| Lbs. per Sq. In. | Ins. of Water | 27.728 |
| Lbs. per Sq. In. | Ft. of Water | 2.3106 |
| Lbs. per Sq. In. | Ins. of Mercury | 2.03602 |
| Lbs. per Sq. In. | mm of Mercury | 51.715 |
| Lbs. per Sq. In. | Bar | 0.06895 |
| Lbs. per Sq. In. | kg per Sq. cm | 0.070307 |
| Lbs. per Sq. In. | kg per Sq. M | 703.070 |
| Lbs. per Sq. Ft. | Lbs. per Sq. In. | 0.0069445 |
| Lbs. per Sq. Ft. | Atmospheres | 0.000473 |
| Lbs. per Sq. Ft. | Ins. of Water | 0.1926 |
| Lbs. per Sq. Ft. | Ft. of Water | 0.01605 |
| Lbs. per Sq. Ft. | Ins. of Mercury | 0.014139 |
| Lbs. per Sq. Ft. | mm of Mercury | 0.35913 |
| Lbs. per Sq. Ft. | Bar | 0.000479 |
| Lbs. per Sq. Ft. | kg per Sq. cm | 0.000488 |
| Lbs. per Sq. Ft. | kg per Sq. M | 4.88241 |
| Atmospheres | Lbs. per Sq. In. | 14.696 |
| Atmospheres | Lbs. per Sq. Ft. | 2116.22 |
| Atmospheres | Ins. of Water | 407.484 |
| Atmospheres | Ft. of Water | 33.957 |
| Atmospheres | Ins. of Mercury | 29.921 |
| Atmospheres | mm of Mercury | 760 |
| Atmospheres | Bar | 1.01325 |
| Atmospheres | kg per Sq. cm | 1.0332 |
| Atmospheres | kg per Sq. M | 10332.27 |
| Ins. of Water | Lbs. per Sq. In. | 0.03609 |
| Ins. of Water | Lbs. per Sq. Ft. | 5.1972 |
| Ins. of Water | Atmospheres | 0.002454 |
| Ins.of Water | Ft. of Water | 0.08333 |
| Ins. of Water | Ins. of Mercury | 0.07343 |
| Ins. of Water | mm of Mercury | 1.8651 |
| Ins. of Water | Bar | 0.00249 |
| Ins. of Water | kg per Sq. cm | 0.00253 |
| Ins. of Water | kg per Sq. M | 25.375 |
| Ft. of Water | Lbs. per Sq. In. | 0.432781 |
| Ft. of Water | Lbs. per Sq. Ft. | 63.3205 |
| Ft. of Water | Atmospheres | 0.029449 |
| Ft. of Water | Ins. of Water | 12 |
| Ft. of Water | Ins. of Mercury | 0.88115 |
| Ft. of Water | mm of Mercury | 22.3813 |
| Ft. of Water | Bar | 0.029839 |
| Ft. of Water | kg per Sq. cm | 0.03043 |
| Ft. of Water | kg per Sq. M | 304.275 |
| Ins. of Mercury | Lbs. per Sq. In. | 0.491154 |
| Ins. of Mercury | Lbs. per Sq. Ft. | 70.7262 |
| Ins. of Mercury | Atmospheres | 0.033421 |
| Ins. of Mercury | Ins. of Water | 13.6185 |
| Ins. of Mercury | Ft. of Water | 1.1349 |
| Ins. of Mercury | mm of Mercury | 25.40005 |
| Ins. of Mercury | Bar | 0.033864 |
| Ins. of Mercury | kg per Sq. cm | 0.03453 |
| Ins. of Mercury | kg per Sq. M | 345.316 |
| mm of Mercury | Lbs. per Sq. In. | 0.019337 |
| mm of Mercury | Lbs. per Sq. Ft. | 2.7845 |
| mm of Mercury | Atmospheres | 0.001316 |
| mm of Mercury | Ins. of Water | 0.53616 |
| mm of Mercury | Ft. of Water | 0.04468 |
| mm of Mercury | Ins. of Mercury | 0.03937 |
| mm of Mercury | Bar | 0.00133 |
| mm of Mercury | kg per Sq. cm | 0.00136 |
| mm of Mercury | kg per Sq. M | 13.59509 |
| kg per Sq. cm | Lbs. per Sq. In. | 14.2233 |
| kg per Sq. cm | Lbs. per Sq. Ft. | 2048.155 |
| kg per Sq. cm | Atmospheres | 0.96784 |
| kg per Sq. cm | Ins. of Water | 394.38 |
| kg per Sq. cm | Ft. of Water | 32.865 |
| kg per Sq. cm | Ins. of Mercury | 28.959 |
| kg per Sq. cm | mm of Mercury | 735.559 |
| kg per Sq. cm | Bar | 0.98067 |
| kg per Sq. cm | kg per Sq. M | 10000 |

Note: All weights and measures of water are based on temperature of 60°F.

Note: Temperature of Water and Mercury is 68°F and 32°F respectively.

### TEMPERATURE

To convert Fahrenheit to Celsius: $\frac{°F - 32}{1.8}$

To convert Celsius to Fahrenheit: (1.8 x °C) + 32

### VELOCITY

1 Ft per Sec. = 0.3048 M Per Sec.

1 M per Sec. = 3.2808 Ft. per Sec.

# PRESSURE TO VACUUM

| Gage Indicated | | Absolute Pressure | | |
|---|---|---|---|---|
| PSIG | Inches of Hg | PSIA | Inches of Hg | Torricelli |
| -14.70000 | 29.92000 | 0.0 | 0.0 | 0.0 |
| -14.69998 | 29.91996 | 0.00002 | 0.00004 | 0.001 |
| -14.69996 | 29.91992 | 0.00004 | 0.00008 | 0.002 |
| -14.69994 | 29.91988 | 0.00006 | 0.00012 | 0.003 |
| -14.69992 | 29.91984 | 0.00008 | 0.00016 | 0.004 |
| -14.69990 | 29.91980 | 0.00010 | 0.00020 | 0.005 |
| -14.69981 | 29.91961 | 0.00019 | 0.00039 | 0.010 |
| -14.69961 | 29.91921 | 0.00039 | 0.00079 | 0.020 |
| -14.69942 | 29.91882 | 0.00058 | 0.00118 | 0.030 |
| -14.69923 | 29.91843 | 0.00077 | 0.00157 | 0.040 |
| -14.69903 | 29.91803 | 0.00097 | 0.00197 | 0.050 |
| -14.69806 | 29.91606 | 0.00194 | 0.00394 | 0.100 |
| -14.69613 | 29.91212 | 0.00387 | 0.00788 | 0.200 |
| -14.69449 | 29.90818 | 0.00551 | 0.01182 | 0.300 |
| -14.69226 | 29.90424 | 0.00774 | 0.01576 | 0.400 |
| -14.69032 | 29.90030 | 0.00968 | 0.01970 | 0.500 |
| -14.68066 | 29.88063 | 0.01934 | 0.03937 | 1.000 |
| -14.66698 | 29.84126 | 0.03302 | 0.07874 | 2.000 |
| -14.64197 | 29.80189 | 0.05803 | 0.11811 | 3.000 |
| -14.62262 | 29.76252 | 0.07738 | 0.15748 | 4.000 |
| -14.60329 | 29.72315 | 0.09671 | 0.19685 | 5.000 |
| -14.50658 | 29.52630 | 0.19342 | 0.39370 | 10.000 |
| -14.40980 | 29.32940 | 0.29020 | 0.59060 | 15.000 |
| -14.31320 | 29.13260 | 0.38680 | 0.78740 | 20.000 |
| -14.21840 | 28.93570 | 0.48160 | 0.98430 | 25.000 |
| -14.20870 | 28.920 | 0.49130 | 1.000 | 25.400 |
| -14.11970 | 28.740 | 0.58030 | 1.181 | 30.000 |
| -13.75700 | 28.000 | 0.94330 | 1.920 | 48.770 |
| -12.28300 | 25.000 | 2.41700 | 4.920 | 124.970 |
| -10.31800 | 21.000 | 4.38200 | 8.920 | 226.570 |
| -8.84400 | 18.000 | 5.85600 | 11.920 | 302.770 |
| -7.37000 | 15.000 | 7.320 | 14.920 | 378.970 |
| -5.89600 | 12.000 | 8.804 | 17.920 | 455.770 |
| -4.91300 | 10.000 | 9.787 | 19.920 | 505.970 |
| -3.93000 | 8.000 | 10.770 | 21.920 | 556.770 |
| -2.94800 | 6.000 | 11.752 | 23.920 | 607.570 |
| -1.96500 | 4.000 | 12.735 | 25.920 | 658.370 |
| -0.98300 | 2.000 | 13.732 | 27.920 | 709.170 |
| -0.49100 | 1.000 | 14.209 | 28.920 | 733.570 |
| -0.24600 | 0.500 | 14.454 | 29.420 | 747.270 |
| ATMOSPHERIC | | | | |
| 0.0 | 0.0 | 14.700 | 29.920 | 760.000 |
| + 0.30 | | 15.000 | 30.540 | 775.720 |
| + 1.00 | | 15.700 | 31.970 | 811.910 |
| + 2.00 | | 16.700 | 34.000 | 863.630 |
| + 10.00 | | 24.700 | 50.290 | 277.35 |

# PROPERTIES OF WATER

| Water Temp. | Saturation Pressure | Weight | Weight Density | Specific Volume |
|---|---|---|---|---|
| Deg. F | PSIA | lbs/Gallon | lbs/Cu.Ft. | Cu.Ft./lb |
| 32 | 0.0886 | 8.344 | 62.414 | 0.016022 |
| 40 | 0.1216 | 8.345 | 62.426 | 0.016019 |
| 50 | 0.1780 | 8.343 | 62.410 | 0.016023 |
| 60 | 0.2561 | 8.338 | 62.371 | 0.016033 |
| 70 | 0.3629 | 8.329 | 62.305 | 0.016050 |
| 80 | 0.5068 | 8.318 | 62.220 | 0.016072 |
| 90 | 0.6981 | 8.304 | 62.116 | 0.016099 |
| 100 | 0.9492 | 8.288 | 61.996 | 0.016130 |
| 110 | 1.2750 | 8.270 | 61.862 | 0.016165 |
| 120 | 1.6927 | 8.250 | 61.713 | 0.016204 |
| 130 | 2.2230 | 8.228 | 61.550 | 0.016247 |
| 140 | 2.8892 | 8.205 | 61.376 | 0.016293 |
| 150 | 3.7184 | 8.180 | 61.188 | 0.016343 |
| 160 | 4.7414 | 8.154 | 60.994 | 0.016395 |
| 170 | 5.9926 | 8.126 | 60.787 | 0.016451 |
| 180 | 7.5110 | 8.097 | 60.569 | 0.016510 |
| 190 | 9.340 | 8.067 | 60.343 | 0.016572 |
| 200 | 11.526 | 8.035 | 60.107 | 0.016637 |
| 210 | 14.123 | 8.002 | 59.862 | 0.016705 |
| 212 | 14.696 | 7.996 | 59.812 | 0.016719 |
| 220 | 17.186 | 7.969 | 59.613 | 0.016775 |
| 240 | 24.968 | 7.898 | 59.081 | 0.016926 |
| 260 | 35.427 | 7.823 | 58.517 | 0.017089 |
| 280 | 49.200 | 7.743 | 57.924 | 0.017264 |
| 300 | 67.005 | 7.661 | 57.307 | 0.01745 |
| 350 | 134.604 | 7.431 | 55.586 | 0.01799 |
| 400 | 247.259 | 7.172 | 53.648 | 0.01864 |
| 450 | 422.55 | 6.880 | 51.467 | 0.01943 |
| 500 | 680.86 | 6.543 | 48.948 | 0.02043 |
| 550 | 1045.43 | 6.143 | 45.956 | 0.02176 |
| 600 | 1543.2 | 5.655 | 42.301 | 0.02364 |
| 650 | 2208.4 | 4.999 | 37.397 | 0.02674 |
| 700 | 3094.3 | 3.651 | 27.307 | 0.03662 |

**NOTE:**
Weight of water per gallon is based on 7.48052 gallons per cubic foot.

Specific gravity of water @ 60°F = 1.00

# PIPE DATA TABLES

| Pipe Size (in.) | Outside Diameter (in.) | Weight Class | Carbon Steel Sched. | Stainless Steel Sched. | Wall Thickness (in.) | Inside Diameter (in.) | Circum. (Ext.) (in.) | Circum (Int.) (in.) | Flow Area (sq. in.) | Weight of Pipe (lbs/Ft.) | Weight of Water (lbs/Ft.) | Gallons of Water per Ft. | Section Modulus | Pipe Size (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | — | — | 10S | .049 | .307 | | .96 | .074 | .19 | .032 | .004 | .00437 | |
| 1/8 | .405 | STD | 40 | 40S | .068 | .269 | 1.27 | .85 | .057 | .24 | .025 | .003 | .00523 | 1/8 |
| | | XS | 80 | 80S | .095 | .215 | | .68 | .036 | .31 | .016 | .002 | .00602 | |
| | | — | — | 10S | .065 | .410 | | 1.29 | .132 | .33 | .057 | .007 | .01032 | |
| 1/4 | .540 | STD | 40 | 40S | .088 | .364 | 1.70 | 1.14 | .104 | .42 | .045 | .005 | .01227 | 1/4 |
| | | XS | 80 | 80S | .119 | .302 | | .95 | .072 | .54 | .031 | .004 | .01395 | |
| | | — | — | 10S | .065 | .545 | | 1.71 | .233 | .42 | .101 | .012 | .01736 | |
| 3/8 | .675 | STD | 40 | 40S | .091 | .493 | 2.12 | 1.55 | .191 | .57 | .083 | .010 | .0216 | 3/8 |
| | | XS | 80 | 80S | .126 | .423 | | 1.33 | .141 | .74 | .061 | .007 | .0255 | |
| | | — | — | 5S | .065 | .710 | | 2.23 | .396 | .54 | .172 | .021 | .0285 | |
| | | — | — | 10S | .083 | .674 | | 2.12 | .357 | .67 | .155 | .019 | .0341 | |
| | | STD | 40 | 40S | .109 | .622 | | 1.95 | .304 | .85 | .132 | .016 | .0407 | |
| 1/2 | .840 | XS | 80 | 80S | .147 | .546 | 2.64 | 1.72 | .234 | 1.09 | .102 | .012 | .0478 | 1/2 |
| | | — | 160 | — | .187 | .466 | | 1.46 | .171 | 1.31 | .074 | .009 | .0527 | |
| | | XXS | — | — | .294 | .252 | | .79 | .050 | 1.71 | .022 | .003 | .0577 | |
| | | — | — | 5S | .065 | .920 | | 2.89 | .665 | .69 | .288 | .035 | .0467 | |
| | | — | — | 10S | .083 | .884 | | 2.78 | .614 | .86 | .266 | .032 | .0566 | |
| | | STD | 40 | 40S | .113 | .824 | 3.30 | 2.59 | .533 | 1.13 | .231 | .028 | .0706 | |
| 3/4 | 1.050 | XS | 80 | 80S | .154 | .742 | | 2.33 | .433 | 1.47 | .188 | .022 | .0853 | 3/4 |
| | | — | 160 | — | .219 | .612 | | 1.92 | .296 | 1.94 | .128 | .015 | .1004 | |
| | | XXS | — | — | .308 | .434 | | 1.36 | .148 | 2.44 | .064 | .008 | .1103 | |
| | | — | — | 5S | .065 | 1.185 | | 3.72 | 1.103 | .87 | .478 | .057 | .0760 | |
| | | — | — | 10S | .109 | 1.097 | | 3.45 | .945 | 1.40 | .409 | .049 | .1151 | |
| | | STD | 40 | 40S | .133 | 1.049 | 4.13 | 3.30 | .864 | 1.68 | .375 | .045 | .1328 | |
| 1 | 1.315 | XS | 80 | 80S | .179 | .957 | | 3.01 | .719 | 2.17 | .312 | .037 | .1606 | 1 |
| | | — | 160 | — | .250 | .815 | | 2.56 | .522 | 2.84 | .230 | .027 | .1903 | |
| | | XXS | — | — | .358 | .599 | | 1.88 | .282 | 3.66 | .122 | .015 | .2136 | |
| | | — | — | 5S | .065 | 1.530 | | 4.81 | 1.839 | 1.11 | .797 | .096 | .1250 | |
| | | — | — | 10S | .109 | 1.442 | | 4.53 | 1.633 | 1.81 | .708 | .085 | .1934 | |
| | | STD | 40 | 40S | .140 | 1.380 | | 4.34 | 1.495 | 2.27 | .649 | .078 | .2346 | |
| 1 1/4 | 1.660 | XS | 80 | 80S | .191 | 1.278 | 5.22 | 4.02 | 1.283 | 3.00 | .555 | .067 | .2913 | 1 1/4 |
| | | — | 160 | — | .250 | 1.160 | | 3.64 | 1.057 | 3.76 | .458 | .055 | .3421 | |
| | | XXS | — | — | .382 | .896 | | 2.81 | .630 | 5.21 | .273 | .033 | .4110 | |
| | | — | — | 5S | .065 | 1.770 | | 5.56 | 2.461 | 1.28 | 1.066 | .128 | .1662 | |
| | | — | — | 10S | .109 | 1.682 | | 5.28 | 2.222 | 2.09 | .963 | .115 | .2598 | |
| | | STD | 40 | 40S | .145 | 1.610 | 5.97 | 5.06 | 2.036 | 2.72 | .882 | .106 | .3262 | |
| 1 1/2 | 1.900 | XS | 80 | 80S | .200 | 1.500 | | 4.71 | 1.767 | 3.63 | .765 | .092 | .4118 | 1 1/2 |
| | | — | 160 | — | .281 | 1.338 | | 4.20 | 1.406 | 4.86 | .608 | .073 | .5078 | |
| | | XXS | — | — | .400 | 1.100 | | 3.46 | .950 | 6.41 | .420 | .049 | .5977 | |
| | | — | — | 5S | .065 | 2.245 | | 7.05 | 3.958 | 1.61 | 1.72 | .206 | .2652 | |
| | | — | — | 10S | .109 | 2.157 | | 6.78 | 3.654 | 2.64 | 1.58 | .190 | .4204 | |
| | | STD | 40 | 40S | .154 | 2.067 | | 6.49 | 3.355 | 3.65 | 1.45 | .174 | .5606 | |
| 2 | 2.375 | XS | 80 | 80S | .218 | 1.939 | 7.46 | 6.09 | 2.953 | 5.02 | 1.28 | .153 | .7309 | 2 |
| | | — | 160 | — | .344 | 1.687 | | 5.30 | 2.241 | 7.46 | .97 | .116 | .9790 | |
| | | XXS | — | — | .436 | 1.503 | | 4.72 | 1.774 | 9.03 | .77 | .092 | 1.1040 | |
| | | — | — | 5S | .083 | 2.709 | | 8.51 | 5.764 | 2.48 | 2.50 | .299 | .4939 | |
| | | — | — | 10S | .120 | 2.635 | | 8.28 | 5.453 | 3.53 | 2.36 | .283 | .6868 | |
| | | STD | 40 | 40S | .203 | 2.469 | | 7.76 | 4.788 | 5.79 | 2.07 | .249 | 1.064 | |
| 2 1/2 | 2.875 | XS | 80 | 80S | .276 | 2.323 | 9.03 | 7.30 | 4.238 | 7.66 | 1.87 | .220 | 1.339 | 2 1/2 |
| | | — | 160 | — | .375 | 2.125 | | 6.68 | 3.546 | 10.01 | 1.54 | .184 | 1.638 | |
| | | XXS | — | — | .552 | 1.771 | | 5.56 | 2.464 | 13.69 | 1.07 | .128 | 1.997 | |

# PIPE DATA TABLES CONT'D.

| Pipe Size (in.) | Outside Diameter (in.) | Weight Class | Carbon Steel Sched. | Stainless Steel Sched. | Wall Thickness (in.) | Inside Diameter (in.) | Circum. (Ext.) (in.) | Circum (Int.) (in.) | Flow Area (sq. in.) | Weight of Pipe (lbs/Ft.) | Weight of Water (lbs/Ft.) | Gallons of Water per Ft. | Section Modulus | Pipe Size (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | — | — | 5S | .083 | 3.334 | | 10.47 | 8.730 | 3.03 | 3.78 | .454 | .744 | |
| | | — | — | 10S | .120 | 3.260 | | 10.24 | 8.347 | 4.33 | 3.62 | .434 | 1.041 | |
| | | STD | 40 | 40S | .216 | 3.068 | | 9.64 | 7.393 | 7.58 | 3.20 | .384 | 1.724 | |
| 3 | 3.500 | XS | 80 | 80S | .300 | 2.900 | 11.00 | 9.11 | 6.605 | 10.25 | 2.86 | .343 | 2.225 | 3 |
| | | — | 160 | — | .438 | 2.624 | | 8.24 | 5.408 | 14.32 | 2.35 | .281 | 2.876 | |
| | | XXS | — | — | .600 | 2.300 | | 7.23 | 4.155 | 18.58 | 1.80 | .216 | 3.424 | |
| | | — | — | 5S | .083 | 4.334 | | 13.62 | 14.75 | 3.92 | 6.39 | .766 | 1.249 | |
| | | — | — | 10S | .120 | 4.260 | | 13.38 | 14.25 | 5.61 | 6.18 | .740 | 1.761 | |
| | | STD | 40 | 40S | .237 | 4.026 | | 12.65 | 12.73 | 10.79 | 5.50 | .661 | 3.214 | |
| 4 | 4.500 | XS | 80 | 80S | .337 | 3.826 | 14.14 | 12.02 | 11.50 | 14.98 | 4.98 | .597 | 4.271 | 4 |
| | | — | 120 | — | .438 | 3.624 | | 11.39 | 10.31 | 19.00 | 4.47 | .536 | 5.178 | |
| | | — | 160 | — | .531 | 3.438 | | 10.80 | 9.28 | 22.51 | 4.02 | .482 | 5.898 | |
| | | XXS | — | — | .674 | 3.152 | | 9.90 | 7.80 | 27.54 | 3.38 | .405 | 6.791 | |
| | | — | — | 5S | .109 | 5.345 | | 16.79 | 22.44 | 6.36 | 9.72 | 1.17 | 2.498 | |
| | | — | — | 10S | .134 | 5.295 | | 16.63 | 22.02 | 7.77 | 9.54 | 1.14 | 3.029 | |
| | | STD | 40 | 40S | .258 | 5.047 | | 15.86 | 20.01 | 14.62 | 8.67 | 1.04 | 5.451 | |
| 5 | 5.563 | XS | 80 | 80S | .375 | 4.813 | 17.48 | 15.12 | 18.19 | 20.78 | 7.88 | .945 | 7.431 | 5 |
| | | — | 120 | — | .500 | 4.563 | | 14.34 | 16.35 | 27.04 | 7.09 | .849 | 9.250 | |
| | | — | 160 | — | .625 | 4.313 | | 13.55 | 14.61 | 32.96 | 6.33 | .759 | 10.796 | |
| | | XXS | — | — | .750 | 4.063 | | 12.76 | 12.97 | 38.55 | 5.61 | .674 | 12.090 | |
| | | — | — | 5S | .109 | 6.407 | | 20.13 | 32.24 | 7.60 | 13.97 | 1.68 | 3.576 | |
| | | — | — | 10S | .134 | 6.357 | | 19.97 | 31.74 | 9.29 | 13.75 | 1.65 | 4.346 | |
| | | STD | 40 | 40S | .280 | 6.065 | | 19.05 | 28.89 | 18.97 | 12.51 | 1.50 | 8.496 | |
| 6 | 6.625 | XS | 80 | 80S | .432 | 5.761 | 20.81 | 18.10 | 26.07 | 28.57 | 11.29 | 1.35 | 12.22 | 6 |
| | | — | 120 | — | .562 | 5.501 | | 17.28 | 23.77 | 36.39 | 10.30 | 1.24 | 14.98 | |
| | | — | 160 | — | .719 | 5.187 | | 16.30 | 21.15 | 45.35 | 9.16 | 1.10 | 17.81 | |
| | | XXS | — | — | .864 | 4.897 | | 15.38 | 18.84 | 53.16 | 8.16 | .978 | 20.02 | |
| | | — | — | 5S | .109 | 8.407 | | 26.41 | 55.51 | 9.93 | 24.06 | 2.88 | 6.131 | |
| | | — | — | 10S | .148 | 8.329 | | 26.17 | 54.48 | 13.40 | 23.61 | 2.83 | 8.212 | |
| | | — | 20 | — | .250 | 8.125 | | 25.53 | 51.85 | 22.36 | 22.47 | 2.69 | 13.39 | |
| | | — | 30 | — | .277 | 8.071 | | 25.36 | 51.16 | 24.70 | 22.17 | 2.66 | 14.69 | |
| | | STD | 40 | 40S | .322 | 7.981 | | 25.07 | 50.03 | 28.55 | 21.70 | 2.60 | 16.81 | |
| | | — | 60 | — | .406 | 7.813 | | 24.55 | 47.94 | 35.64 | 20.77 | 2.49 | 20.58 | |
| 8 | 8.625 | XS | 80 | 80S | .500 | 7.625 | 27.10 | 23.95 | 45.66 | 43.39 | 19.78 | 2.37 | 24.51 | 8 |
| | | — | 100 | — | .594 | 7.437 | | 23.36 | 43.46 | 50.95 | 18.83 | 2.26 | 28.14 | |
| | | — | 120 | — | .719 | 7.187 | | 22.58 | 40.59 | 60.71 | 17.59 | 2.11 | 32.58 | |
| | | — | 140 | — | .812 | 7.001 | | 21.99 | 38.50 | 67.76 | 16.68 | 2.00 | 35.65 | |
| | | XXS | — | — | .875 | 6.875 | | 21.60 | 37.12 | 72.42 | 16.10 | 1.93 | 37.56 | |
| | | — | 160 | — | .906 | 6.813 | | 21.40 | 36.46 | 74.69 | 15.80 | 1.89 | 38.48 | |
| | | — | — | 5S | .134 | 10.482 | | 32.93 | 86.29 | 15.19 | 37.39 | 4.48 | 11.71 | |
| | | — | — | 10S | .165 | 10.420 | | 32.74 | 85.28 | 18.65 | 36.95 | 4.43 | 14.30 | |
| | | — | 20 | — | .250 | 10.250 | | 32.20 | 82.52 | 28.04 | 35.76 | 4.29 | 21.15 | |
| | | — | 30 | — | .307 | 10.136 | | 31.84 | 80.69 | 34.24 | 34.96 | 4.19 | 25.57 | |
| | | STD | 40 | 40S | .365 | 10.020 | | 31.48 | 78.86 | 40.48 | 34.20 | 4.10 | 29.90 | |
| 10 | 10.750 | XS | 60 | 80S | .500 | 9.750 | 33.77 | 30.63 | 74.66 | 54.74 | 32.35 | 3.88 | 39.43 | 10 |
| | | — | 80 | — | .594 | 9.562 | | 30.04 | 71.84 | 64.43 | 31.13 | 3.73 | 45.54 | |
| | | — | 100 | — | .719 | 9.312 | | 29.25 | 68.13 | 77.03 | 29.53 | 3.54 | 53.22 | |
| | | — | 120 | — | .844 | 9.062 | | 28.47 | 64.53 | 89.29 | 27.96 | 3.35 | 60.32 | |
| | | XXS | 140 | — | 1.000 | 8.750 | | 27.49 | 60.13 | 104.13 | 26.06 | 3.12 | 68.43 | |
| | | — | 160 | — | 1.125 | 8.500 | | 26.70 | 56.75 | 115.64 | 24.59 | 2.95 | 74.29 | |

# PIPE DATA TABLES CONT'D.

| Pipe Size (in.) | Outside Diameter (in.) | Weight Class | Carbon Steel Sched. | Stainless Steel Sched. | Wall Thickness (in.) | Inside Diameter (in.) | Circum. (Ext.) (in.) | Circum (Int.) (in.) | Flow Area (sq. in.) | Weight of Pipe (lbs/Ft.) | Weight of Water (lbs/Ft.) | Gallons of Water per Ft. | Section Modulus | Pipe Size (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | — | — | 5S | .156 | 12.438 | | 39.08 | 121.50 | 20.98 | 52.65 | 6.31 | 19.2 | |
| | | — | — | 10S | .180 | 12.390 | | 38.92 | 120.57 | 24.17 | 52.25 | 6.26 | 22.0 | |
| | | — | 20 | — | .250 | 12.250 | | 38.48 | 117.86 | 33.38 | 51.07 | 6.12 | 30.2 | |
| | | — | 30 | — | .330 | 12.090 | | 37.98 | 114.80 | 43.77 | 49.74 | 5.96 | 39.0 | |
| | | STD | — | 40S | .375 | 12.000 | | 37.70 | 113.10 | 49.56 | 49.00 | 5.88 | 43.8 | |
| | | — | 40 | — | .406 | 11.938 | | 37.50 | 111.93 | 53.52 | 48.50 | 5.81 | 47.1 | |
| 12 | 12.750 | XS | — | 80S | .500 | 11.750 | 40.06 | 36.91 | 108.43 | 65.42 | 46.92 | 5.63 | 56.7 | 12 |
| | | — | 60 | — | .562 | 11.626 | | 36.52 | 106.16 | 73.15 | 46.00 | 5.51 | 62.8 | |
| | | — | 80 | — | .688 | 11.374 | | 35.73 | 101.64 | 88.63 | 44.04 | 5.28 | 74.6 | |
| | | — | 100 | — | .844 | 11.062 | | 34.75 | 96.14 | 107.32 | 41.66 | 4.99 | 88.1 | |
| | | XXS | 120 | — | 1.000 | 10.750 | | 33.77 | 90.76 | 125.49 | 39.33 | 4.71 | 100.7 | |
| | | — | 140 | — | 1.125 | 10.500 | | 32.99 | 86.59 | 139.67 | 37.52 | 4.50 | 109.9 | |
| | | — | 160 | — | 1.312 | 10.126 | | 31.81 | 80.53 | 160.27 | 34.89 | 4.18 | 122.6 | |
| | | — | — | 5S | .156 | 13.688 | | 43.00 | 147.15 | 23.07 | 63.77 | 7.64 | 23.2 | |
| | | — | | 10S | .188 | 13.624 | | 42.80 | 145.78 | 27.73 | 63.17 | 7.57 | 27.8 | |
| | | — | 10 | — | .250 | 13.500 | | 42.41 | 143.14 | 36.71 | 62.03 | 7.44 | 36.6 | |
| | | — | 20 | — | .312 | 13.376 | | 42.02 | 140.52 | 45.61 | 60.89 | 7.30 | 45.0 | |
| | | STD | 30 | — | .375 | 13.250 | | 41.63 | 137.88 | 54.57 | 59.75 | 7.16 | 53.2 | |
| | | — | 40 | — | .438 | 13.124 | | 41.23 | 135.28 | 63.44 | 58.64 | 7.03 | 61.3 | |
| 14 | 14.000 | XS | — | — | .500 | 13.000 | 43.98 | 40.84 | 132.73 | 72.09 | 57.46 | 6.90 | 69.1 | 14 |
| | | — | 60 | — | .594 | 12.812 | | 40.25 | 128.96 | 85.05 | 55.86 | 6.70 | 80.3 | |
| | | — | 80 | — | .750 | 12.500 | | 39.27 | 122.72 | 106.13 | 53.18 | 6.37 | 98.2 | |
| | | — | 100 | — | .938 | 12.124 | | 38.09 | 115.49 | 130.85 | 50.04 | 6.00 | 117.8 | |
| | | — | 120 | — | 1.094 | 11.812 | | 37.11 | 109.62 | 150.79 | 47.45 | 5.69 | 132.8 | |
| | | — | 140 | — | 1.250 | 11.500 | | 36.13 | 103.87 | 170.28 | 45.01 | 5.40 | 146.8 | |
| | | — | 160 | — | 1.406 | 11.188 | | 35.15 | 98.31 | 189.11 | 42.60 | 5.11 | 159.6 | |
| | | — | — | 5S | .165 | 15.670 | | 49.23 | 192.85 | 27.90 | 83.57 | 10.02 | 32.2 | |
| | | — | — | 10S | .188 | 15.624 | | 49.08 | 191.72 | 31.75 | 83.08 | 9.96 | 36.5 | |
| | | — | 10 | — | .250 | 15.500 | | 48.69 | 188.69 | 42.05 | 81.74 | 9.80 | 48.0 | |
| | | — | 20 | — | .312 | 15.376 | | 48.31 | 185.69 | 52.27 | 80.50 | 9.65 | 59.2 | |
| | | STD | 30 | — | .375 | 15.250 | | 47.91 | 182.65 | 82.58 | 79.12 | 9.49 | 70.3 | |
| | | XS | 40 | — | .500 | 15.000 | | 47.12 | 176.72 | 82.77 | 76.58 | 9.18 | 91.5 | |
| 16 | 16.00 | — | 60 | — | .656 | 14.688 | 50.27 | 46.14 | 169.44 | 107.50 | 73.42 | 8.80 | 116.6 | 16 |
| | | — | 80 | — | .844 | 14.312 | | 44.96 | 160.92 | 136.61 | 69.73 | 8.36 | 144.5 | |
| | | — | 100 | — | 1.031 | 13.938 | | 43.79 | 152.58 | 164.82 | 66.12 | 7.93 | 170.5 | |
| | | — | 120 | — | 1.219 | 13.562 | | 42.61 | 144.50 | 192.43 | 62.62 | 7.50 | 194.5 | |
| | | — | 140 | — | 1.438 | 13.124 | | 41.23 | 135.28 | 233.64 | 58.64 | 7.03 | 220.0 | |
| | | — | 160 | — | 1.594 | 12.812 | | 40.26 | 128.96 | 245.25 | 55.83 | 6.70 | 236.7 | |
| | | — | — | 5S | .165 | 17.67 | | 55.51 | 245.22 | 31.43 | 106.26 | 12.74 | 40.8 | |
| | | — | — | 10S | .188 | 17.62 | | 55.37 | 243.95 | 35.76 | 105.71 | 12.67 | 46.4 | |
| | | — | 10 | — | .250 | 17.50 | | 54.98 | 240.53 | 47.39 | 104.21 | 12.49 | 61.1 | |
| | | — | 20 | — | .312 | 17.38 | | 54.59 | 237.13 | 58.94 | 102.77 | 12.32 | 75.5 | |
| | | STD | — | — | .375 | 17.25 | | 54.19 | 233.71 | 70.59 | 101.18 | 12.14 | 89.6 | |
| | | — | 30 | — | .438 | 17.12 | | 53.80 | 230.30 | 82.15 | 99.84 | 11.96 | 103.4 | |
| | | XS | — | — | .500 | 17.00 | | 53.41 | 226.98 | 93.45 | 98.27 | 11.79 | 117.0 | |
| 18 | 18.00 | — | 40 | — | .562 | 16.88 | 56.55 | 53.02 | 223.68 | 104.87 | 96.93 | 11.62 | 130.1 | 18 |
| | | — | 60 | — | .750 | 16.50 | | 51.84 | 213.83 | 138.17 | 92.57 | 11.11 | 168.3 | |
| | | — | 80 | — | .938 | 16.12 | | 50.66 | 204.24 | 170.92 | 88.50 | 10.61 | 203.8 | |
| | | — | 100 | — | 1.156 | 15.69 | | 49.29 | 193.30 | 207.96 | 83.76 | 10.04 | 242.3 | |
| | | — | 120 | — | 1.375 | 15.25 | | 47.91 | 182.66 | 244.14 | 79.07 | 9.49 | 277.6 | |
| | | — | 140 | — | 1.562 | 14.88 | | 46.73 | 173.80 | 274.22 | 75.32 | 9.03 | 305.5 | |
| | | — | 160 | — | 1.781 | 14.44 | | 45.36 | 163.72 | 308.50 | 70.88 | 8.50 | 335.6 | |

# PIPE DATA TABLES CONT'D.

| Pipe Size (in.) | Outside Diameter (in.) | Weight Class | Carbon Steel Sched. | Stainless Steel Sched. | Wall Thickness (in.) | Inside Diameter (in.) | Circum. (Ext.) (in.) | Circum (Int.) (in.) | Flow Area (sq. in.) | Weight of Pipe (lbs/Ft.) | Weight of Water (lbs/Ft.) | Gallons of Water per Ft. | Section Modulus | Pipe Size (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | — | — | 5S | .188 | 19.62 | | 61.65 | 302.46 | 39.78 | 131.06 | 15.71 | 57.4 | |
| | | — | — | 10S | .218 | 19.56 | | 61.46 | 300.61 | 46.06 | 130.27 | 15.62 | 66.3 | |
| | | — | 10 | — | .250 | 19.50 | | 61.26 | 298.65 | 52.73 | 129.42 | 15.51 | 75.6 | |
| | | — | 20 | — | .375 | 19.25 | | 60.48 | 290.04 | 78.60 | 125.67 | 15.12 | 111.3 | |
| | | STD | 30 | — | .500 | 19.00 | | 59.69 | 283.53 | 104.13 | 122.87 | 14.73 | 145.7 | |
| | | XS | 40 | — | .594 | 18.81 | | 59.10 | 278.00 | 123.11 | 120.46 | 14.44 | 170.4 | |
| 20 | 20.00 | — | 60 | — | .812 | 18.38 | 62.83 | 57.73 | 265.21 | 166.40 | 114.92 | 13.78 | 225.7 | 20 |
| | | — | 80 | — | 1.031 | 17.94 | | 56.35 | 252.72 | 208.87 | 109.51 | 13.13 | 277.1 | |
| | | — | 100 | — | 1.281 | 17.44 | | 54.78 | 238.83 | 256.10 | 103.39 | 12.41 | 331.5 | |
| | | — | 120 | — | 1.500 | 17.00 | | 53.41 | 226.98 | 296.37 | 98.35 | 11.79 | 375.5 | |
| | | — | 140 | — | 1.750 | 16.50 | | 51.84 | 213.82 | 341.09 | 92.66 | 11.11 | 421.7 | |
| | | — | 160 | — | 1.969 | 16.06 | | 50.46 | 202.67 | 379.17 | 87.74 | 10.53 | 458.5 | |
| | | — | — | 5S | .188 | 21.62 | | 67.93 | 367.25 | 43.80 | 159.14 | 19.08 | 69.7 | |
| | | — | — | 10S | .218 | 21.56 | | 67.75 | 365.21 | 50.71 | 158.26 | 18.97 | 80.4 | |
| | | — | 10 | — | .250 | 21.50 | | 67.54 | 363.05 | 58.07 | 157.32 | 18.86 | 91.8 | |
| | | STD | 20 | — | .375 | 21.25 | | 66.76 | 354.66 | 86.61 | 153.68 | 18.42 | 135.4 | |
| | | XS | 30 | — | .500 | 21.00 | | 65.97 | 346.36 | 114.81 | 150.09 | 17.99 | 117.5 | |
| 22 | 22.00 | — | 60 | — | .875 | 20.25 | 69.12 | 63.62 | 322.06 | 197.41 | 139.56 | 16.73 | 295.0 | 22 |
| | | — | 80 | — | 1.125 | 19.75 | | 62.05 | 306.35 | 250.81 | 132.76 | 15.91 | 366.4 | |
| | | — | 100 | — | 1.375 | 19.25 | | 60.48 | 291.04 | 302.88 | 126.12 | 15.12 | 432.6 | |
| | | — | 120 | — | 1.625 | 18.75 | | 58.90 | 276.12 | 353.61 | 119.65 | 14.34 | 493.8 | |
| | | — | 140 | — | 1.875 | 18.25 | | 57.33 | 261.59 | 403.00 | 113.36 | 13.59 | 550.3 | |
| | | — | 160 | — | 2.125 | 17.75 | | 55.76 | 247.45 | 451.06 | 107.23 | 12.85 | 602.4 | |
| | | — | — | 5S | .218 | 23.56 | | 74.03 | 436.10 | 55 | 188.98 | 22.65 | 96.0 | |
| | | — | 10 | 10S | .250 | 23.50 | | 73.83 | 433.74 | 63 | 187.95 | 22.53 | 109.6 | |
| | | STD | 20 | — | .375 | 23.25 | | 73.04 | 424.56 | 95 | 183.95 | 22.05 | 161.9 | |
| | | XS | — | — | .500 | 23.00 | | 72.26 | 415.48 | 125 | 179.87 | 21.58 | 212.5 | |
| | | — | 30 | — | .562 | 22.88 | | 71.86 | 411.00 | 141 | 178.09 | 21.35 | 237.0 | |
| 24 | 24.00 | — | 40 | — | .688 | 22.62 | 75.40 | 71.08 | 402.07 | 171 | 174.23 | 20.88 | 285.1 | 24 |
| | | — | 60 | — | .969 | 22.06 | | 69.31 | 382.35 | 238 | 165.52 | 19.86 | 387.7 | |
| | | — | 80 | — | 1.219 | 21.56 | | 67.74 | 365.22 | 297 | 158.26 | 18.97 | 472.8 | |
| | | — | 100 | — | 1.531 | 20.94 | | 65.78 | 344.32 | 367 | 149.06 | 17.89 | 570.8 | |
| | | — | 120 | — | 1.812 | 20.38 | | 64.01 | 326.08 | 430 | 141.17 | 16.94 | 652.1 | |
| | | — | 140 | — | 2.062 | 19.88 | | 62.44 | 310.28 | 483 | 134.45 | 16.12 | 718.9 | |
| | | — | 160 | — | 2.344 | 19.31 | | 60.67 | 292.98 | 542 | 126.84 | 15.22 | 787.9 | |
| | | — | — | 5S | .250 | 29.50 | | 92.68 | 683.49 | 79 | 296.18 | 35.51 | 172.3 | |
| | | — | 10 | 10S | .312 | 29.38 | | 92.29 | 677.71 | 99 | 293.70 | 35.21 | 213.8 | |
| 30 | 30.00 | STD | — | — | .375 | 29.25 | 94.25 | 91.89 | 671.96 | 119 | 291.18 | 34.91 | 255.3 | 30 |
| | | XS | 20 | — | .500 | 29.00 | | 91.11 | 660.52 | 158 | 286.22 | 34.31 | 336.1 | |
| | | — | 30 | — | .625 | 28.75 | | 90.32 | 649.18 | 196 | 281.31 | 33.72 | 414.9 | |

# PRESSURE TEMPERATURE LIMITS

## Body Material and End Connection Selection

**BASED ON: ANSI B16.1-1989 (Cast Iron) B16.24-1991 (Cast Bronze) B16.5-1996 (All Steels)**

Enter selection table at the service temperature and read down the column. Obtain a figure for maximum allowable pressure which equals or exceeds the inlet pressure in the system. The materials are ranked in the order of their relative cost.

It is wise in most cases to make several tentative selections for body material and end connection to determine which is most economical. For instance, it may be advantageous to go to a higher body rating than to select a stronger alloy.

See product design limitations prior to final selection. Regular type (not bold) indicates recommended temperatures for each material.

Bold type areas indicate temperatures permitted by ANSI B16.5-1996, but NOT recommended.

**Code Designations**
2 = Class B Cast Iron
6 = Grade WC1 (0.50% Moly)
4 = Grade C5 (5.50% Chrome)
22 = Cast Bronze
8 = Grade WC6 (1.25% Chrome)
9 = Grade CF8 (304 SST)
3 = Grade WCB Carbon Steel
7 = Grade WC9 (2.25% Chrome)
5 = Grade CF8M (316 SST)

### MAXIMUM PRESSURE (PSIG) AT SERVICE TEMPERATURE (ºF) - (NON-SHOCK)

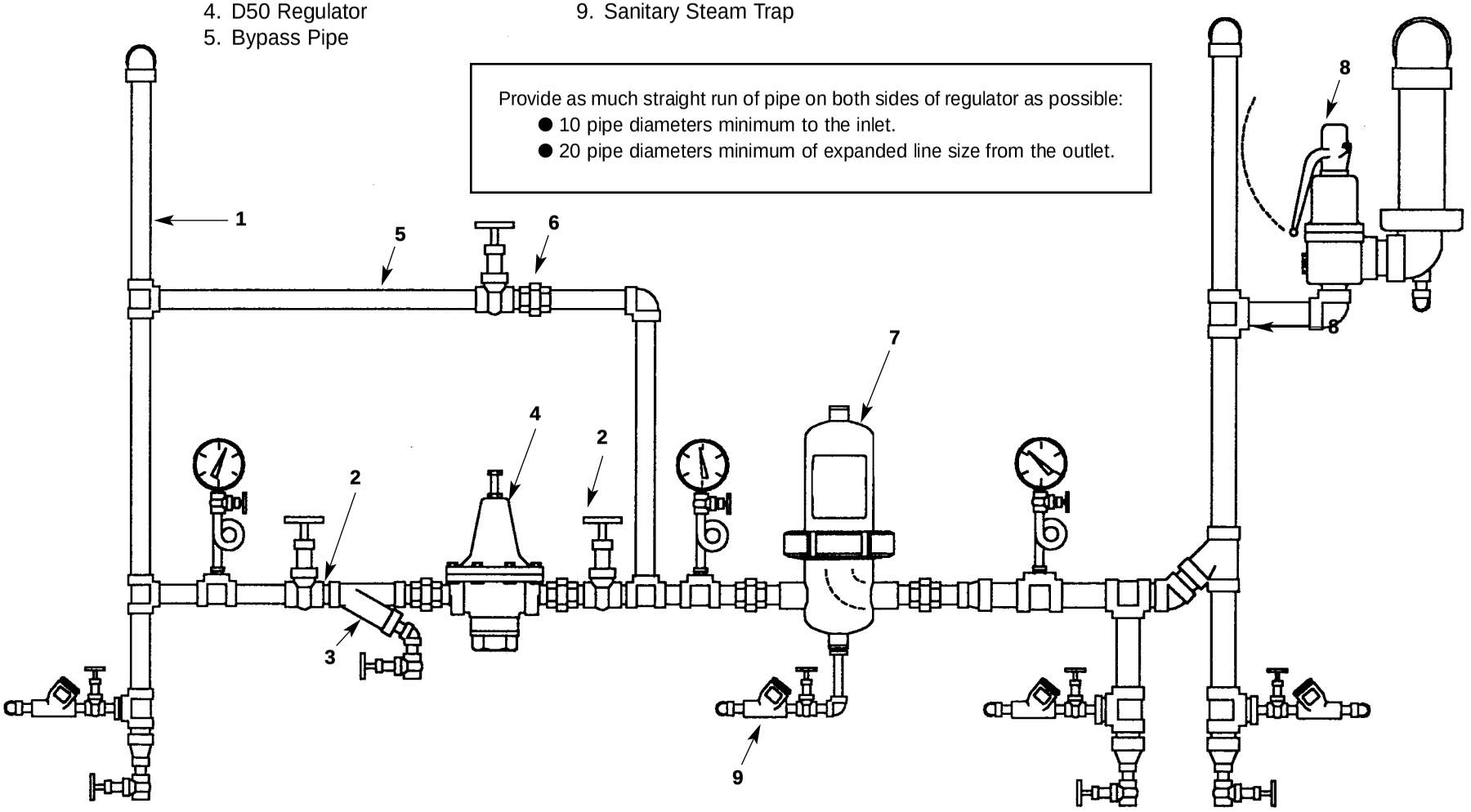
| END CONNECTIONS | BODY MAT'L CODE | ASTM SPEC. | TEMPERATURE (ºF) 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 | 650 | 700 | 750 | 800 | 850 | 900 | 950 | 1000 | 1050 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 125# FLANGES THREADS 2"-12" | 2 | A126 | 200 | 200 | 190 | 175 | 165 | 150 | 140 | 125 | | | | | | | | | | | | |
| | 22 | B62 | 200 | 200 | 190 | 180 | 165 | 150 | 125 | | | | | | | | | | | | | |
| 125# FLANGES THREADS 14" - 24" | 2 | A126 | 150 | 150 | 135 | 125 | 110 | 100 | | | | | | | | | | | | | | |
| | 22 | B62 | 200 | 200 | 190 | 180 | 165 | 150 | 125 | | | | | | | | | | | | | |
| 150# FLANGES SWE, BWE THREADS | 22 | B61 | 225 | 225 | 215 | 205 | 195 | 180 | 170 | 160 | 150 | 140 | | | | | | | | | | |
| | 22 | B62 | 225 | 225 | 210 | 195 | 180 | 165 | 150 | | | | | | | | | | | | | |
| | 3 | A216 | 285 | | 260 | | 230 | | 200 | | 170 | | 140 | 125 | 110 | 95 | 80 | **65** | **50** | **35** | **20** | |
| | 6 | A217 | 265 | | 260 | | 230 | | 200 | | 170 | | 140 | 125 | 110 | 95 | 80 | 65 | **50** | **35** | **20** | |
| | 8 | A217 | 290 | | 260 | | 230 | | 200 | | 170 | | 140 | 125 | 110 | 95 | 80 | 65 | 50 | 35 | 20 | |
| | 7 | A217 | 290 | | 260 | | 230 | | 200 | | 170 | | 140 | 125 | 110 | 95 | 80 | 65 | 50 | 35 | 20 | |
| | 4 | A217 | 290 | | 260 | | 230 | | 200 | | 170 | | 140 | 125 | 110 | 95 | 80 | 65 | 50 | 35 | 20 | |
| | 9 | A351 | 275 | | 230 | | 205 | | 190 | | 170 | | 140 | 125 | 110 | 95 | 80 | 65 | 50 | 35 | 20 | |
| | 5 | A351 | 275 | | 235 | | 215 | | 195 | | 170 | | 140 | 125 | 110 | 95 | 80 | 65 | 50 | 35 | 20 | |
| 250# FLANGES THREADS | 2 | A126 | 500 | 500 | 460 | 415 | 375 | 335 | 290 | 250 | | | | | | | | | | | | |
| | 22 | B62 | 400 | 400 | 385 | 365 | 335 | 300 | 250 | | | | | | | | | | | | | |
| 300# FLANGES SWE, BWE THREADS | 22 | B61 | 500 | 500 | 475 | 450 | 425 | 400 | 375 | 350 | 325 | 300 | | | | | | | | | | |
| | 22 | B62 | 500 | 500 | 465 | 425 | 390 | 350 | 315 | | | | | | | | | | | | | |
| | 3 | A216 | 740 | | 675 | | 655 | | 635 | | 600 | | 550 | 535 | 535 | 505 | 410 | **270** | **170** | **105** | **50** | |
| | 6 | A217 | 695 | | 680 | | 655 | | 640 | | 620 | | 605 | 590 | 570 | 530 | 510 | 485 | **450** | **280** | **165** | |
| | 8 | A217 | 750 | | 750 | | 720 | | 695 | | 665 | | 605 | 590 | 570 | 530 | 510 | 485 | 450 | 320 | 215 | **145** |
| | 7 | A217 | 750 | | 750 | | 730 | | 705 | | 665 | | 605 | 590 | 570 | 530 | 510 | 485 | 450 | 375 | 260 | **175** |
| | 4 | A217 | 750 | | 745 | | 715 | | 705 | | 665 | | 605 | 590 | 570 | 530 | 510 | 485 | 370 | 275 | 200 | 145 |
| | 9 | A351 | 720 | | 600 | | 540 | | 495 | | 465 | | 435 | 430 | 425 | 415 | 405 | 395 | 390 | 380 | 329 | **305** |
| | 5 | A351 | 720 | | 620 | | 560 | | 515 | | 480 | | 450 | 445 | 430 | 425 | 420 | 420 | 415 | 385 | 350 | 345 |
| 600# FLANGES SWE, BWE THREADS | 3 | A216 | 1480 | | 1350 | | 1315 | | 1270 | | 1200 | | 1095 | 1075 | 1065 | 1010 | 825 | **535** | **345** | **205** | **105** | |
| | 6 | A217 | 1390 | | 1360 | | 1305 | | 1280 | | 1245 | | 1210 | 1175 | 1135 | 1065 | 1015 | 975 | **900** | **560** | **330** | |
| | 8 | A217 | 1500 | | 1500 | | 1445 | | 1385 | | 1330 | | 1210 | 1175 | 1135 | 1065 | 1015 | 975 | 900 | 640 | 430 | **290** |
| | 7 | A217 | 1500 | | 1500 | | 1455 | | 1410 | | 1330 | | 1210 | 1175 | 1135 | 1065 | 1015 | 975 | 900 | 755 | 520 | **350** |
| | 4 | A217 | 1500 | | 1490 | | 1430 | | 1410 | | 1330 | | 1210 | 1175 | 1135 | 1055 | 1015 | 965 | 740 | 550 | 400 | 290 |
| | 9 | A351 | 1440 | | 1200 | | 1080 | | 995 | | 930 | | 875 | 860 | 850 | 830 | 805 | 790 | 780 | 765 | 640 | **615** |
| | 5 | A351 | 1440 | | 1240 | | 1120 | | 1025 | | 955 | | 900 | 890 | 870 | 855 | 845 | 835 | 830 | 775 | 700 | 685 |
| 900# FLANGES SWE, BWE | 3 | A216 | 2220 | | 2025 | | 1970 | | 1900 | | 1795 | | 1640 | 1610 | 1600 | 1510 | 1235 | **805** | **515** | **310** | **155** | |
| | 6 | A217 | 2085 | | 2035 | | 1955 | | 1920 | | 1865 | | 1815 | 1765 | 1705 | 1595 | 1525 | 1460 | **1350** | **845** | **495** | |
| | 8 | A217 | 2250 | | 2250 | | 2165 | | 2080 | | 1995 | | 1815 | 1765 | 1705 | 1595 | 1525 | 1460 | 1350 | 955 | 650 | **430** |
| | 7 | A217 | 2250 | | 2250 | | 2185 | | 2115 | | 1995 | | 1815 | 1765 | 1705 | 1595 | 1525 | 1460 | 1350 | 1130 | 780 | **525** |
| | 4 | A217 | 2250 | | 2235 | | 2150 | | 2115 | | 1995 | | 1815 | 1765 | 1705 | 1585 | 1525 | 1450 | 1110 | 825 | 595 | 430 |
| | 9 | A351 | 2160 | | 1800 | | 1620 | | 1490 | | 1395 | | 1310 | 1290 | 1275 | 1245 | 1210 | 1190 | 1165 | 1145 | 965 | **925** |
| | 5 | A351 | 2160 | | 1860 | | 1680 | | 1540 | | 1435 | | 1355 | 1330 | 1305 | 1280 | 1265 | 1255 | 1245 | 1160 | 1050 | 1030 |
| 1500# FLANGES SWE, BWE | 3 | A216 | 3705 | | 3375 | | 3280 | | 3170 | | 2995 | | 2735 | 2685 | 2665 | 2520 | 2060 | **1340** | **860** | **515** | **260** | |
| | 6 | A217 | 3470 | | 3395 | | 3260 | | 3200 | | 3105 | | 3025 | 2940 | 2840 | 2660 | 2540 | 2435 | **2245** | **1405** | **825** | |
| | 8 | A217 | 3750 | | 3750 | | 3610 | | 3465 | | 3325 | | 3025 | 2940 | 2840 | 2660 | 2540 | 2435 | 2245 | 1595 | 1080 | **720** |
| | 7 | A217 | 3750 | | 3750 | | 3640 | | 3530 | | 3325 | | 3025 | 2940 | 2840 | 2660 | 2540 | 2435 | 2245 | 1885 | 1305 | **875** |
| | 4 | A217 | 3750 | | 3725 | | 3580 | | 3530 | | 3325 | | 3025 | 2940 | 2840 | 2640 | 2540 | 2415 | 1850 | 1370 | 995 | 720 |
| | 9 | A351 | 3600 | | 3000 | | 2700 | | 2485 | | 2330 | | 2185 | 2150 | 2125 | 2075 | 2015 | 1980 | 1945 | 1910 | 1605 | **1545** |
| | 5 | A351 | 3600 | | 3095 | | 2795 | | 2570 | | 2390 | | 2255 | 2220 | 2170 | 2135 | 2110 | 2090 | 2075 | 1930 | 1750 | 1720 |
| 2500# FLANGES SWE, BWE | 3 | A216 | 6170 | | 5625 | | 5470 | | 5280 | | 4990 | | 4560 | 4475 | 4440 | 4200 | 3430 | **2230** | **1430** | **860** | **430** | |
| | 6 | A217 | 5785 | | 5660 | | 5435 | | 5330 | | 5180 | | 5040 | 4905 | 4730 | 4430 | 4230 | 4060 | **3745** | **2345** | **1370** | |
| | 8 | A217 | 6250 | | 6250 | | 6015 | | 5775 | | 5540 | | 5040 | 4905 | 4730 | 4430 | 4230 | 4060 | 3745 | 2655 | 1800 | **1200** |
| | 7 | A217 | 6250 | | 6250 | | 6070 | | 5880 | | 5540 | | 5040 | 4905 | 4730 | 4430 | 4230 | 4060 | 3745 | 3145 | 2170 | **1455** |
| | 4 | A217 | 6250 | | 6205 | | 5965 | | 5880 | | 5540 | | 5040 | 4905 | 4730 | 4400 | 4230 | 4030 | 3085 | 2285 | 1655 | 1200 |
| | 9 | A351 | 6000 | | 5000 | | 4500 | | 4140 | | 3880 | | 3640 | 3580 | 3540 | 3460 | 3360 | 3300 | 3240 | 3180 | 2675 | **2570** |
| | 5 | A351 | 6000 | | 5160 | | 4660 | | 4280 | | 3980 | | 3760 | 3700 | 3620 | 3560 | 3520 | 3480 | 3460 | 3220 | 2915 | 2865 |
| 3500# FLANGES SWE, BWE | 3 | A216 | 8640 | | 7870 | | 7655 | | 7390 | | 6985 | | 6385 | 6265 | 6215 | 5880 | 4800 | **3120** | **2000** | **1200** | **600** | |
| | 6 | A217 | 8100 | | 7920 | | 7605 | | 7460 | | 7250 | | 7055 | 6865 | 6620 | 6200 | 5920 | 5680 | **5240** | **3280** | **1920** | |
| | 8 | A217 | 8750 | | 8750 | | 8420 | | 8085 | | 7750 | | 7055 | 6865 | 6620 | 6200 | 5920 | 5680 | 5240 | 3720 | 2520 | **1680** |
| | 7 | A217 | 8750 | | 8750 | | 8495 | | 8230 | | 7750 | | 7055 | 6865 | 6620 | 6200 | 5920 | 5680 | 5240 | 4405 | 3040 | **2040** |
| | 4 | A217 | 8750 | | 8685 | | 8350 | | 8230 | | 7750 | | 7055 | 6865 | 6620 | 6160 | 5920 | 5640 | 4320 | 3200 | 2320 | 1680 |
| | 9 | A351 | 8400 | | 7000 | | 6300 | | 5795 | | 5430 | | 5095 | 5010 | 4955 | 4845 | 4705 | 4620 | 4535 | 4450 | 3745 | **3600** |
| | 5 | A351 | 8400 | | 7225 | | 6525 | | 5990 | | 5570 | | 5265 | 5180 | 5065 | 4925 | 4845 | 4730 | 4590 | 4505 | 4240 | 4200 |
| 4500# FLANGES SWE, BWE | 3 | A216 | 11110 | | 10120 | | 9845 | | 9505 | | 8980 | | 8210 | 8055 | 7990 | 7560 | 6170 | **4010** | **2570** | **1545** | **770** | |
| | 6 | A217 | 10415 | | 10185 | | 9780 | | 9595 | | 9320 | | 9070 | 8825 | 8515 | 7970 | 7610 | 7305 | **6740** | **4215** | **2470** | |
| | 8 | A217 | 11250 | | 11250 | | 10830 | | 10400 | | 9965 | | 9070 | 8825 | 8515 | 7970 | 7610 | 7305 | 6740 | 4785 | 3240 | **2160** |
| | 7 | A217 | 11250 | | 11250 | | 10925 | | 10585 | | 9965 | | 9070 | 8825 | 8515 | 7970 | 7610 | 7305 | 6740 | 5665 | 3910 | **2625** |
| | 4 | A217 | 11250 | | 11170 | | 10740 | | 10585 | | 9965 | | 9070 | 8825 | 8515 | 7920 | 7610 | 7250 | 5555 | 4115 | 2985 | 2160 |
| | 9 | A351 | 10800 | | 9000 | | 8100 | | 7450 | | 6985 | | 6550 | 6445 | 6370 | 6230 | 6050 | 5940 | 5830 | 5725 | 4815 | **4630** |
| | 5 | A351 | 10800 | | 9290 | | 8390 | | 7705 | | 7165 | | 6770 | 6660 | 6515 | 6410 | 6335 | 6265 | 6230 | 5795 | 5245 | 5155 |

NOTES: FOR 125# ANSI CAST IRON, PRESSURE LIMIT @ 353*F, THE TEMPERATURE OF 125 PSIG SATURATED STEAM
FOR 250# ANSI CAST IRON, PRESSURE LIMIT @ 406*F, THE TEMPERATURE OF 250 PSIG SATURATED STEAM
FOR 400# ANSI STEEL PRESSURE/TEMPERATURE LIMITS, SEE 5/0.3.3 - 5/79 - 3R

# SPENCE TYPICAL INSTALLATION FOR SANITARY STEAM SYSTEM

1. Inlet Pipe
2. Isolation Valve
3. Strainer
4. D50 Regulator
5. Bypass Pipe
6. Bypass Valve
7. Steam Scrubber Filter
8. SRV Type
9. Sanitary Steam 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.

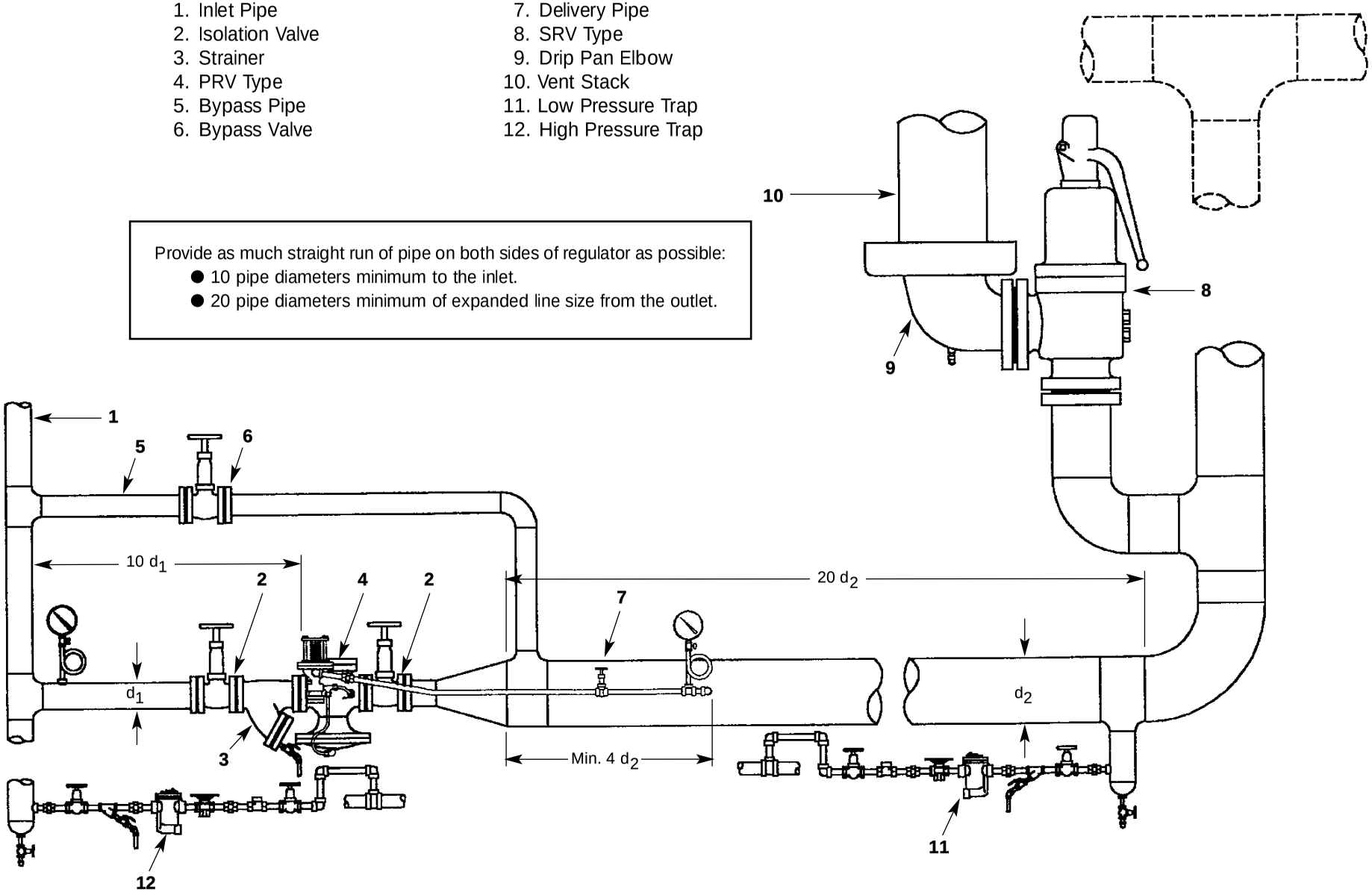


# SPENCE SINGLE STAGE PRESSURE REDUCING STATION

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.





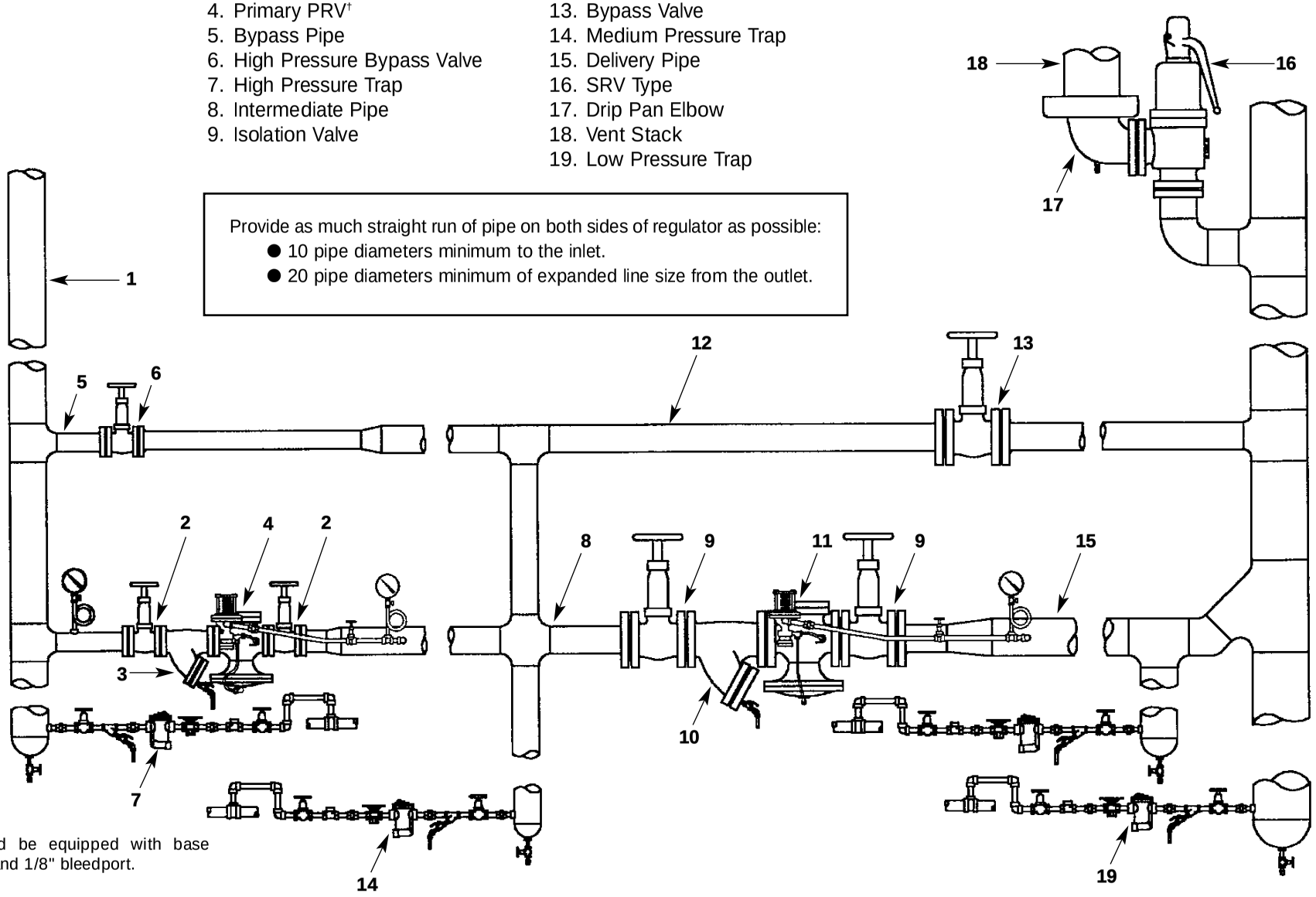

SINGLE STAGE
PR STATION

# SPENCE TWO STAGE PRESSURE REDUCING STATION

1. Inlet Pipe
2. Isolation Valve
3. Strainer
4. Primary PRV†
5. Bypass Pipe
6. High Pressure Bypass Valve
7. High Pressure Trap
8. Intermediate Pipe
9. Isolation Valve
10. Strainer
11. Secondary PRV
12. Bypass Pipe
13. Bypass Valve
14. Medium Pressure Trap
15. Delivery Pipe
16. SRV Type
17. Drip Pan Elbow
18. Vent Stack
19. Low Pressure Trap

Provide as much straight run of pipe on both sides of regulator as possible:

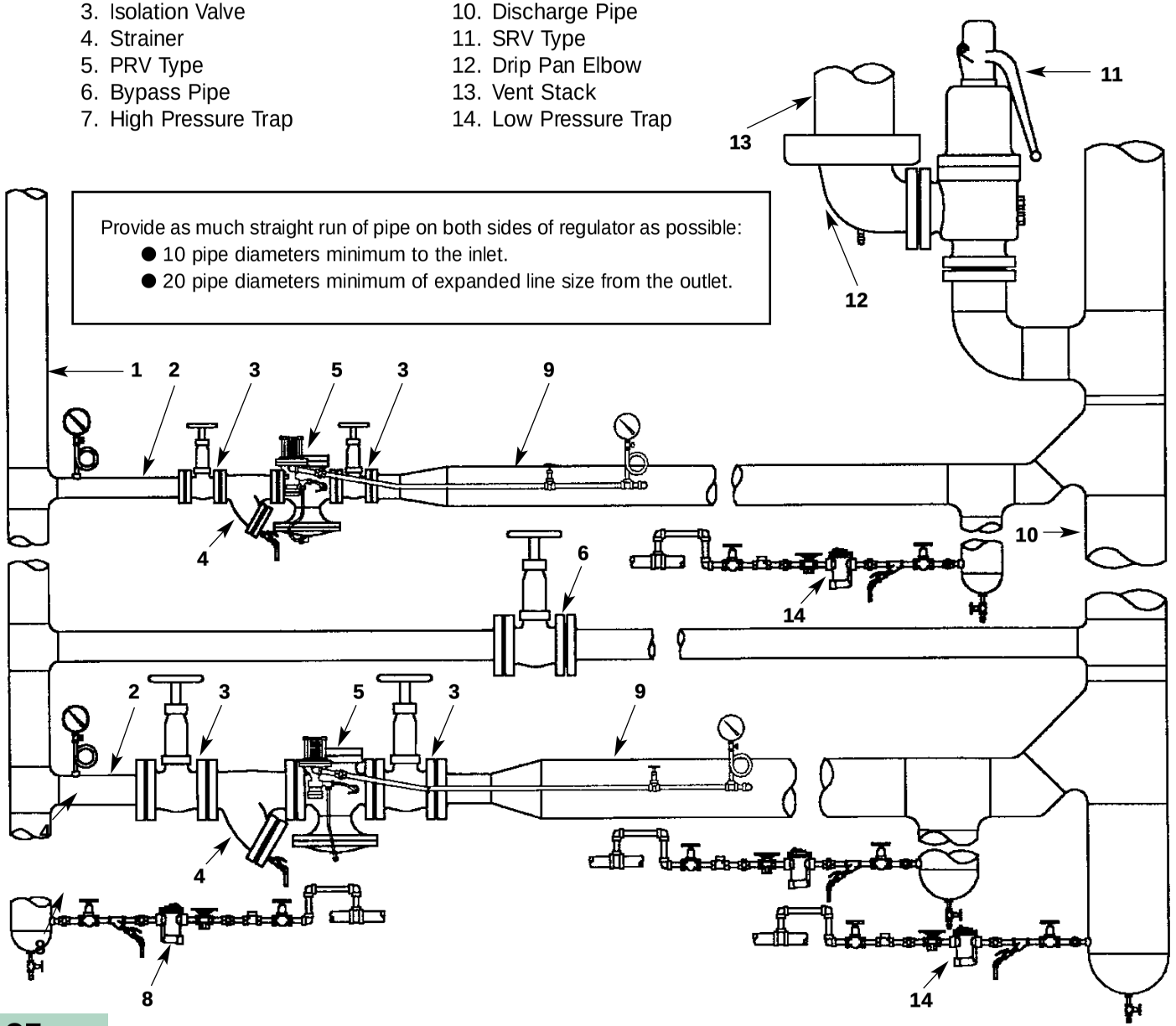
- 10 pipe diameters minimum to the inlet.
- 20 pipe diameters minimum of expanded line size from the outlet.




† Should be equipped with base bypass and 1/8" bleedport.

# SPENCE SINGLE STAGE PARALLEL PRESSURE REDUCING STATION

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



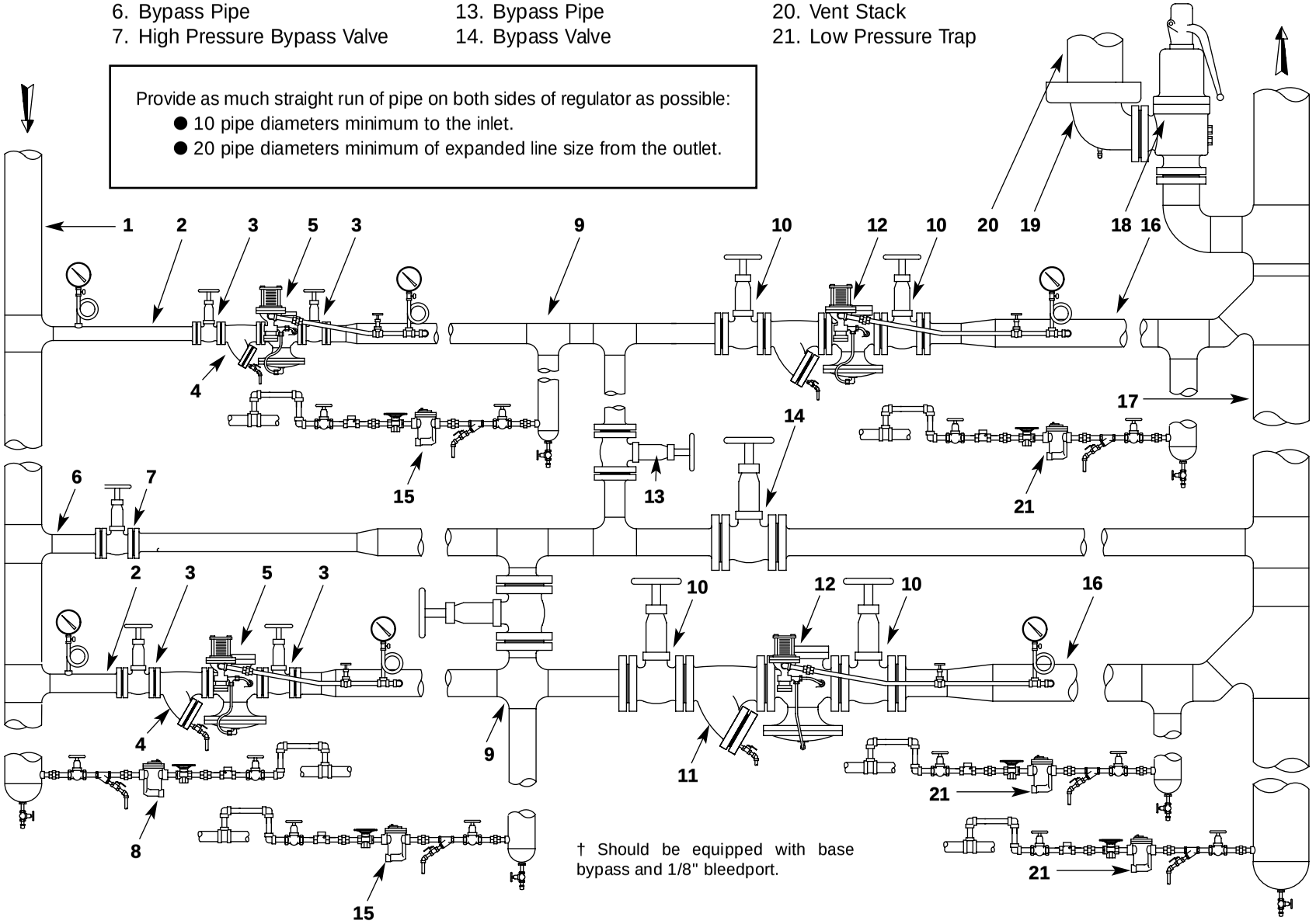



SINGLE STAGE
PARALLEL PR STATION

# SPENCE TWO STAGE PARALLEL PRESSURE REDUCING STATION

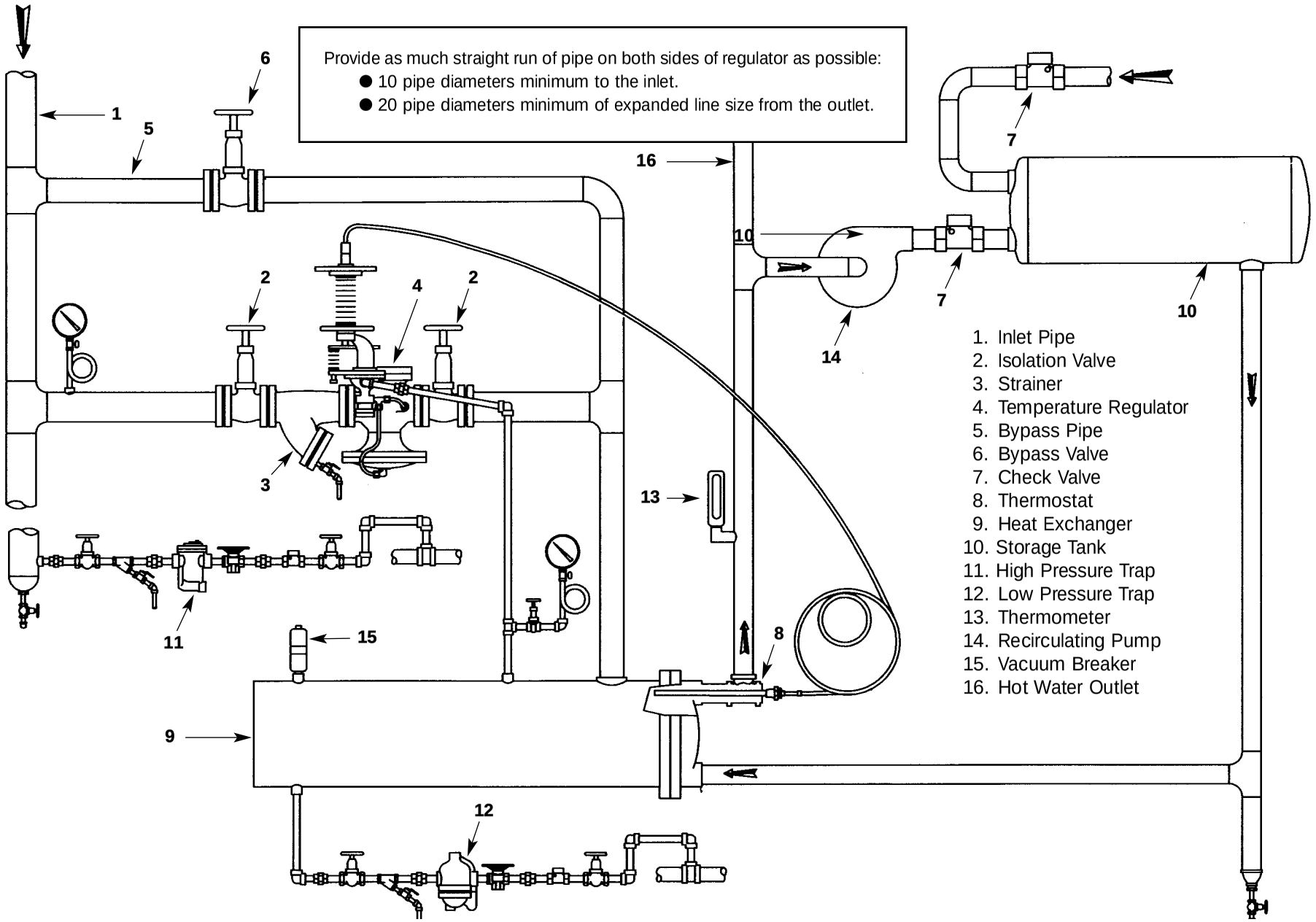
1. Supply Pipe
2. Inlet Pipe
3. Isolation Valve
4. Strainer
5. Primary PRV†
6. Bypass Pipe
7. High Pressure Bypass Valve
8. High Pressure Trap
9. Intermediate Pipe
10. Isolation Valve
11. Strainer
12. Secondary PRV
13. Bypass Pipe
14. Bypass Valve
15. Medium Pressure Trap
16. Delivery Pipe
17. Discharge Pipe
18. SRV Type
19. Drip Pan Elbow
20. Vent Stack
21. Low 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.



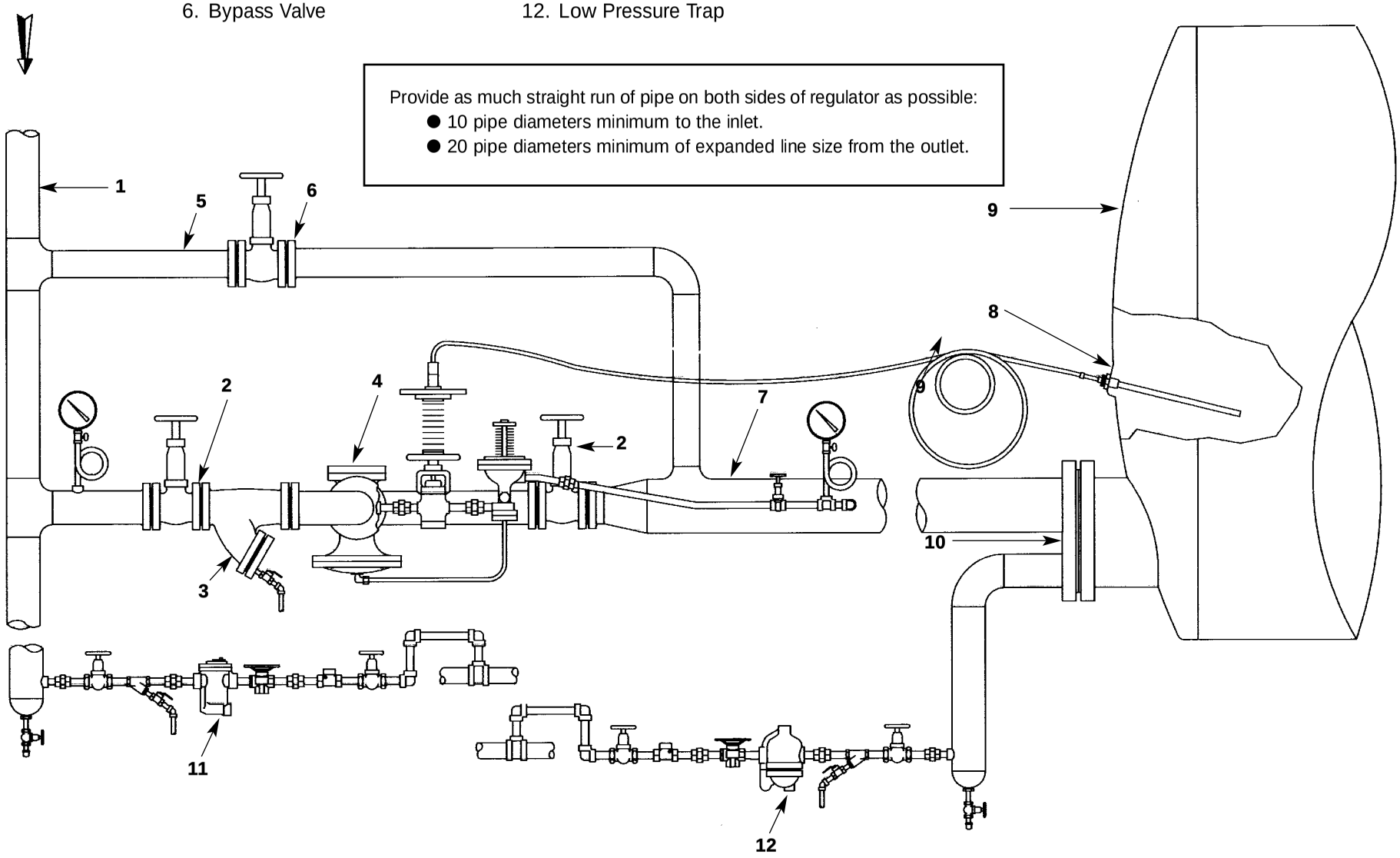

† Should be equipped with base bypass and 1/8" bleedport.

# SPENCE TYPICAL INSTALLATION FOR INSTANTANEOUS HEATER



# SPENCE TYPICAL INSTALLATION FOR STORAGE HEATER

1. Inlet Pipe
2. Isolation Valve
3. Strainer
4. Temperature Regulator
5. Bypass Pipe
6. Bypass Valve
7. Delivery Pipe
8. Thermostat
9. Storage Heater
10. Tube Bundle
11. High Pressure Trap
12. Low Pressure Trap



## NOTES:

# PRODUCT INDEX

# PRODUCT INDEX

## NOTES:

## NOTES:

# STEAM TABLE*

h = Total heat of steam, Btu per pound
v = Specific volume, cubic feet per pound

| Pressure psi (gage) | Temperature F° (sat.) | | Saturated Liquid | Saturated Vapor | TOTAL TEMPERATURE, °F | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 220 | 240 | 260 | 280 | 300 | 320 | 340 | 360 | 380 | 400 | 420 | 440 | 460 |
| 0 | 212 | h | 180.1 | 1150.4 | 1154.4 | 1164.2 | 1173.8 | 1183.3 | 1192.8 | 1202.3 | 1211.7 | 1221.1 | 1230.5 | 1239.9 | 1249.3 | 1258.8 | 1268.2 |
| | | v | 0.0167 | 26.80 | 27.15 | 28.00 | 28.85 | 29.70 | 30.53 | 31.37 | 32.20 | 33.03 | 33.85 | 34.68 | 35.50 | 36.32 | 37.14 |
| 5 | 228 | h | 196.2 | 1156.3 | | 1162.3 | 1172.2 | 1182.0 | 1191.6 | 1201.2 | 1210.8 | 1220.3 | 1229.7 | 1239.2 | 1248.7 | 1258.2 | 1267.6 |
| | | v | 0.0168 | 20.089 | | 20.48 | 21.11 | 21.74 | 22.36 | 22.98 | 23.60 | 24.21 | 24.82 | 25.43 | 26.04 | 26.65 | 27.25 |
| 10 | 240 | h | 208.4 | 1160.6 | | | 1170.7 | 1180.6 | 1190.5 | 1200.2 | 1209.8 | 1219.4 | 1229.0 | 1238.5 | 1248.1 | 1257.6 | 1267.1 |
| | | v | 0.0169 | 16.303 | | | 16.819 | 17.330 | 17.836 | 18.337 | 18.834 | 19.329 | 19.821 | 20.31 | 20.80 | 21.29 | 21.77 |
| 15 | 250 | h | 218.8 | 1164.1 | | | 1169.1 | 1179.3 | 1189.3 | 1199.1 | 1208.9 | 1218.6 | 1228.3 | 1237.9 | 1247.5 | 1257.0 | 1266.6 |
| | | v | 0.0170 | 13.746 | | | 13.957 | 14.390 | 14.816 | 15.238 | 15.657 | 16.072 | 16.485 | 16.897 | 17.306 | 17.714 | 18.121 |
| 20 | 259 | h | 227.9 | 1167.1 | | | 1167.5 | 1177.9 | 1188.1 | 1198.1 | 1208.0 | 1217.8 | 1227.5 | 1237.2 | 1246.8 | 1256A | 1266.1 |
| | | v | 0.0171 | 11.898 | | | 11.911 | 12.288 | 12.659 | 13.025 | 13.387 | 13.746 | 14.103 | 14.457 | 14.810 | 15.162 | 15.512 |
| 25 | 267 | h | 236.0 | 1169.7 | | | | 1176.5 | 1186.8 | 1197.0 | 1207.0 | 1216.9 | 1226.7 | 1236.5 | 12462 | 1255.9 | 1265.5 |
| | | v | 0.0171 | 10.498 | | | | 10.711 | 11.040 | 11.364 | 11.684 | 12.001 | 12.315 | 12.628 | 12.938 | 13.247 | 13.555 |
| 30 | 274 | h | 243.4 | 1172.0 | | | | 1175.0 | 1185.6 | 1195.9 | 1206.0 | 1216.0 | 1225.9 | 1235.8 | 1245.6 | 1255.3 | 1265.0 |
| | | v | 0.0172 | 9.401 | | | | 9.484 | 9.781 | 10.072 | 10.359 | 10.643 | 10.925 | 11.204 | 11.482 | 11.758 | 120033 |
| 40 | 287 | h | 256.3 | 1175.9 | | | | | 1183.0 | 1193.6 | 1204.0 | 1214.3 | 1224.4 | 1234.3 | 1244.3 | 1254.1 | 1263.9 |
| | | v | 0.0173 | 7.787 | | | | | 7.947 | 8.192 | 8.432 | 8.668 | 8.902 | 9.134 | 9.364 | 9.592 | 9.819 |
| 50 | 298 | h | 267.5 | 1179.1 | | | | | 1180.3 | 1191.3 | 1202.0 | 1212.5 | 1222.7 | 1232.9 | 1242.9 | 1252.9 | 1262.8 |
| | | v | 0.0174 | 6.655 | | | | | 6.676 | 6.889 | 7.096 | 7.300 | 7.501 | 7.700 | 7.896 | 8.091 | 8.285 |
| 60 | 308 | h | 277.4 | 1181.9 | | | | | | 1188.9 | 1199.9 | 1210.6 | 1221.1 | 1231.4 | 1241.6 | 1251.7 | 1261.7 |
| | | v | 0.0175 | 5.816 | | | | | | 5.9321 | 6.116 | 6.296 | 6.473 | 6.648 | 6.820 | 6.991 | 7.161 |
| 70 | 316 | h | 286.4 | 1184.2 | | | | | | 1186.4 | 1197.7 | 1208.7 | 1219.4 | 1229.9 | 1240.2 | 1250.4 | 1260.6 |
| | | v | 0.0176 | 5.168 | | | | | | 5.200 | 5.366 | 5.528 | 5.687 | 5.843 | 5.997 | 6.150 | 6.301 |
| 80 | 324 | h | 294.6 | 1186.2 | | | | | | | 1195.5 | 1206.7 | 1217.7 | 1228.3 | 1238.8 | 1249.2 | 1259.4 |
| | | v | 0.0177 | 4.652 | | | | | | | 4.773 | 4.921 | 5.065 | 5.207 | 5.347 | 5.485 | 5.621 |
| 90 | 331 | h | 302.1 | 1188.1 | | | | | | | 1193.2 | 1204.7 | 1215.9 | 1226.7 | 1237.4 | 1247.9 | 1258.2 |
| | | v | 0.0178 | 4.232 | | | | | | | 4.292 | 4.429 | 4.562 | 4.693 | 4.821 | 4.947 | 5.071 |
| 100 | 338 | h | 309.1 | 1189.7 | | | | | | | 1190.8 | 1202.7 | 1214.1 | 1225.2 | 1236.0 | 1246.6 | 1257.1 |
| | | v | 0.0178 | 3.882 | | | | | | | 3.895 | 4.022 | 4.146 | 4.267 | 4.385 | 4.502 | 4.617 |
| 125 | 353 | h | 324.8 | 1193.0 | | | | | | | | 1197.3 | 1209.4 | 1211.1 | 1232.3 | 1243.3 | 1254.1 |
| | | v | 0.0180 | 3.220 | | | | | | | | 3.258 | 3.365 | 3.468 | 3.569 | 3.667 | 3.764 |
| 150 | 366 | h | 338.5 | 1195.6 | | | | | | | | | 1204.5 | 1216.7 | 1228.4 | 1239.8 | 1251.0 |
| | | v | 0.0182 | 2.752 | | | | | | | | | 2.818 | 2.910 | 2.998 | 3.085 | 3.169 |
| 175 | 378 | h | 350.8 | 1197.6 | | | | | | | | | 1199.3 | 1212.2 | 1224.5 | 1236.3 | 1247.8 |
| | | v | 0.0183 | 2.404 | | | | | | | | | 2.414 | 2.498 | 2.577 | 2.655 | 2.730 |
| 200 | 388 | h | 361.9 | 1199.3 | | | | | | | | | | 1207.4 | 1220.3 | 1232.6 | 1244.5 |
| | | v | 0.0185 | 2.134 | | | | | | | | | | 2.180 | 2.253 | 2.324 | 2.393 |
| 225 | 397 | h | 372.1 | 1200.6 | | | | | | | | | | 1202.5 | 1216.0 | 1228.8 | 1241.1 |
| | | v | 0.0186 | 1.9183 | | | | | | | | | | 1.9276 | 1.9964 | 2.062 | 2.126 |
| 250 | 406 | h | 381.6 | 1201.7 | | | | | | | | | | | 1211.5 | 1224.9 | 1237.6 |
| | | v | 0.0187 | 1.7422 | | | | | | | | | | | 1.7870 | 1.8488 | 1.9081 |
| 275 | 414 | h | 390.5 | 1202.6 | | | | | | | | | | | 1206.8 | 1220.8 | 1234.0 |
| | | v | 0.0188 | 1.5954 | | | | | | | | | | | 1.6130 | 1.6717 | 1.7277 |
| 300 | 422 | h | 398.8 | 1203.2 | | | | | | | | | | | | 1216.5 | 1230.3 |
| | | v | 0.0190 | 1.4711 | | | | | | | | | | | | 1.5222 | 1.5755 |
| 350 | 436 | h | 414.1 | 1204.1 | | | | | | | | | | | | 1207.5 | 1222.4 |
| | | v | 0.0192 | 1.2720 | | | | | | | | | | | | 1.2831 | 1.3326 |
| 400 | 448 | h | 428.1 | 1204.6 | | | | | | | | | | | | | 1214.0 |
| | | v | 0.0194 | 1.1194 | | | | | | | | | | | | | 1.1468 |
| 450 | 460 | h | 440.9 | 1204.6 | | | | | | | | | | | | | |
| | | v | 0.0196 | 0.9985 | | | | | | | | | | | | | |
| 500 | 470 | h | 452.9 | 1204.2 | | | | | | | | | | | | | |
| | | v | 0.0198 | 0.9004 | | | | | | | | | | | | | |
| 550 | 480 | h | 464.1 | 1203.7 | | | | | | | | | | | | | |
| | | v | 0.0200 | 0.8191 | | | | | | | | | | | | | |
| 600 | 489 | h | 474.7 | 1203.0 | | | | | | | | | | | | | |
| | | v | 0.0202 | 0.7503 | | | | | | | | | | | | | |

*Adapted with permission from “Thermodynamic Properties of Steam”, Keenan and Keyes, published by John Wiley & Sons, Inc.

# STEAM TABLE*

h = Total heat of steam, Btu per pound
v = Specific volume, cubic feet per pound

| TOTAL TEMPERATURE, °F | | | | | | | | | | | | | | | | | Temp-erature °F (sat.) | Pres-sure psi (gage) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 480 | 500 | 520 | 540 | 560 | 580 | 600 | 620 | 640 | 660 | 680 | 700 | 720 | 740 | 750 | | | | |
| 1277.6 | 1287.1 | 1296.6 | 1306.2 | 1315.7 | 1325.3 | 1334.8 | 1344.5 | 1354.2 | 1363.8 | 1373.5 | 1383.2 | 1393.0 | 1402.8 | 1407.7 | h | 212 | 0 |
| 37.96 | 38.78 | 39.60 | 40.41 | 41.23 | 42.04 | 42.86 | 43.68 | 44.49 | 45.31 | 46.12 | 46.94 | 47.75 | 48.56 | 48.97 | v | | |
| 1277.1 | 1286.6 | 1296.2 | 1305.7 | 1315.3 | 1324.8 | 1334.4 | 1344.1 | 1353.8 | 1363.5 | 1373.2 | 1382.9 | 1392.7 | 1402.6 | 1407.5 | h | 228 | 5 |
| 27.86 | 28.46 | 29.06 | 29.67 | 30.27 | 30.87 | 31.47 | 32.07 | 32.67 | 33.27 | 33.87 | 34.47 | 35.07 | 35.67 | 35.96 | v | | |
| 1276.6 | 1286.2 | 1295.8 | 1305.3 | 1314.9 | 1324.5 | 1334.1 | 1343.8 | 1353.5 | 1363.2 | 1372.9 | 1382.6 | 1392.5 | 1402.3 | 1407.2 | h | 240 | 10 |
| 22.26 | 22.74 | 23.22 | 23.71 | 24.19 | 24.68 | 25.16 | 25.64 | 26.12 | 26.60 | 27.08 | 27.56 | 28.04 | 28.52 | 28.76 | v | | |
| 1276.2 | 1285.7 | 1295.3 | 1304.9 | 1314.5 | 1324.2 | 1333.8 | 1343.5 | 1353.2 | 1362.9 | 1372.6 | 1382.4 | 1392.3 | 1402.1 | 1407.0 | h | 250 | 15 |
| 18.528 | 18.933 | 19.337 | 19.741 | 20.144 | 20.547 | 20.95 | 21.35 | 21.75 | 22.15 | 22.56 | 22.96 | 23.36 | 23.76 | 23.96 | v | | |
| 1275.7 | 1285.3 | 1294.9 | 1304.5 | 1314.1 | 1323.8 | 1333.5 | 1343.2 | 1352.9 | 1362.6 | 1372.3 | 1382.1 | 1391.9 | 1401.8 | 1406.7 | h | 259 | 20 |
| 15.862 | 16.210 | 16.558 | 16.905 | 17.251 | 17.597 | 17.943 | 18.288 | 18.633 | 18.977 | 19.322 | 19.666 | 20.01 | 20.35 | 20.52 | v | | |
| 1275.2 | 1284.8 | 1294.5 | 1304.1 | 1313.8 | 1323.4 | 1333.1 | 1342.8 | 1352.5 | 1362.3 | 1372.1 | 1381.9 | 1391.7 | 1401.6 | 1406.5 | h | 267 | 25 |
| 13.862 | 14.168 | 14.473 | 14.778 | 15.082 | 15.385 | 15.688 | 15.990 | 16.293 | 16.595 | 16.896 | 17.198 | 17.499 | 17.8001 | 7.951 | v | | |
| 1274.7 | 1284.4 | 1294.0 | 1303.7 | 1313.4 | 1323.1 | 1332.8 | 1342.5 | 1352.2 | 1362.0 | 1371.8 | 1381.6 | 1391.5 | 1401.4 | 1406.3 | h | 274 | 30 |
| 12.307 | 12.580 | 12.852 | 13.123 | 13.394 | 13.665 | 13.935 | 14.204 | 14.473 | 14.742 | 15.011 | 15.279 | 15.547 | 15.815 | 15.949 | v | | |
| 1273.7 | 1283.4 | 1293.2 | 1302.9 | 1312.6 | 1322.4 | 1332.1 | 1341.9 | 1351.7 | 1361.5 | 1371.3 | 1381.1 | 1391.0 | 1400.9 | 1405.8 | h | 287 | 40 |
| 10.044 | 10.269 | 10.493 | 10.717 | 10.940 | 11.162 | 11.384 | 11.605 | 11.826 | 12.047 | 12.268 | 12.488 | 12.708 | 12.927 | 13.037 | v | | |
| 1272.7 | 1282.5 | 1292.3 | 1302.1 | 1311.9 | 1321.7 | 1331.5 | 1341.3 | 1351.1 | 1360.9 | 1370.8 | 1380.6 | 1390.5 | 1400.4 | 1405.4 | h | 298 | 50 |
| 8.478 | 8.670 | 8.861 | 9.051 | 9.240 | 9.429 | 9.618 | 9.806 | 9.993 | 10.181 | 10.368 | 10.555 | 10.741 | 10.928 | 11.021 | v | | |
| 1271.6 | 1281.5 | 1291.4 | 1301.3 | 1311.1 | 1321.0 | 1330.8 | 1340.6 | 1350.5 | 1360.3 | 1370.2 | 1380.1 | 1390.0 | 1399.9 | 1404.9 | h | 308 | 60 |
| 7.329 | 7.496 | 7.663 | 7.829 | 7.994 | 8.159 | 8.323 | 8.486 | 8.649 | 8.812 | 8.975 | 9.138 | 9.300 | 9.462 | 9.543 | v | | |
| 1270.6 | 1280.6 | 1290.5 | 1300.5 | 1310.4 | 1320.2 | 1330.1 | 1340.0 | 1349.9 | 1359.8 | 1369.7 | 1379.6 | 1389.6 | 1399.5 | 1404.5 | h | 316 | 70 |
| 6.450 | 6.599 | 6.747 | 6.894 | 7.041 | 7.187 | 7.332 | 7.477 | 7.622 | 7.766 | 7.910 | 8.054 | 8.198 | 8.341 | 8.413 | v | | |
| 1269.5 | 1279.6 | 1289.6 | 1299.6 | 1309.6 | 1319.5 | 1329.4 | 1339.4 | 1349.3 | 1359.3 | 1369.2 | 1379.1 | 1389.1 | 1399.0 | 1404.0 | h | 324 | 80 |
| 5.756 | 5.891 | 6.024 | 6.156 | 6.288 | 6.419 | 6.550 | 6.680 | 6.810 | 6.940 | 7.069 | 7.199 | 7.327 | 7.456 | 7.520 | v | | |
| 1268.5 | 1278.6 | 1288.7 | 1298.8 | 1308.8 | 1318.8 | 1328.7 | 1338.7 | 1348.7 | 1358.6 | 1368.6 | 1378.5 | 1388.5 | 1398.5 | 1403.5 | h | 331 | 90 |
| 5.195 | 5.317 | 5.439 | 5.559 | 5.679 | 5.799 | 5.918 | 6.036 | 6.154 | 6.272 | 6.389 | 6.506 | 6.623 | 6.740 | 6.798 | v | | |
| 1267.4 | 1277.7 | 1287.8 | 1297.9 | 1308.0 | 1318.0 | 1328.1 | 1338.1 | 1348.0 | 1358.0 | 1368.0 | 1378.0 | 1388.1 | 1398.1 | 1403.1 | h | 338 | 100 |
| 4.730 | 4.843 | 4.955 | 5.066 | 5.176 | 5.285 | 5.394 | 5.503 | 5.611 | 5.719 | 5.827 | 5.934 | 6.041 | 6.148 | 6.201 | v | | |
| 1264.7 | 1275.2 | 1285.5 | 1295.8 | 1306.0 | 1316.2 | 1326.4 | 1336.5 | 1346.6 | 1356.6 | 1366.7 | 1376.8 | 1386.9 | 1397.0 | 1402.0 | h | 353 | 125 |
| 3.860 | 3.954 | 4.047 | 4.140 | 4.232 | 4.323 | 4.413 | 4.503 | 4.593 | 4.683 | 4.772 | 4.861 | 4.949 | 5.038 | 5.082 | v | | |
| 1261.9 | 1272.6 | 1283.2 | 1293.6 | 1304.0 | 1314.3 | 1324.6 | 1334.8 | 1345.0 | 1355.2 | 1365.3 | 1375.4 | 1385.6 | 1395.8 | 1400.8 | h | 366 | 150 |
| 3.252 | 3.334 | 3.414 | 3.494 | 3.573 | 3.652 | 3.730 | 3.807 | 3.884 | 3.960 | 4.037 | 4.113 | 4.188 | 4.264 | 4.301 | v | | |
| 1259.0 | 1270.0 | 1280.8 | 1291.4 | 1302.0 | 1312.4 | 1322.8 | 1333.2 | 1343.5 | 1353.7 | 1363.9 | 1374.2 | 1384.4 | 1394.6 | 1399.7 | h | 378 | 175 |
| 2.804 | 2.877 | 2.948 | 3.019 | 3.089 | 3.157 | 3.226 | 3.294 | 3.361 | 3.429 | 3.495 | 3.562 | 3.628 | 3.694 | 3.727 | v | | |
| 1256.0 | 1267.3 | 1278.3 | 1289.2 | 1299.9 | 1310.5 | 1321.0 | 1331.4 | 1341.8 | 1352.2 | 1362.5 | 1372.8 | 1383.1 | 1393.3 | 1398.5 | h | 388 | 200 |
| 2.460 | 2.525 | 2.590 | 2.653 | 2.716 | 2.777 | 2.839 | 2.900 | 2.960 | 3.019 | 3.079 | 3.139 | 3.198 | 3.256 | 3.286 | v | | |
| 1253.0 | 1264.5 | 1275.8 | 1286.9 | 1297.8 | 1308.5 | 1319.2 | 1329.8 | 1340.3 | 1350.7 | 1361.1 | 1371.5 | 1381.9 | 1392.2 | 1397.3 | h | 397 | 225 |
| 2.187 | 2.247 | 2.306 | 2.364 | 2.421 | 2.477 | 2.533 | 2.587 | 2.642 | 2.696 | 2.750 | 2.804 | 2.857 | 2.910 | 2.936 | v | | |
| 1249.9 | 1261.7 | 1273.2 | 1284.5 | 1295.6 | 1306.5 | 1317.3 | 1328.0 | 1338.7 | 1349.2 | 1359.7 | 1370.2 | 1380.6 | 1391.0 | 1396.2 | h | 406 | 250 |
| 1.9654 | 2.021 | 2,076 | 2.129 | 2.181 | 2.233 | 2.284 | 2.334 | 2.384 | 2.434 | 2.483 | 2.532 | 2.580 | 2.629 | 2.653 | v | | |
| 1246.6 | 1258.8 | 1270.6 | 1282.1 | 1293.4 | 1304.5 | 1315.5 | 1326.3 | 1337.0 | 1347.7 | 1358.3 | 1368.8 | 1379.3 | 1389.8 | 1395.0 | h | 414 | 275 |
| 1.7816 | 1.8338 | 1.8846 | 1.9342 | 1.9829 | 2.031 | 2.078 | 2.125 | 2.171 | 2.217 | 2.262 | 2.307 | 2.352 | 2.396 | 2.418 | v | | |
| 1243.3 | 1255.8 | 1267.9 | 1279.7 | 1291.2 | 1302.5 | 1313.6 | 1324.5 | 1335.4 | 1346.1 | 1356.8 | 1367.4 | 1378.0 | 1388.6 | 1393.8 | h | 422 | 300 |
| 1.6266 | 1.6759 | 1.7237 | 1.7703 | 1.8159 | 1.8607 | 1.9048 | 1.9483 | 1.9912 | 2.034 | 2.076 | 2.118 | 2.159 | 2.200 | 2.220 | v | | |
| 1236.4 | 1249.6 | 1262.4 | 1274.7 | 1286.6 | 1298.2 | 1309.7 | 1320.9 | 1332.0 | 1343.0 | 1353.9 | 1364.7 | 1375.4 | 1386.1 | 1391.4 | h | 436 | 350 |
| 1.3795 | 1.4243 | 1.4675 | 1.5094 | 1.5501 | 1.5900 | 1.6291 | 1.6676 | 1.7056 | 1.7430 | 1.7801 | 1.8168 | 1.8531 | 1.8892 | 1.9071 | v | | |
| 1229.0 | 1243.2 | 1256.6 | 1269.4 | 1281.8 | 1293.9 | 1305.7 | 1317.2 | 1328.6 | 1339.8 | 1350.9 | 1361.9 | 1372.8 | 1383.6 | 1389.0 | h | 448 | 400 |
| 1.1908 | 1.2325 | 1.2724 | 1.3108 | 1.3480 | 1.3842 | 1.4196 | 1.4544 | 1.4885 | 1.5222 | 1.5554 | 1.5883 | 1.6207 | 1.6529 | 1.6689 | v | | |
| 1221.2 | 1236.3 | 1250.5 | 1264.0 | 1276.9 | 1289.4 | 1301.6 | 1313.5 | 1325.1 | 1336.5 | 1347.8 | 1359.0 | 1370.1 | 1381.1 | 1386.5 | h | 460 | 450 |
| 1.0416 | 1.0811 | 1.1186 | 1.1544 | 1.1889 | 1.2224 | 1.2550 | 1.2868 | 1.3180 | 1.3488 | 1.3789 | 1.4088 | 1.4382 | 1.4675 | 1.4819 | v | | |
| 1212.8 | 1229.0 | 1244.0 | 1258.3 | 1271.8 | 1284.8 | 1297.3 | 1309.6 | 1321.5 | 1333.2 | 1344.7 | 1356.1 | 1367.3 | 1378.4 | 1384.0 | h | 470 | 500 |
| 0.9204 | 0.9584 | 0.9941 | 1.0280 | 1.0604 | 1.0917 | 1.1221 | 1.1516 | 1.1805 | 1.2088 | 1.2367 | 1.2641 | 1.2913 | 1.3180 | 1.3313 | v | | |
| | 1221.4 | 1237.4 | 1252.4 | 1266.5 | 1280.0 | 1293.0 | 1305.6 | 1317.8 | 1329.8 | 1341.6 | 1353.2 | 1364.6 | 1375.8 | 1381.4 | h | 480 | 550 |
| | 0.8565 | 0.8909 | 0.9234 | 0.9542 | 0.9838 | 1.0124 | 1.0401 | 1.0671 | 1.0935 | 1.1195 | 1.1449 | 1.1700 | 1.1947 | 1.2070 | v | | |
| | 1213.2 | 1230.3 | 1246.1 | 1261.0 | 1275.1 | 1288.5 | 1301.5 | 1314.1 | 1326.3 | 1338.3 | 1350.2 | 1361.8 | 1373.2 | 1378.9 | h | 489 | 600 |
| | 0.7703 | 0.8040 | 0.8353 | 0.8649 | 0.8931 | 0.9203 | 0.9465 | 0.9720 | 0.9968 | 1.0211 | 1.0450 | 1.0684 | 1.0916 | 1.1030 | v | | |

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