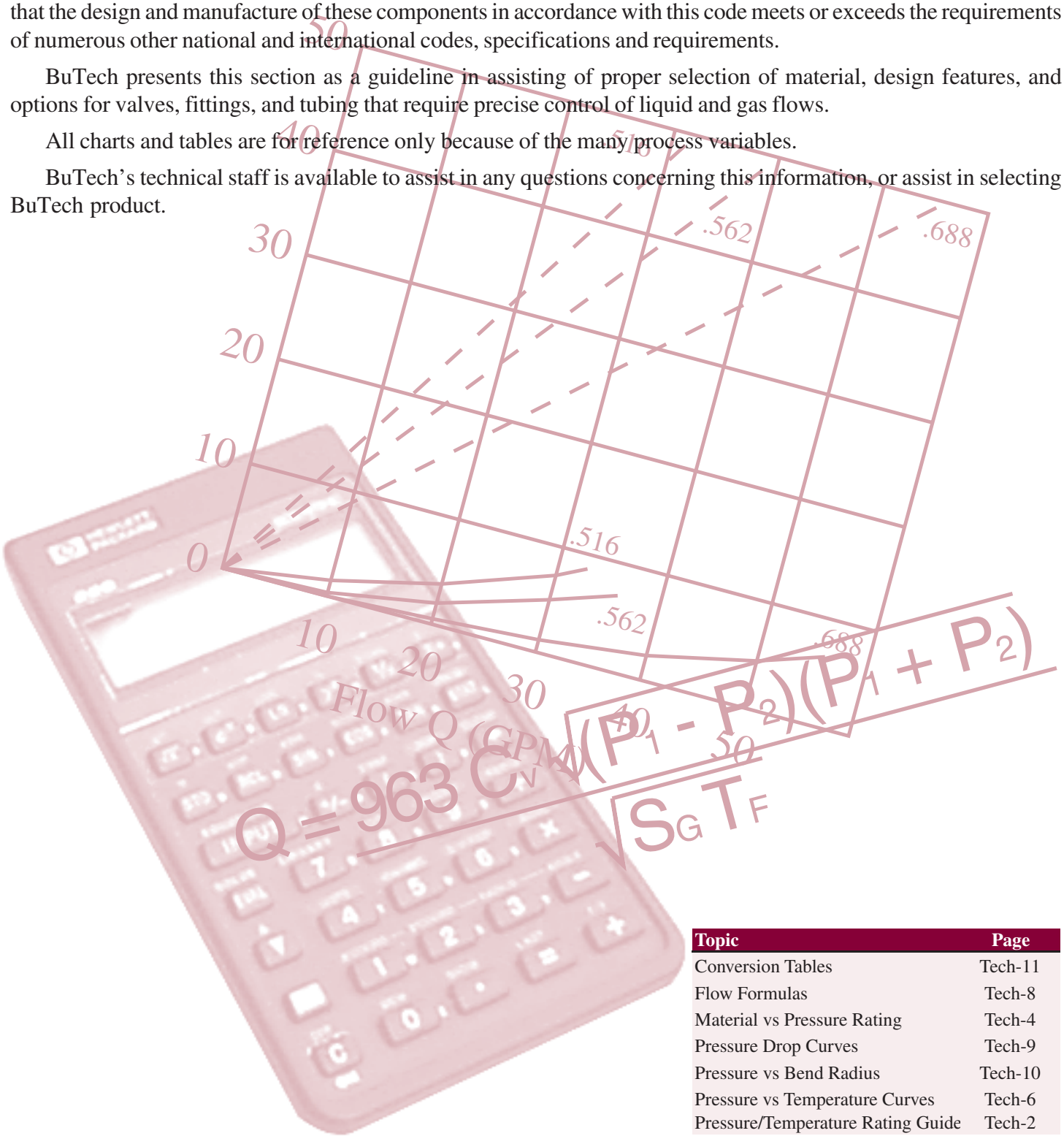
# Technical Information

BuTech designs all pressure-containing equipment to meet or exceed the applicable requirements of Section VIII, Division1 or Division 2 of the ASME Boiler and Pressure Vessel Code and applicable requirements of B31.3, ASME Code for Pressure Piping, maintaining a minimum safety factor of three-to-one (3:1). Furthermore, we believe that the design and manufacture of these components in accordance with this code meets or exceeds the requirements of numerous other national and international codes, specifications and requirements.

BuTech presents this section as a guideline in assisting of proper selection of material, design features, and options for valves, fittings, and tubing that require precise control of liquid and gas flows.

All charts and tables are for reference only because of the many process variables.

BuTech's technical staff is available to assist in any questions concerning this information, or assist in selecting BuTech product.









2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

# Pressure/Temperature Rating Guide

Information in this rating guide is furnished for reference in approximating the pressure/temperature capabilities of BuTech valves with various options. To determine approximate ratings, the following factors should be considered:

- Refer to individual sections to determine pressure rating of component at room temperature.
- Refer to Pressure/Temperature Rating Curve on page Tech-3 to determine pressure at desired temperature.
- Refer to tubing section for pressure ratings of standard tubing at various temperatures to 800°F (427°C).
- Note maximum temperature ratings for needle valves with various packing options in the table below.
- Note temperature information checklist on page Tech-3.

| | | Standard Glass-Filled Teflon | | Standard Glass-Filled Teflon/Nylatron | | Optional Virgin Teflon Packing | | Optional Grafoil[1] | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Valve Series** | **Stem Type** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | **Min** | **Max** | |
| SLPV[2] | Vee or Regulating Metal to Metal | -100 (-73) | 650 (343) | N/A | N/A | -100 (-73) | 450 (232) | -10 (-18) | 800 (427) | °F °C |
| SFPV | Vee or Regulating Metal to Metal | -100 (-73) | 650 (343) | N/A | N/A | -100 (-73) | 450 (232) | -10 (-18) | 800 (427) | °F °C |
| DHP | Vee or Regulating Metal to Metal | -100 (-73) | 650 (343) | N/A | N/A | -100 (-73) | 450 (232) | -10 (-18) | 800 (427) | °F °C |
| 20UV[3] | Vee or Regulating Metal to Metal | -100 (-73) | 650 (343) | N/A | N/A | -100 (-73) | 450 (232) | -10 (-18) | 800 (427) | °F °C |
| 30UV | Vee or Regulating Metal to Metal | -100 (-73) | 650 (343) | N/A | N/A | -100 (-73) | 450 (232) | -10 (-18) | 800 (427) | °F °C |
| 40UV | Vee or Regulating Metal to Metal | N/A | N/A | -100 (-73) | 230 (110) | N/A | N/A | -10 (-18) | 800 (427) | °F °C |
| 60UV | Vee or Regulating Metal to Metal | N/A | N/A | -100 (-73) | 230 (110) | N/A | N/A | -10 (-18) | 800 (427) | °F °C |

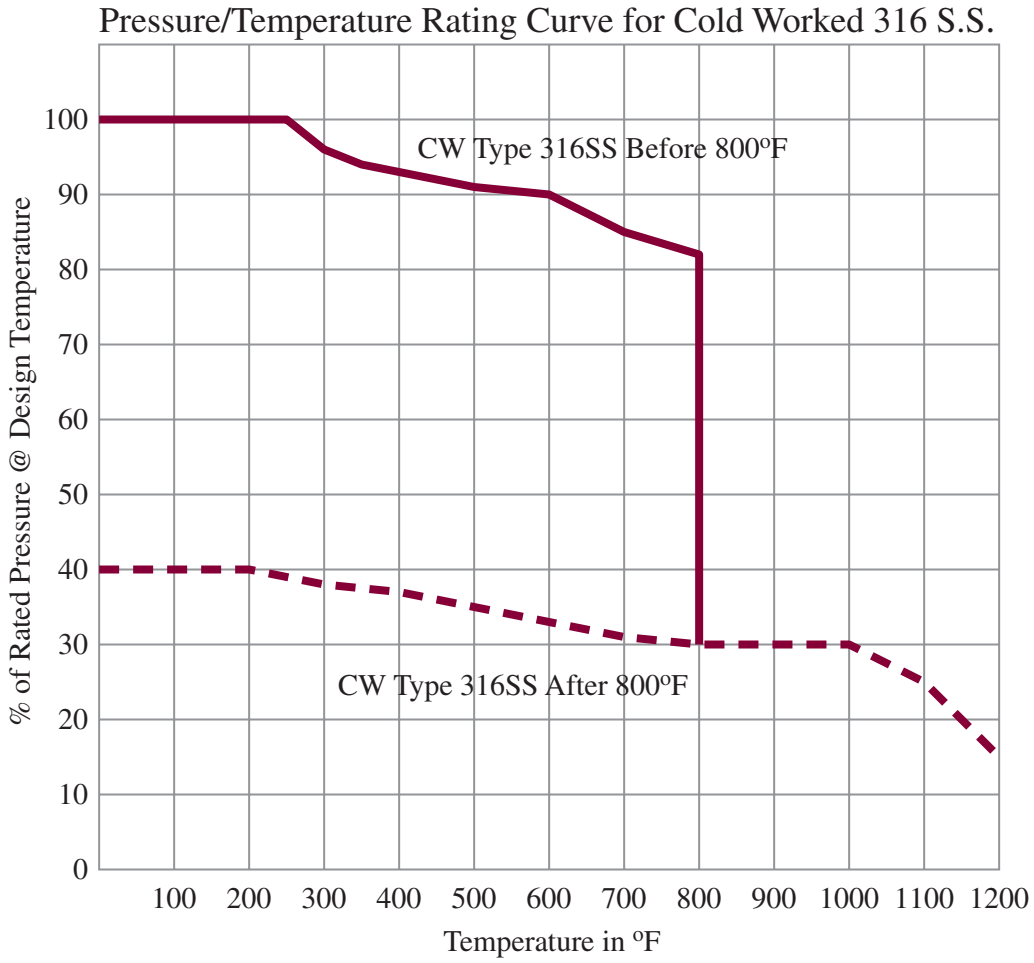
*Notes:*

1. *Optional grafoil packing not recommended for hydrogen or helium service.*
2. *Compression type (L/P) connections not recommended for service above 650°F (343°C) or below 0°F (-18°C). For these applications, BuTech recommends medium pressure M/P Coned-and-Threaded connections.*
3. *Chart above refers to sizes through 9/16" only. Consult factory for 3/4" and 1" sizes.*



2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

# PRESSURE/TEMPERATURE RATING GUIDE




*Notes:*

1. *This curve is valid for cold-worked type 316 stainless steel components* ***providing operating temperature does not exceed 800°F (426°C)****. After this temperature, the material is PERMANENTLY altered, and the component should be considered as annealed from then on, derating it to 40% of its cold-worked value.*
2. *Curves and ratings presented here are average values for reference only, and can be significantly affected by pressure and temperature charactistics of packing and trim materials. For extreme pressure/temperature requirements, please contact factory for recommendations.*
3. *For pressure/temperature information for other materials, please see pages Tech-4 thru Tech-7.*

## Temperature Information Checklist

| | -423˚ to -100˚F<br>-253˚ to -73˚C | -100˚ to 0˚F<br>-73˚ to -18˚C | 0˚ to 650˚F<br>-18˚ to 343˚C | 650˚ to 800˚F<br>343˚ to 427˚C | 800˚ to 1200˚F<br>427˚ to 649˚C |
|---|---|---|---|---|---|
| Compression Type Connections | Not Recommended | Not Recommended | Recommended | Not Recommended | Not Recommended |
| Coned-and-Threaded Connections | Required | Required | Recommended | Required | Required |
| Extended Stuffing Box | Required (See note 1) | May be required (See note 2) | May be required (See note 2) | May be required (See note 2) | Required (See note 3) |

*Notes:*

1. *Packing temperature not to go below -100ºF (-73º)*
2. *Extended Stuffing box required for operation below -100ºF (-73º) and above 450ºF (232ºC) (with Teflon packing) or 600ºF (315ºC) (with Teflon Glass packing).*
3. *Packing temperature not to exceed 800ºF (427ºC)*



2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

# Material vs. Pressure Rating - Valves/Fittings

| | | | Material vs. Pressure Rating @ Room Temperature* | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Valve Series** | **Conn** | **Tube Size** | **316CW (Std)** | **Hastelloy C276** | **Inconel 600** | **Inconel 625** | **Monel 400** | **Super Duplex 2507** | **Titanium 6AL4V** |
| SLPV2 | 1/8" L/P | 1/8" | 15.000 PSI 1030 bar | 12,500 PSI 860 bar | 12,500 PSI 860 bar | 12,500 PSI 860 bar | 11,000 PSI 760 bar | 12,500 PSI 860 bar | 12,500 PSI 860 bar |
| SLPV4 | 1/4" SL/P | 1/4" | 11,500 PSI 790 bar | 10,000 PSI 690 bar | 7,500 PSI 520 bar | 10,000 PSI 690 bar | 7,000 PSI 480 bar | 11,500 PSI 790 bar | 11,500 PSI 790 bar |
| SLPV6 | 3/8" SL/P | 3/8" | 7,500 PSI 520 bar | 7,500 PSI 520 bar | 7,500 PSI 520 bar | 7,500 PSI 520 bar | 6,500 PSI 450 bar | 7,500 PSI 520 bar | 7,500 PSI 520 bar |
| SLPV8 | 1/2" L/P | 1/2" | 5,500 PSI 380 bar | 5,500 PSI 380 bar | 5,500 PSI 380 bar | 5,500 PSI 380 bar | 4,600 PSI 320 bar | 5,500 PSI 380 bar | 5,500 PSI 380 bar |
| 20UV4 | 1/4" M/P | 1/4" | 20,000 PSI 1380 bar | 12,000 PSI 830 bar | 9,000 PSI 620 bar | 12,000 PSI 830 bar | 10,000 PSI 690 bar | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar |
| 20UV6 | 3/8" M/P | 3/8" | 20,000 PSI 1380 bar | 12,000 PSI 830 bar | 9,000 PSI 620 bar | 12,000 PSI 830 bar | 10,000 PSI 690 bar | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar |
| 20UV9 | 9/16" M/P | 9/16" | 20,000 PSI 1380 bar | 12,000 PSI 830 bar | 9,000 PSI 620 bar | 12,000 PSI 830 bar | 10,000 PSI 690 bar | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar |
| 20V12 | 3/4" M/P | 3/4" | 20,000 PSI 1380 bar | 12,000 PSI 830 bar | 9,000 PSI 620 bar | 12,000 PSI 830 bar | 10,000 PSI 690 bar | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar |
| 20V16 | 1" M/P | 1" | 20,000 PSI 1380 bar | 12,000 PSI 830 bar | 9,000 PSI 620 bar | 12,000 PSI 830 bar | 10,000 PSI 690 bar | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar |
| 30UV4 | 1/4" H/P | 1/4" | 30,000 PSI 2070 bar | 21,000 PSI 1450 bar | 16,500 PSI 1140 bar | 20,000 PSI 1380 bar | 12,000 PSI 830 bar | 30,000 PSI 2070 bar | 30,000 PSI 2070 bar |
| 30UV6 | 3/8" H/P | 3/8" | 30,000 PSI 2070 bar | 21,000 PSI 1450 bar | 16,500 PSI 1140 bar | 20,000 PSI 1380 bar | 12,000 PSI 830 bar | 30,000 PSI 2070 bar | 30,000 PSI 2070 bar |
| 30UV9 | 9/16" H/P | 9/16" | 30,000 PSI 2070 bar | 30,000 PSI 2070 bar | 20,000 PSI 1380 bar | 30,000 PSI 2070 bar | 12,000 PSI 830 bar | 30,000 PSI 2070 bar | 30,000 PSI 2070 bar |
| 30V16 | 1" H/P | 3/4" | 30,000 PSI 2070 bar | 21,000 PSI 1450 bar | 16,500 PSI 1140 bar | 20,000 PSI 1380 bar | 12,000 PSI 830 bar | 30,000 PSI 2070 bar | 30,000 PSI 2070 bar |
| 40UV9 | 9/16" H/P | 9/16" | 40,000 PSI 2760 bar | 35,000 PSI 2410 bar | 25,000 PSI 1720 bar | 35,000 PSI 2410 bar | 20,000 PSI 1380 bar | 40,000 PSI 2760 bar | 40,000 PSI 2760 bar |
| 60UV4 | 1/4" H/P | 1/4" | 60,000 PSI 4140 bar | 35,000 PSI 2410 bar | 27,500 PSI 1900 bar | 35,000 PSI 2410 bar | 20,000 PSI 1380 bar | 60,000 PSI 4140 bar | 60,000 PSI 4140 bar |
| 60UV6 | 3/8" H/P | 3/8" | 60,000 PSI 4140 bar | 35,000 PSI 2410 bar | 27,500 PSI 1900 bar | 35,000 PSI 2410 bar | 20,000 PSI 1380 bar | 60,000 PSI 4140 bar | 60,000 PSI 4140 bar |
| 60UV9 | 9/16" H/P | 9/16" | 60,000 PSI 4140 bar | 35,000 PSI 2410 bar | 27,500 PSI 1900 bar | 35,000 PSI 2410 bar | 20,000 PSI 1380 bar | 60,000 PSI 4140 bar | 60,000 PSI 4140 bar |

*Notes:*

*1. For ratings at elevated temperatures, see Pressure/Temperature rating curves on pages Tech-6 and Tech-7.*

*2. Tubing, connection type and/or packing material may limit maximum temperature rating. See pages Tech-2 and Tech-3 for details.*



2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

# Material vs Pressure Rating - Tubing

| Tube Size OD x ID | Material vs. Pressure Rating @ Room Temperature[1,2] | | | | | |
|---|---|---|---|---|---|---|
| | 316CW (Std)[3] | 304CW | Hastelloy C276 | Inconel 600 | Inconel 625 | Monel 400 |
| 1/8" x .062 | 12,500 PSI 860 bar | 12,500 PSI 860 bar | 12,500 PSI 860 bar | 12,500 PSI 860 bar | 12,500 PSI 860 bar | 10,000 PSI 690 bar |
| 1/8" x .069 | 9,500 PSI 650 bar | 9,500 PSI 650 bar | 12,500 PSI 860 bar | 10,500 PSI 720 bar | 12,500 PSI 860 bar | 9,500 PSI 650 bar |
| 1/8" x .085 | 6,000 PSI 410 bar | 6,000 PSI 410 bar | 12,500 PSI 860 bar | 7,000 PSI 480 bar | 12,500 PSI 860 bar | 6,000 PSI 410 bar |
| 1/4" x .125 | 11,500 PSI 790 bar | 11,500 PSI 790 bar | 11,500 PSI 790 bar | 11,500 PSI 790 bar | 11,500 PSI 790 bar | 10,000 PSI 690 bar |
| 1/4" x .180 | 5,200 PSI 360 bar | 5,200 PSI 360 bar | 7,000 PSI 480 bar | 6,250 PSI 430 bar | 550 bar | 5,500 PSI 380 bar |
| 1/4" x .194 | 4,500 PSI 310 bar | 4,500 PSI 310 bar | 6,000 PSI 410 bar | 4,800 PSI 330 bar | 8,000 PSI 550 bar | 4,300 PSI 300 bar |
| 3/8" x .250 | 7,500 PSI 520 bar | 7,500 PSI 520 bar | 7,500 PSI 520 bar | 7,500 PSI 520 bar | 7,500 PSI 520 bar | 6,500 PSI 450 bar |
| 3/8" x .277 | 5,000 PSI 340 bar | 5,000 PSI 340 bar | 6,200 PSI 430 bar | 5,600 PSI 390 bar | 7,500 PSI 520 bar | 5,200 PSI 360 bar |
| 3/8" x .305 | 3,300 PSI 230 bar | 3,300 PSI 230 bar | 4,500 PSI 310 bar | 4,000 PSI 280 bar | 6,000 PSI 410 bar | 3,500 PSI 240 bar |
| 1/2" x .375 | 5,500 PSI 380 bar | 5,500 PSI 380 bar | 7,000 PSI 480 bar | 5,000 PSI 340 bar | 7,000 PSI 480 bar | 4,600 PSI 320 bar |
| 1/2" x .402 | 3,500 PSI 240 bar | 3,500 PSI 240 bar | 5,000 PSI 340 bar | 4,000 PSI 280 bar | 7,000 PSI 480 bar | 3,500 PSI 240 bar |
| 1/4" x .109 | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar | 10,000 PSI 690 bar | 10,000 PSI 690 bar | 15,000 PSI 1030 bar | 10,000 PSI 690 bar |
| 3/8" x .203 | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar | 10,000 PSI 690 bar | 10,000 PSI 690 bar | 15,000 PSI 1030 bar | 10,000 PSI 690 bar |
| 9/16" x .312 | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar | 10,000 PSI 690 bar | 10,000 PSI 690 bar | 15,000 PSI 1030 bar | 10,000 PSI 690 bar |
| 9/16" x .359 | 10,000 PSI 690 bar | 10,000 PSI 690 bar | 8,000 PSI 550 bar | 6,000 PSI 410 bar | 10,000 PSI 690 bar | 6,000 PSI 410 bar |
| 3/4" x .438 | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar | 10,000 PSI 690 bar | 10,000 PSI 690 bar | 15,000 PSI 1030 bar | 10,000 PSI 690 bar |
| 3/4" x .516 | 10,000 PSI 690 bar | 10,000 PSI 690 bar | 8,000 PSI 550 bar | 6,000 PSI 410 bar | 10,000 PSI 690 bar | 6,000 PSI 410 bar |
| 1" x .438 | 30,000 PSI 2070 bar | 30,000 PSI 2070 bar | 18,000 PSI 1240 bar | 13,250 PSI 910 bar | 15,000 PSI 1030 bar | 12,750 PSI 880 bar |
| 1" x .562 | 20,000 PSI 1380 bar | 20,000 PSI 1380 bar | 10,000 PSI 690 bar | 10,000 PSI 690 bar | 15,000 PSI 1030 bar | 10,000 PSI 690 bar |
| 1" x .688 | 10,000 PSI 690 bar | 10,000 PSI 690 bar | 8,000 PSI 550 bar | 6,000 PSI 410 bar | 10,000 PSI 690 bar | 6,000 PSI 410 bar |
| 1/4" x .083 | 60,000 PSI 4140 bar | 60,000 PSI 4140 bar | 28,000 PSI 1930 bar | 22,000 PSI 1520 bar | 38,000 PSI 2620 bar | 20,000 PSI 1380 bar |
| 3/8" x .125 | 60,000 PSI 4140 bar | 60,000 PSI 4140 bar | 28,000 PSI 1930 bar | 22,000 PSI 1520 bar | 38,000 PSI 2620 bar | 20,000 PSI 1380 bar |
| 9/16" x .188 | 60,000 PSI 4140 bar | 60,000 PSI 4140 bar | 28,000 PSI 1930 bar | 22,000 PSI 1520 bar | 38,000 PSI 2620 bar | 20,000 PSI 1380 bar |
| 9/16" x .250 | 40,000 PSI 2760 bar | 40,000 PSI 2760 bar | 20,000 PSI 1380 bar | 15,000 PSI 1030 bar | 28,000 PSI 1930 bar | 15,000 PSI 1030 bar |

*Notes:*

*1. In some instances, the pressure rating of tubing is lower than the rating of the valves and fittings.*

*2. For ratings at elevated temperatures, see Pressure/Temperature rating curves on pages Tech-6 and Tech-7.*

*3. Tubing, connection type and/or packing material may limit maximum temperature rating. See pages Tech-2 and Tech-3 for further details.*

*4. Except low pressure series which is 316 annealed.*

*5. Tubing is seamless except Hastelloy C276 which is welded and drawn or seamless.*



ButTech MILTON ROY

2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

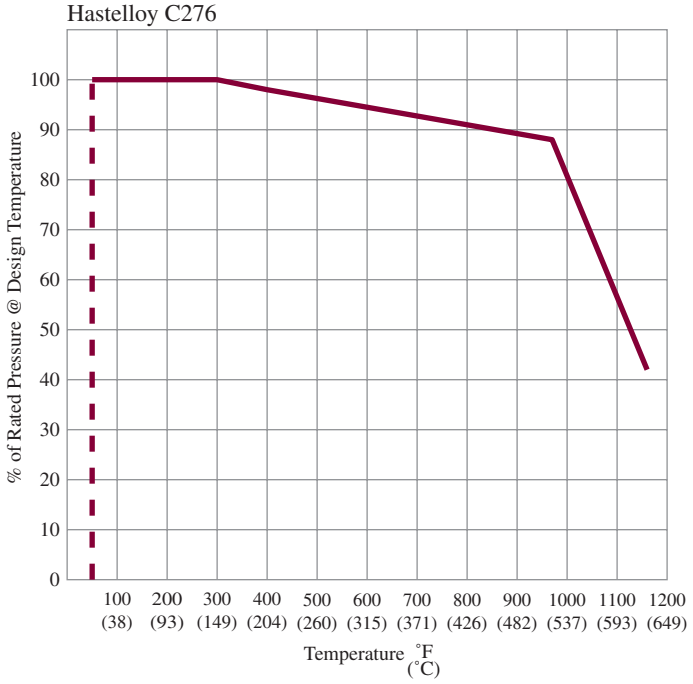
# Pressure vs Temperature Rating Curves

Curves and ratings presented here are average values for reference only. These values can be significantly affected by pressure and temperature charactistics of trim materials, stem packing materials or o-ring, and connection type. Other options such as extended stuffing box will be required to achieve the maximum temperature rating. See pages Tech-2 through Tech-3 for details.

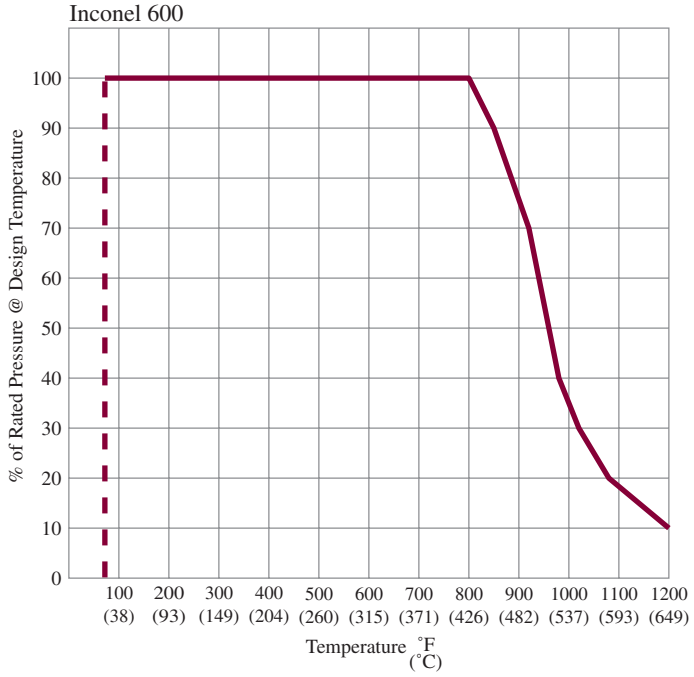
For extreme pressure/temperature requirements, please contact factory for recommendations.

To obtain the maximum pressure rating at an elevated temperature, multiply the maximum pressure rating of the item in special material at room temperature, by the elevated temperature factor (% of Design Temperature)

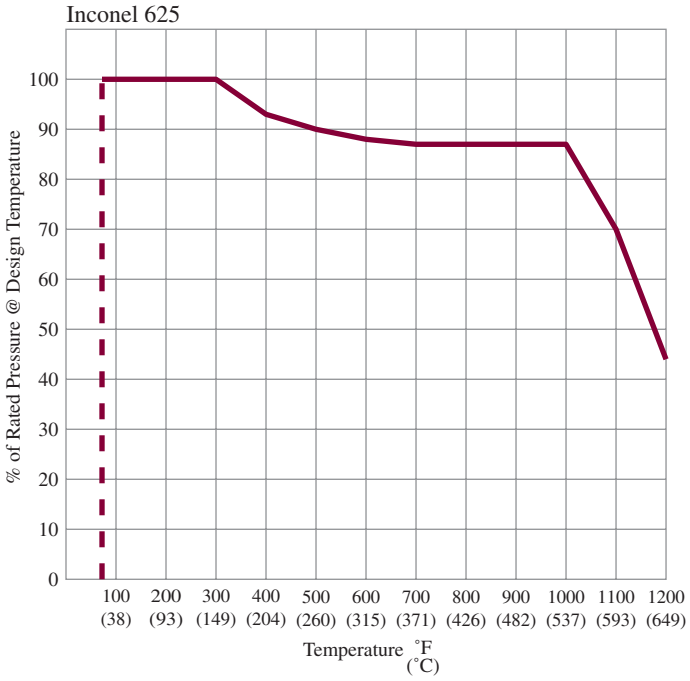
Hastelloy C276




Inconel 600




Inconel 625







2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

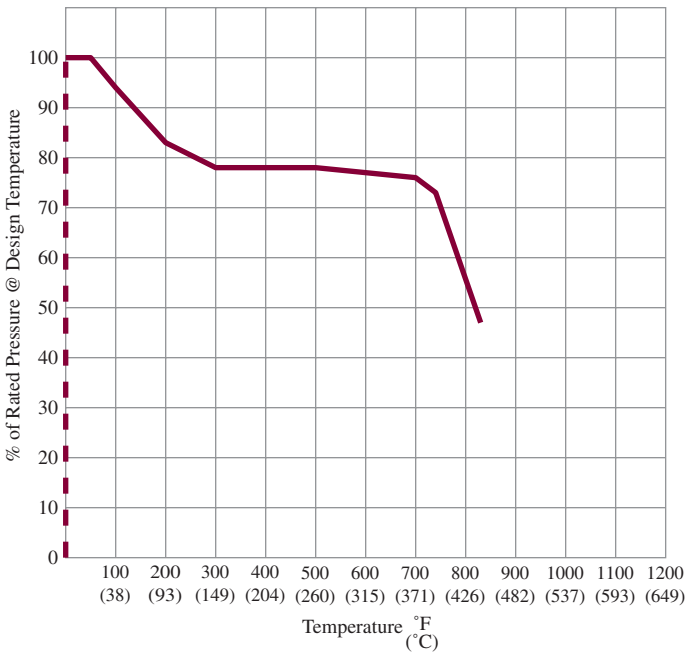
# Pressure vs Temperature Rating Curves

Example: Determine the pressure rating of a 1/4" 30UV valve constructed of Hastelloy C276 with an operating temperature of 600°F.

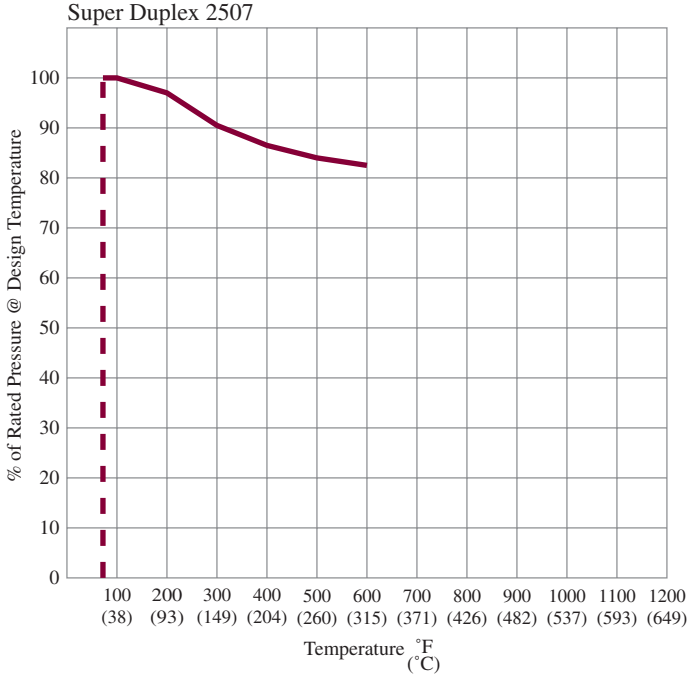
From the Material vs Pressure Rating chart on page Tech-4, the maximum pressure rating for a 30UV valve constructed of Hastelloy C276 would be 21,000 PSI at room temperature.

Turn to the Pressure vs Temperature rating curves on pages Tech-6 and Tech-7. Find 600°F on the X-axis of the Hastelloy C-276 chart. Follow the line up to read a value of 95%. Multiplying the room temperature rating by this reduction factor (21,000 x .95) yields a rating of 19,950 PSI at 600°F.

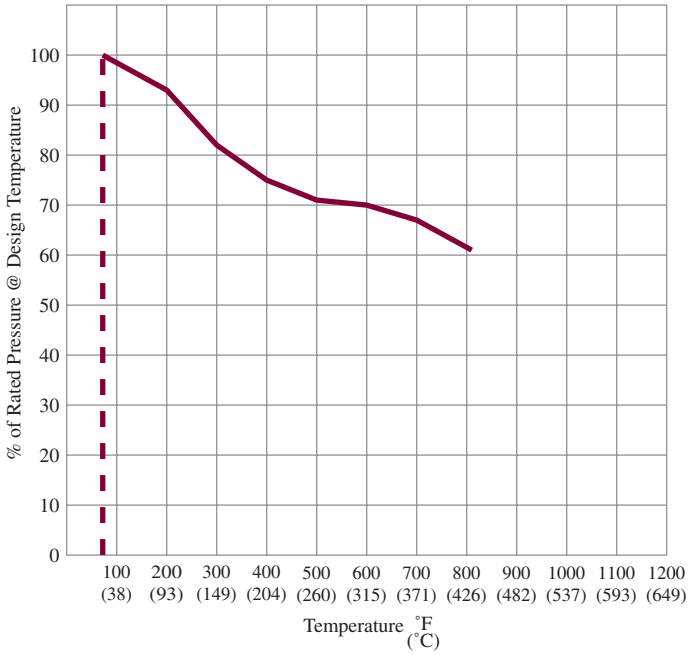
Monel 400




Super Duplex 2507




Titanium 6AL4V






2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

# FLOW FORMULAS

Coefficient of flow (Cv) of a valve is the volume of water in U.S. gallons per minute at room temperature, which will flow through the valve with the stem fully open, with a pressure drop of 1 PSI across the valve. Cv is the valve sizing factor that permits selection of the appropriate valve to meet the flow requirements of a given fluid system.

The Cv values shown on the technical page of the previous sections represent the full-open Cv for that particular valve. In determining estimated capacity, this Cv value should be used in the following formulas.

*Flow of Liquid in U.S. Gallons/min*

$$V = \frac{C_v\sqrt{P_1 - P_2}}{\sqrt{S_{GF}}}$$

*Flow of Liquid in lb/hr*

$$W = 500\, C_v\sqrt{(P_1 - P_2) / S_{GF}}$$

*Flow of Gases in SCFH* [1,2]

$$Q = \frac{42.2\, C_v\sqrt{(P_1 - P_2)(P_1 + P_2)}}{\sqrt{S_G}}$$

*Flow of Gases in SCFH* [2]
*(temperature corrected)*

$$Q = \frac{963\, C_v\sqrt{(P_1 - P_2)(P_1 + P_2)}}{\sqrt{S_G\, T_F}}$$

*Flow of Gases in lb/hr* [2]

$$W = 3.22\, C_v\sqrt{(P_1 - P_2)(P_1 + P_2) / S_G}$$

*Flow of Saturated Steam in lb/hr* [2]

$$W = 2.1\, C_v\sqrt{(P_1 - P_2)(P_1 + P_2)}$$

*Flow of Super Heated Steam in lb/hr* [2]

$$W = \frac{2.1\, C_v\sqrt{(P_1 - P_2)(P_1 + P_2)}}{(1 + 0.0007\, T_S)}$$

*Formula Nomenclature*

- $C_v$ = Valve coefficient of flow, full open
- $P_1$ = Inlet pressure, psia (14.7+psig)
- $P_2$ = Outlet pressure, psia (14.7+psig)
- $Q$ = Flow, standard cubic feet per hour (SCFH)
- $S_G$ = Specific gravity of gas
- $S_{GF}$ = Specific gravity of liquid
- $T_F$ = Flowing temp °R absolute (460+°F)
- $T_S$ = Superheat in °F
- $V$ = Flow, U.S. gallons per minute (GPM)
- $W$ = Flow, pounds per hour (lb/hr)

Specific Gravity ($S_G$)

| Liquid | Sgf@RT Relative to Water |
|---|---|
| Acetone | 0.792 |
| Alcohol | 0.792 |
| Benzine | 0.902 |
| Gasoline | 0.751 |
| Gasoline, nat. | 0.680 |
| Kerosene | 0.815 |
| Pentane | 0.624 |
| Water | 1 |

| Gas | Sg@RT Relative to Air |
|---|---|
| Acetylene | 0.897 |
| Air | 1.000 |
| Ammonia | 0.587 |
| Argon | 1.377 |
| Butane | 2.070 |
| Carbon Dioxide | 1.516 |
| Ethylene | 0.967 |
| Helium | 0.137 |
| Hydrogen | 0.0695 |
| Methane | 0.553 |
| Nitrogen | 0.966 |
| Oxygen | 1.103 |
| Propane | 1.562 |
| Sulphur Dioxide | 2.208 |

1. *Effect of flowing temperatures of gas flow are minimal for temperatures between 30°and 150°F (-1° to 65°C). Correction should be included if temperatures are higher or lower.*
2. *Where outlet pressure $P_2$ is less than $^1/_2$ inlet pressure $P_1$, the term $\sqrt{(P_1 - P_2)(P_1 + P_2)}$ becomes 0.87 $P_1$.*

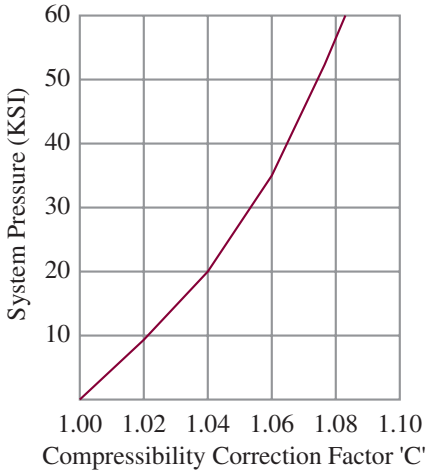

2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

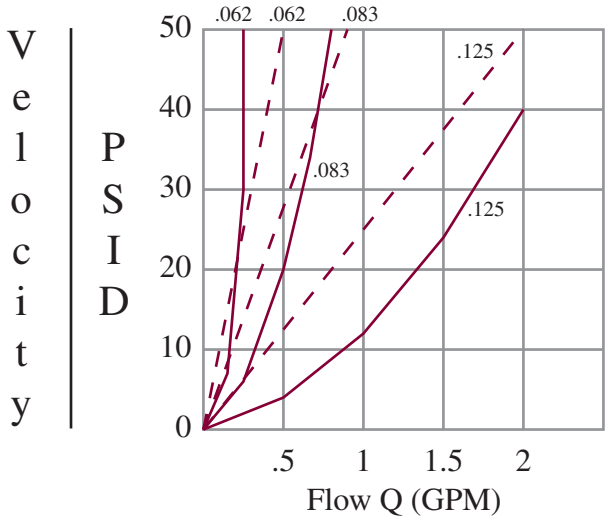
# Pressure Drop Curves

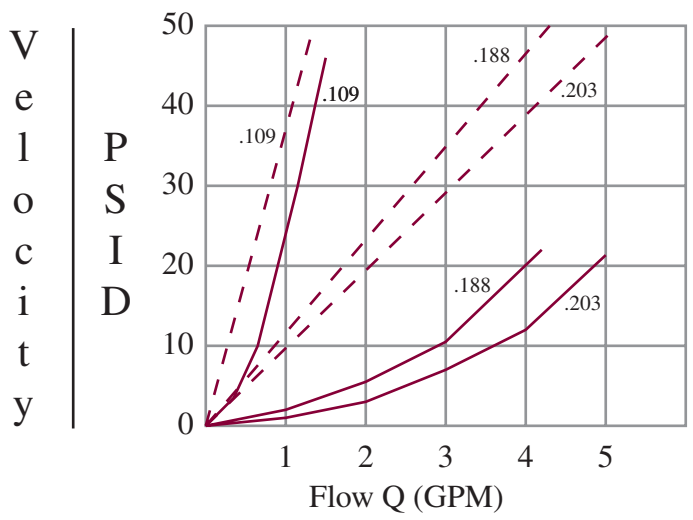
Theoretical Pressure Drop and Fluid Velocity vs Flow for BuTech Medium and High Pressure Tubing (based on water)

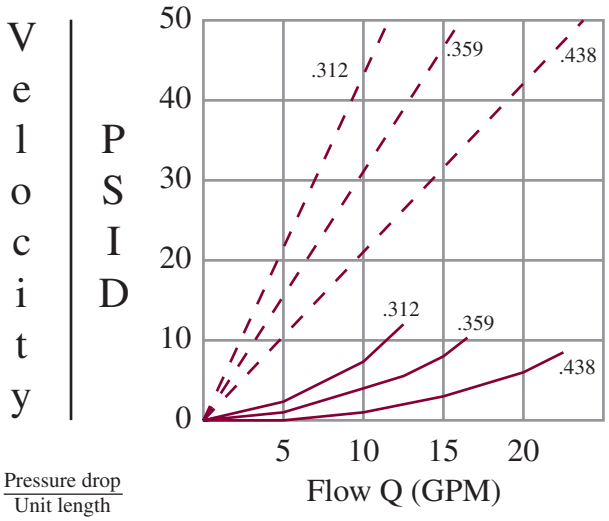
To determine the expected pressure drop per foot of tube length:
1. Select the appropriate curves based on tube I.D.
2. Find system flow rate on X-axis and follow graph vertically until it reaches the solid line corresponding with the tube I.D.
3. Move horizontally in the chart to read the pressure drop per foot on the Y-axis.
4. Multiply this value by the total tube length to obtain total pressure loss.
5. Multiply value from step 4 by the compressibility correction factor from the chart at the right to correct for system pressure above atmospheric.

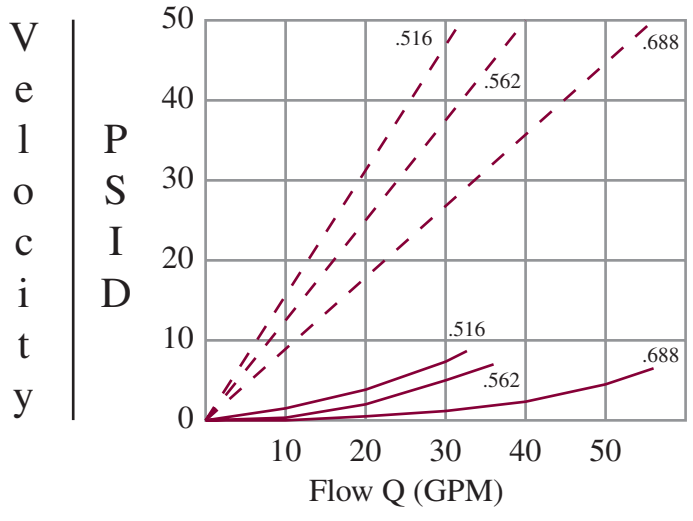
To determine average fluid velocity, follow the same procedure except use the dashed line.




Pressure drop / Unit length
ΔP = psi/ft ——

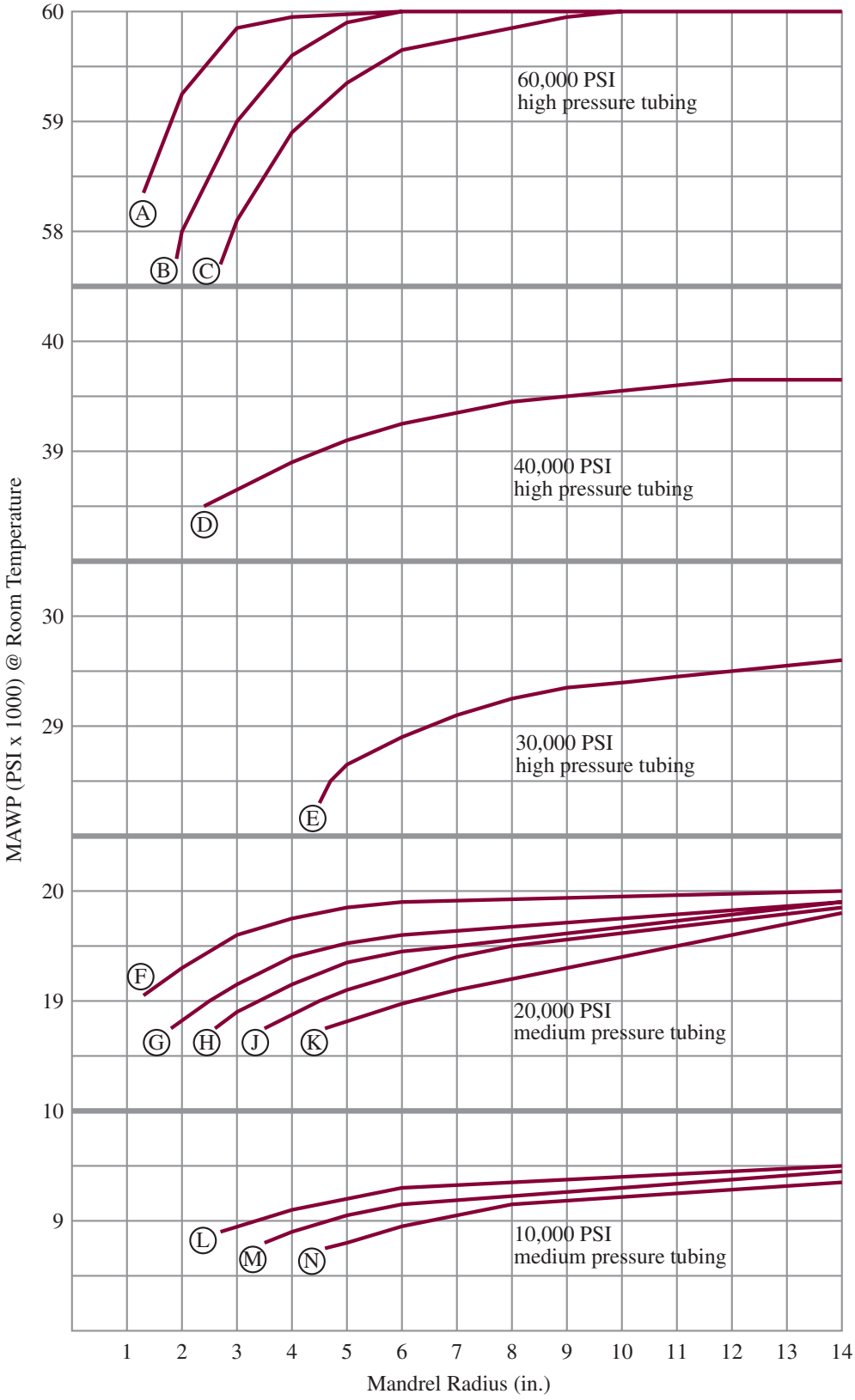
Velocity:
V = ft/sec – – –



2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

# Pressure vs Bend Radius

## *Allowable Pressure vs Mandrel Radius*




60,000 PSI Tubing

| | O.D. | I.D. | Minimum Radius |
|---|---|---|---|
| A | 1/4" | .083" | 1.25" (31.8 mm) |
| B | 3/8" | .125" | 1.75" (44.5 mm) |
| C | 9/16" | .188" | 2.625" (66.7 mm) |

40,000 PSI Tubing

| | O.D. | I.D. | Minimum Radius |
|---|---|---|---|
| D | 9/16" | 0.250" | 2.625" (66.7) |

30,000 PSI Tubing

| | O.D. | I.D. | Minimum Radius |
|---|---|---|---|
| E | 1" | 0.438" | 4.625" (117.5) |

20,000 PSI Tubing

| | O.D. | I.D. | Minimum Radius |
|---|---|---|---|
| F | 1/4" | 0.109" | 1.25" (31.8) |
| G | 3/8" | 0.203" | 1.75" (44.5) |
| H | 9/16" | 0.312" | 2.625" (66.7) |
| J | 3/4" | 0.438" | 3.50" (88.9) |
| K | 1" | 0.562" | 4.625" (117.5) |

10,000 PSI Tubing

| | O.D. | I.D. | Minimum Radius |
|---|---|---|---|
| L | 9/16" | 0.359" | 2.625" (66.7) |
| M | 3/4" | 0.516" | 3.50" (88.9) |
| N | 1" | 0.688" | 4.625" (117.5) |




2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com

# Conversion Tables

| PRESSURE | | |
|---|---|---|
| To convert.. | into… | Multiply by: |
| atm | bar | 1.01325 |
| | kg/cm$^2$ | 1.0332 |
| | PSI | 14.696 |
| | MPa | 0.101325 |
| | Pa | 101325 |
| bar | atm | 0.98692 |
| | kg/cm$^2$ | 1.01971 |
| | PSI | 14.504 |
| | MPa | 0.1 |
| | Pa | 100,000 |
| kg/cm$^2$ | atm | 0.96784 |
| | bar | 0.98067 |
| | PSI | 14.223 |
| | MPa | 0.098067 |
| | Pa | 98066.5 |
| Mpa | atm | 9.8692 |
| | bar | 10 |
| | kg/cm$^2$ | 10.1971 |
| | PSI | 145.04 |
| | Pa | 1,000,000 |
| Pa | atm | 0.0000098692 |
| | bar | 0.00001 |
| | kg/cm$^2$ | 0.0000101971 |
| | PSI | 0.00014504 |
| | MPa | 0.000001 |
| PSI | atm | 0.068046 |
| | bar | 0.068947 |
| | kg/cm$^2$ | 0.070307 |
| | MPa | 0.0068948 |
| | Pa | 6894.757 |

| LINEAR | | |
|---|---|---|
| To convert.. | into… | Multiply by: |
| cm | ft | 0.032808 |
| | in | 0.3937 |
| | meters | 0.01 |
| | microns | 10,000 |
| | mm | 10 |
| ft | cm | 30.48006 |
| | in | 12 |
| | meters | 0.3048 |
| | microns | 304,800 |
| | mm | 304.8006 |
| in | cm | 2.540005 |
| | ft | 0.08333 |
| | meters | 0.0254 |
| | microns | 25,400 |
| | mm | 25.40005 |
| meters | cm | 100 |
| | ft | 3.28083 |
| | in | 39.37 |
| | microns | 1,000,000 |
| | mm | 1,000 |
| microns | cm | 0.0001 |
| | ft | ----- |
| | in | 0.00003937 |
| | meters | 0.000001 |
| | mm | 0.001 |
| mm | cm | 0.1 |
| | ft | 0.003281 |
| | in | 0.03937 |
| | meters | 0.001 |
| | microns | 1000 |

| VOLUME | | |
|---|---|---|
| To convert.. | into… | Multiply by: |
| cc | ft$^3$ | 0.00003531 |
| | in$^3$ | 0.06102 |
| | liter | 0.001 |
| | M$^3$ | 0.000001 |
| | quart | 0.0010568 |
| | U.S. Gallon | 0.0002642 |
| ft$^3$ | cc | 28,317 |
| | in$^3$ | 1728 |
| | liter | 28.317 |
| | M$^3$ | 0.028317 |
| | quart | 29.92 |
| | U.S. Gallon | 7.4805 |
| in$^3$ | cc | 16.387 |
| | ft$^3$ | 0.0005787 |
| | liter | 0.016387 |
| | M$^3$ | 0.05787 |
| | quart | 0.01732 |
| | U.S. Gallon | 0.004329 |
| liter | cc | 1000.028 |
| | ft$^3$ | 0.03531 |
| | in$^3$ | 61.023 |
| | M$^3$ | 0.001 |
| | quart | 1.057 |
| | U.S. Gallon | 0.2642 |
| M$^3$ | cc | 1,000,000 |
| | ft$^3$ | 35.31 |
| | in$^3$ | 61,023 |
| | liter | 1,000 |
| | quart | 1056.8 |
| | U.S. Gallon | 264.2 |
| quart | cc | 946.25 |
| | ft$^3$ | 0.03342 |
| | in$^3$ | 57.75 |
| | liter | 0.9463 |
| | M$^3$ | 0.0009463 |
| | U.S. Gallon | 0.25 |
| U.S. Gallon | cc | 3,785 |
| | ft$^3$ | 0.1337 |
| | in$^3$ | 231 |
| | liter | 3.785 |
| | M$^3$ | 0.003785 |
| | quart | 4 |

| FLOW | | |
|---|---|---|
| To convert.. | into… | Multiply by: |
| cc/min | ft$^3$/min | 0.0000353145 |
| | gal/min | 0.0002642 |
| | in$^3$/min | 0.061 |
| | lit/min | 0.001 |
| ft$^3$/min | cc/min | 28,320 |
| | gal/min | 7.48 |
| | in$^3$/min | 28.8 |
| | lit/min | 28.32 |
| gal/min | cc/min | 3,784.8 |
| | ft$^3$/min | 0.1337 |
| | in$^3$/min | 231 |
| | lit/min | 3.7843 |
| in$^3$/min | cc/min | 16.39 |
| | ft$^3$/min | 0.035 |
| | lit/min | 0.016 |
| | gal/min | 0.004 |
| lit/min | cc/min | 1,000 |
| | ft$^3$/min | 0.03531 |
| | in$^3$/min | 61.02 |
| | gal/min | 0.26418 |

| AREA | | |
|---|---|---|
| To convert.. | into… | Multiply by: |
| cm$^2$ | ft$^2$ | 0.0010764 |
| | in$^2$ | 0.155 |
| | m$^2$ | 0.0001 |
| | mm$^2$ | 100. |
| ft$^2$ | cm$^2$ | 929.0341 |
| | in$^2$ | 144 |
| | m$^2$ | 0.092903 |
| | mm$^2$ | 9,290 |
| in$^2$ | cm$^2$ | 6.4516258 |
| | ft$^2$ | 0.006944 |
| | m$^2$ | 0.0006451 |
| | mm$^2$ | 645.16258 |
| m$^2$ | cm$^2$ | 10,000 |
| | ft$^2$ | 10.76387 |
| | in$^2$ | 1,550 |
| | mm$^2$ | 1,000,000 |
| mm$^2$ | cm$^2$ | 0.01 |
| | ft$^2$ | 0.000010764 |
| | in$^2$ | 0.00155 |
| | m$^2$ | 0.000001 |

| TEMPERATURE |
|---|
| deg F = (deg C x 1.8) + 32 |
| deg C = (deg F - 32) / 1.8 |



BuTech MILTON ROY

2121 EBCO Drive, Suite 1 • Erie, PA 16506 USA • Ph: (814) 833-4904 • Fax: (814) 833-2612 • E-mail: hq@butech-valve.com