



High Pressure Equipment

Technical Information

Selecting the right product to plumb your pressure system or conduct your research project is a critical decision. In this section, High Pressure Equipment Company provides a variety of technical information to assist you in this selection process. We have included a number of English to Metric conversion charts, flow coefficient formulas and valve ratings, reactor pressure ratings, and recommended torque values for our air operated valves and tubing connections.

As you work with this data, it is important to consider that it is general in nature and may vary depending on the actual parameters of your application. If you have any questions concerning this information or would like assistance in selecting an HiP product, our engineering staff is available and ready to help.



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Pressure

	Pa	kPa	psi	kg/cm ²	bar	atm	MPa
Pa	1	0.001	1.450×10^{-4}	1.020×10^{-5}	1×10^{-5}	9.869×10^{-6}	1×10^{-6}
kPa	1000	1	0.145	0.01	0.01	0.01	0.001
psi	6.895×10^3	6.895	1	0.07	0.069	0.068	0.007
kg/cm ²	9.807×10^4	98.07	14.22	1	0.981	0.968	0.098
bar	1×10^5	100	14.50	1.02	1	0.987	0.1
atm	101.3×10^5	101.3	14.7	1.033	1.013	1	0.101
MPa	1×10^6	1000	145	10.2	10	9.869	1

Flow

	mL/min	in ³ /min	ft ³ /hr	liter/min	gal/min
mL/min	1	0.061	0.002	0.001	6.242×10^{-4}
in ³ /min	16.39	1	0.035	0.016	0.004
ft ³ /hr	472	28.8	1	0.472	0.125
liter/min	1000	61.02	2.119	1	0.264
gal/min	3785	231	8.021	3.785	1

Weight/Mass

	gram	oz	lb	kg
gram	1	0.035	0.002	0.001
oz	28.35	1	0.063	0.028
lb	453.6	16	1	0.454
kg	1000	35.28	2.205	1

Volume

	mL	in ³	liter	gal	ft ³	m ³
mL	1	0.061	0.001	2.642×10^{-4}	3.531×10^{-5}	1×10^{-6}
in ³	16.39	1	0.016	0.004	5.787×10^{-4}	1.639×10^{-5}
liter	1000	61.02	1	0.264	0.035	0.001
gal	3.785×10^3	231	3.785	1	0.134	0.004
ft ³	2.832×10^4	1.728×10^3	28.32	7.481	1	0.028
m ³	1×10^6	6.102×10^4	1000	264.2	35.32	1

Linear

	micron	millimeter	centimeter	inch	foot	meter
micron	1	0.001	1×10^{-4}	3.937×10^{-5}	3.281×10^{-6}	1×10^{-10}
millimeter	1000	1	0.1	0.03937	0.003	0.001
centimeter	1×10^{-4}	10	1	0.394	0.033	0.01
inch	2.540×10^4	25.4	2.54	1	0.083	0.025
foot	3.048×10^5	304.8	30.48	12	1	0.305
meter	1×10^6	1000	100	39.37	3.281	1

Conversion Tables

Temperature

Fahrenheit to Celsius

°F	°C	°F	°C	°F	°C
-440	-262	260	127	820	438
-420	-251	270	132	840	449
-400	-240	280	138	860	460
-380	-229	290	143	880	471
-360	-218	300	149	900	482
-340	-207	310	154	920	493
-320	-196	320	160	940	504
-300	-184	330	166	960	516
-280	-173	340	171	980	527
-260	-162	350	177	1000	538
-240	-151	360	182	1020	549
-220	-140	370	188	1040	560
-200	-129	380	193	1060	571
-180	-118	390	199	1080	582
-160	-107	400	204	1100	593
-140	-96	410	210	1120	604
-120	-84	420	216	1140	616
-100	-73	430	221	1160	627
-80	-62	440	227	1180	638
-60	-51	450	232	1200	649
-40	-40	460	238	1220	660
-30	-34	470	243	1240	671
-20	-29	480	249	1260	682
-10	-23	490	254	1280	693
0	-18	500	260	1300	704
10	-12	510	266	1320	716
20	-7	520	271	1340	727
30	-1	530	277	1360	738
40	4	540	282	1380	749
50	10	550	288	1400	760
60	16	560	293	1420	771
70	21	570	299	1440	782
80	27	580	304	1460	793
90	32	590	310	1480	804
100	38	600	316	1500	816
110	43	610	321	1520	827
120	49	620	327	1540	838
130	54	630	332	1560	849
140	60	640	338	1580	860
150	66	650	343	1600	871
160	71	660	349	1620	882
170	77	670	354	1640	893
180	82	680	360	1660	904
190	88	690	366	1680	916
200	93	700	371	1700	927
210	99	720	382	1720	938
220	104	740	393	1740	949
230	110	760	404	1760	960
240	116	780	416	1780	971
250	121	800	427	1800	982

Celsius to Fahrenheit

°C	°F	°C	°F	°C	°F
-270	-454	230	446	730	1346
-260	-436	240	464	740	1364
-250	-418	250	482	750	1382
-240	-400	260	500	760	1400
-230	-382	270	518	770	1418
-220	-364	280	536	780	1436
-210	-346	290	554	790	1454
-200	-328	300	572	800	1472
-190	-310	310	590	810	1490
-180	-292	320	608	820	1508
-170	-274	330	626	830	1526
-160	-256	340	644	840	1544
-150	-238	350	662	850	1562
-140	-220	360	680	860	1580
-130	-202	370	698	870	1598
-120	-184	380	716	880	1616
-110	-166	390	734	890	1634
-100	-148	400	752	900	1652
-90	-130	410	770	910	1670
-80	-112	420	788	920	1688
-70	-94	430	806	930	1706
-60	-76	440	824	940	1724
-50	-58	450	842	950	1742
-40	-40	460	860	960	1760
-30	-22	470	878	970	1778
-20	-4	480	896	980	1796
-10	14	490	914	990	1814
0	32	500	932	1000	1832
10	50	510	950		
20	68	520	968		
30	86	530	986		
40	104	540	1004		
50	122	550	1022		
60	140	560	1040		
70	158	570	1058		
80	176	580	1076		
90	194	590	1094		
100	212	600	1112		
110	230	610	1130		
120	248	620	1148		
130	266	630	1166		
140	284	640	1184		
150	302	650	1202		
160	320	660	1220		
170	338	670	1238		
180	356	680	1256		
190	374	690	1274		
200	392	700	1292		
210	410	710	1310		
220	428	720	1328		

$$^{\circ}\text{F} = \frac{9}{5} ^{\circ}\text{C} + 32$$

$$^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32)$$

$$^{\circ}\text{R} = ^{\circ}\text{F} + 459.67$$

$$\text{K} = ^{\circ}\text{C} + 273.15$$



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Flow Coefficients

The flow coefficient C_v is a valve sizing designation commonly determined by laboratory test. It corresponds to the flow rate of water through a valve in US gallons per minute at 60°F with a differential pressure drop of one psi.

With the C_v coefficient known, the following values can be calculated:

1. Liquid flow capacity in US gallons per minute $Q_l = C_v \cdot \sqrt{\frac{\Delta P}{G}}$

2. Pressure drop across valve (liquid flow) $\Delta P = G \cdot \frac{Q_l^2}{C_v^2}$

3. Gas flow capacity in standard cubic feet per hour (SCFH) $Q_g = 1360 \cdot C_v \cdot \sqrt{\frac{P \cdot \Delta P}{T \cdot G \cdot Z}}$

4. Pressure drop across valve (gas flow) $\Delta P = \frac{T \cdot G \cdot Z}{P} \cdot \left(\frac{Q_g}{1360 \cdot C_v} \right)^2$

Where:

C_v = Valve flow coefficient

G = Specific gravity of fluid

ΔP = Differential pressure drop across valve (psi)

P = System pressure at valve inlet (psia)

Q_l = Liquid flow in US gallons per minute (GPM)

Q_g = Gas flow in standard cubic feet per hour (SCFH)

T = System temperature (°R)

Z = Gas compressibility factor at operating conditions

Flow coefficients of various HiP valves

Valve	C_v	Valve	C_v
15-11AF1	0.05	40-11HF9	0.23
15-11AF2	0.06	60-11HF2	0.06
10-11AF4	0.22	60-11HF4	0.09
10-11AF6	0.22	60-11HF6	0.13
20-11LF4	0.41	60-11HF9	0.13
20-11LF6	0.62	100-11XF4	0.09
20-11LF9	1.47	150-11XF6	0.09
20-11LF12	4.01	10-11NFA	0.22
20-11LF16	4.78	10-11NFB	0.22
30-11HF2	0.06	10-11NFC	0.22
30-11HF4	0.17	10-11NFD	1.47
30-11HF6	0.22		
30-11HF9	0.22		
30-11HF16	2.89		

Pressure Ratings

Bolted Closure Reactors (psi) at Elevated Temperatures

Temperature °F (°C)	BC-1	BC-2, BC-3, BC-5	BC-4, BC-6
100 (38)	5600	5250	3150
200 (93)	5600	5250	3150
300 (149)	5500	5100	3100
400 (204)	5400	5050	3050
500 (260)	5350	5050	3050
600 (316)	5100	5050	3050
650 (343)	5000	5000	3000

Temperature °F (°C)	BC-1	BC-2, BC-3, BC-5	BC-4, BC-6
700 (371)	4900	4900	2950
750 (399)	4800	4800	2850
800 (427)	4200	4200	2500
850 (454)	3400	3400	2050
900 (482)	2500	2500	1500
950 (510)	1700	1700	1000
1000 (538)	900	900	550

Recommended Torque

Tubing Connections

Connection	Recommended Torque
AF1	55 inch pounds
AF2	10 foot pounds initial to compress sleeve onto tube 25 foot pounds to tighten connection
AF4	30 foot pounds initial to compress sleeve onto tube 50 foot pounds to tighten connection
AF6	40 foot pounds initial to compress sleeve onto tube 60 foot pounds to tighten connection
LF4	20 foot pounds
LF6	30 foot pounds
LF9	50 foot pounds
LF12	90 foot pounds
LF16	125 foot pounds
HF2	75 inch pounds
HF4	25 foot pounds
HF6	50 foot pounds
HF9	110 foot pounds
HF16	150 foot pounds
XF4	45 foot pounds
XF6	70 foot pounds

Minimum Packing Gland Torque for Valves

Valve Series	Pressure Rating	Packing Gland Torque
15-**AF1 15-**AF2	15,000 psi	15 foot pounds
10-**AF4 10-**AF6	10,000 psi	30 foot pounds
10-**NFA 10-**NFB 10-**NFC	10,000 psi	35 foot pounds
10-**NFD	10,000 psi	50 foot pounds
20-**LF4 20-**LF6	20,000 psi 20,000 psi	35 foot pounds
20-**LF9	20,000 psi	70 foot pounds
30-**HF2 30-**HF4 30-**HF6 30-**HF9	30,000 psi	30 foot pounds
60-**HF2 60-**HF4 60-**HF6 60-**HF9	60,000 psi	40 foot pounds
100-**XF4	100,000 psi	60 foot pounds
150-**XF6	150,000 psi	90 foot pounds



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Minimum Safety Head Hold Down Nut Torque

Pressure psi	Torque foot pounds
10,000	40
15,000	45
20,000	50
25,000	55
30,000	60
35,000	65
40,000	70
45,000	75
50,000	80
55,000	85
60,000	90

Minimum Recommended Bend Radius For High Pressure Tubing

Tube Size O.D. x I.D.	Minimum Bend Radius
0.250 x 0.062 0.250 x 0.083 0.250 x 0.109 0.250 x 0.125	1.25 in
0.375 x 0.062 0.375 x 0.125 0.375 x 0.203 0.375 x 0.250	1.75 in
0.562 x 0.188 0.562 x 0.250 0.562 x 0.312	2.62 in
0.750 x 0.438 0.750 x 0.516	3.50 in
1" x 0.438 1" x 0.562 1" x 0.688	4.62 in