

Pressure/Temperature Relationship

Maximum Operating Temperatures For Various Piping Systems (de-rate operating pressure at temperatures in excess of 73°F)

Piping System	Max. Operating Temp. °F
ABS	140
PVC	140
CPVC - FlowGuard Gold® CTS	180
CPVC - Corzan® Sch. 80	200
CPVC - ChemDrain®*	220

* See the ChemDrain Technical Manual for more information on this product.

NOTICE: The maximum recommended temperature and de-rating of working pressure applies to both heat generated from fluid being distributed through pipe system and heat generated from sources external to the pipe system.

Temperature De-Rating For Schedule 40 & 80 PVC & CPVC

The operating pressure of PVC and CPVC pipe will be reduced as the operating temperature increases above 73° F. To calculate this reduction, multiply the operating pressures shown on the previous pages by the correction factors shown below:

Operating Temperature (°F)	Correction Factors	
	PVC	CPVC
73	1.00	1.00
80	.88	1.00
90	.75	.91
100	.62	.82
110	.50	.77
120	.40	.65
130	.30	.62
140	.22	.50
150	NR	.47
160	NR	.40
170	NR	.32
180	NR	.25
200	NR	.20

For example, the operating pressure for 6" Schedule 80 PVC pipe is 280 psi. If the operating temperature is 140° F, the maximum operating pressure is now 62 psi (280 x .22).

Temperature De-Rating for ASTM D 2846 CTS CPVC SDR 11 Piping Systems

Temperature °F	De-Rating Factor	Pressure Rating, PSI
73	1.00	400
80	1.00	400
90	0.91	360
100	0.82	325
120	0.65	260
140	0.50	200
160	0.40	160
180	0.25	100

Source: PPSA Bulletin No. 2-80 (10/79)

Example: Determine the maximum allowable operating pressure for a CTS CPVC piping system with an operating temperature of 140°F. The de-rating factor from the above chart is 0.50. Maximum allowable operating pressure = 400 x 0.50 = 200 psi.

De-rating Threaded Fittings, Valves and Unions

Pressure ratings shown are for socket (solvent cement) systems. The system must always be de-rated to the pressure rating of the lowest rated system component at the expected maximum system operating temperature.

- For pressure ratings of flanges or unions, see flanges and unions in the installation procedures section of this manual.
- Pressure ratings of Sch. 40 and Sch. 80 molded or cut threads are 50% of solvent cement systems. Please see table in the Threaded Joints and Threading of PVC and CPVC Pipe section of this manual.

- For pressure ratings of valves or other system components, always consult the technical recommendations from the manufacturers of those products.

NOTICE

Do not exceed the maximum working pressure of any system components including pipe, fittings, valves, molded or cut threads, unions, mechanical coupling or flanges.

- The pressure rating of all components must be reduced at temperatures above 73 degrees F. Refer to de-rating table in this manual.
- Exceeding the maximum working temperature or pressure of the system may result in system failure and property damage.

NOTICE

Use of FlowGuard Gold® CTS CPVC all-plastic threaded male adapters in hot water applications may result in system failure and property damage.

- Use plastic threaded CTS CPVC male adapters in cold water applications only.
- Use CTS CPVC x brass threaded transition fittings for hot water applications.
- Do not use compression fittings with brass ferrules to connect to CTS CPVC pipe or fittings where water temperatures will exceed 140 degrees F.
- CPVC pipe can be used with standard brass ferrules to make compression connections where the operating temperature will not exceed 140°F. Apply Teflon (PTFE) tape over the ferrule to allow for the dissimilar thermal expansion and contraction characteristics of the metal ferrule and the plastic pipe.

Pressure Rating of Fittings, Flanges, and Unions

Pressure Rating PVC Schedule 40 and PVC Schedule 80

One of the more complex questions in the plastic pipe and fittings industry is associated with the pressure rating of fittings used in PVC Schedule 40 and PVC Schedule 80 systems. While these fittings are used in pressure systems, strictly speaking, they are not pressure rated.

There has been an effort underway at ASTM International for many years to solve this question. However, the industry has not been able to develop a methodology for pressure rating fittings due to their varied configurations. The best effort to date is found within ASTM F 2261 *Standard Test Method for Pressure Rating PVC Plastic Pipe Fittings, Schedule 40 and 80 Socket Type*. This test method is similar to that found within ASTM D 2837 which is used to determine the Hydrostatic Design Basis (HDB) of plastic pipe. However, plastic pipe has a uniform shape that reacts consistently to pressure and fittings do not.

ASTM F 2261 indicates:

1.2 Unless the data (for fitting failure tests) approximates a straight line, when calculated using log-log coordinates, it is not possible to assign a pressure rating to that product or sample product. ... where the lower confidence level limits

are not met the data shall be classified as unsuitable.

Unfortunately, logged fitting failure test data is typically dispersed and judged as unsuitable.

The 1987 publication *Designing, Operating and Maintaining Piping Systems Using PVC Fittings* by Ron D. Bliesner is a respected reference addressing the pressure rating of fittings. This publication establishes a rule of thumb indicating that the working pressure for fittings is 60% of the working pressure of pipe. Charlotte Pipe agrees with this rule of thumb and recommends that the maximum working pressure for PVC Schedule 40 and PVC Schedule 80 fittings is 60% of the maximum working pressure of pipe of the same diameter and schedule. As with pipe, the maximum working pressure must be de-rated at temperatures exceeding 73 degrees F.

Special engineered fittings such as flanges, unions or valves differ in that they carry a pressure rating specified by the manufacturer which is usually lower than that of pipe of the same diameter.

Pressure Rating of PVC Flanges at Elevated Temperatures

System Operating Temperature °F (C)	73	80	90	100	110	120	130	140
	(23)	(27)	(32)	(38)	(43)	(49)	(54)	(60)
Pressure Rating (psi)	150	132	113	93	75	60	45	33

Maximum operating temperature for PVC is 140°F. Exceeding the maximum operating temperature could cause system failure and/or property damage.

Pressure Rating for PVC Schedule 80 Unions

Size	Unions	
	Socket Type	Threaded Type
	Max Working Pressure @ 73°F	Max Working Pressure @ 73°F
½"	235 psi	235 psi
¾"	235 psi	235 psi
1"	235 psi	235 psi
1¼"	235 psi	235 psi
1½"	235 psi	235 psi
2"	235 psi	200 psi
3"	235 psi	185 psi

Threaded Joints and Threading of PVC and CPVC Pipe

Only Schedule 80 PVC pipe can be threaded. Schedule 40, Schedule 80 CPVC or SDR pipe cannot be threaded; molded threaded adapters must be used on those systems.

The pressure rating of molded or cut threads must be derated by an additional 50% beyond the pressure rating for pipe and fittings. See pressure/temperature derating information in this technical manual for systems exposed to operating conditions above 73°F.

NOTICE

Do not exceed the maximum working pressure of any system components including pipe, fittings, valves, molded or cut threads, unions, mechanical coupling or flanges.

- The pressure rating of all components must be reduced at temperatures above 73 degrees F. Refer to de-rating table in this manual.
- Exceeding the maximum working temperature or pressure of the system may result in system failure and property damage.

Maximum Pressure Rating for PVC and CPVC Piping Systems With Threaded Fittings or Threaded Pipe in Pressure Applications

Size	Type	Pressure Rating (PSI) @								
		73 °F	80 °F	90 °F	100 °F	110 °F	120 °F	130 °F	140 °F	150 °F
1/2"	PVC Sch. 40	300	264	225	186	150	120	90	66	NR
	PVC Sch. 80 / CPVC Sch. 80	425	374	319	264	213	170	128	94	NR
3/4"	PVC Sch. 40	240	211	180	149	120	96	72	53	NR
	PVC Sch. 80 / CPVC Sch. 80	345	304	259	214	173	138	104	76	NR
1"	PVC Sch. 40	225	198	169	140	113	90	68	50	NR
	PVC Sch. 80 / CPVC Sch. 80	315	277	236	195	158	126	95	69	NR
1-1/4"	PVC Sch. 40	185	163	139	115	93	74	56	41	NR
	PVC Sch. 80 / CPVC Sch. 80	260	229	195	161	130	104	78	57	NR
1-1/2"	PVC Sch. 40	165	145	124	102	83	66	50	36	NR
	PVC Sch. 80 / CPVC Sch. 80	235	207	176	146	118	94	71	52	NR
2"	PVC Sch. 40	140	123	105	87	70	56	42	31	NR
	PVC Sch. 80 / CPVC Sch. 80	200	176	150	124	100	80	60	44	NR
3"	PVC Sch. 40	130	114	98	81	65	52	39	29	NR
	PVC Sch. 80 / CPVC Sch. 80	185	163	139	115	93	74	56	41	NR
4"	PVC Sch. 40	110	97	83	68	55	44	33	24	NR
	PVC Sch. 80 / CPVC Sch. 80	160	141	120	99	80	64	48	35	NR
6"	PVC Sch. 40	90	79	68	56	45	36	27	20	NR

Note: Threading of PVC Schedule 40 and CPVC Schedule 80 pipe is not recommended.
Threading pipe over 4" in diameter is not recommended.

PVC Schedule 40 Pressure Ratings

Size	Pipe	Pressure Rating (psi) @ 73°F			
		Socket Fittings	Threaded Fittings	Flanges	Unions
½"	600	360	300	150	235
¾"	480	288	240	150	235
1"	450	270	225	150	235
1¼"	370	222	185	150	235
1½"	330	198	165	150	235
2"	280	168	140	150	235
2½"	300	180	150	150	-
3"	260	156	130	150	235
4"	220	132	110	150	-
5"	190	114	95	-	-
6"	180	108	90	150	-
8"	160	96	80	150	-
10"	140	84	70	150	-
12"	130	78	65	150	-
14"	130	78	65	-	-
16"	130	78	65	-	-

Pipe	Pressure Rating (psi) @ 140°F				Unions
	Socket Fittings	Threaded Fittings	Flanges	Unions	
132	79	66	33	52	
106	63	53	33	52	
99	59	50	33	52	
81	49	41	33	52	
73	44	36	33	52	
62	37	31	33	52	
66	40	33	33	-	
57	34	29	33	52	
48	29	24	33	-	
42	25	21	-	-	
40	24	20	33	-	
35	21	18	33	-	
31	18	15	33	-	
29	17	14	33	-	
29	17	14	-	-	
29	17	14	-	-	

PVC Schedule 80 Pressure Ratings

Size	Pipe	Pressure Rating (psi) @ 73°F			
		Socket Fittings	Threaded Fittings	Flanges	Unions (Socket)
½"	850	510	425	150	235
¾"	690	414	345	150	235
1"	630	378	315	150	235
1¼"	520	312	260	150	235
1½"	470	282	235	150	235
2"	400	240	200	150	235
2½"	420	252	210	150	-
3"	370	222	185	150	235
4"	320	192	160	150	-
5"	290	174	145	-	-
6"	280	168	140	150	-
8"	250	150	125	150	-
10"	230	138	115	150	-
12"	230	138	115	150	-
14"	220	132	110	-	-
16"	220	132	110	-	-

Pipe	Pressure Rating (psi) @ 140°F				Unions (Socket)
	Socket Fittings	Threaded Fittings	Flanges	Unions (Socket)	
187	112	94	33	52	
152	91	76	33	52	
139	83	69	33	52	
114	69	57	33	52	
103	62	52	33	52	
88	53	44	33	52	
92	55	46	33	-	
81	49	41	33	52	
70	42	35	33	-	
64	38	32	-	-	
62	37	31	33	-	
55	33	28	33	-	
51	30	25	33	-	
51	30	25	33	-	
48	29	24	-	-	
48	29	24	-	-	

NOTICE

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- Exceeding the maximum working temperature or pressure of the system may result in system failure and property damage.