

Physical Properties of Thermoplastic Piping Materials

ASTM		MATERIAL			
Test		PVC	CPVC		
Methods	Properties	12454-B	23447-B	PVDF	Polypropylene
GENERAL					
D-792	Specific Gravity	1.38	1.55	1.76	.905
D-570	Water Absorption % 24 Hrs. @ 73°F	.05	.05	.04	.02
MECHANICAL					
D-638	Tensile Strength psi @ 73°F	7,940	8,400	6,000	5,000
D-638	Modulus of Elasticity in Tension psi @ 73°F x 10 ⁵	4.2	4.2	2.1	1.7
D-790	Flexural Strength psi	14,500	15,600	9,700	7,000
D-256	Izod Impact Strength @ 73°F (Notched)	.65	3.0	3.8	1.3
THERMAL					
D-696	Coefficient of thermal Expansion in/in/°F 10 ⁻⁵	3.0	3.8	7.9	5.0
C-177	Thermal Conductivity BTU/HR/Sq. Ft./ °F/in	1.2	.95	.79	1.2
D-648	Heat Distortion Temp. °F @ 66 psi	NA	238	284	220
D-648	Heat Distortion Temp. °F @ 264 psi	160	221	194	140
	Resistance to Heat °F at continuous Drainage	140	210	280	180
FLAMMABILITY					
D-2863	Limiting Oxygen Index (%)	43	60	44	17
E-84	Flame Spread	15-20	15	0	NA
	Underwriters Lab Rating	94V-O	94V-O	94V-O	94HB

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PVC Pipe Type I and Type II

SCHEDULE 40 NSF								SCHEDULE 80 NSF							
Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ Ft.		Max. W.P. PSI *		Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ Ft.		Max. W.P. PSI *	
				Type I	Type II	Type I	Type II					Type I	Type II	Type I	Type II
1/8	.405	.261	.068	.045	.044	810	400	1/8	.405	.203	.095	.058	.056	1230	610
1/4	.540	.354	.088	.081	.080	780	390	1/4	.540	.288	.119	.100	.098	1130	570
3/8	.675	.483	.091	.109	.107	620	310	3/8	.675	.407	.126	.138	.135	920	460
1/2	.840	.608	.109	.161	.158	600	300	1/2	.840	.528	.147	.202	.197	850	420
3/4	1.050	.810	.113	.214	.210	480	240	3/4	1.050	.724	.154	.273	.268	690	340
1	1.315	1.033	.133	.315	.309	450	220	1	1.315	.935	.179	.402	.394	630	320
1 1/4	1.660	1.364	.140	.426	.417	370	180	1 1/4	1.660	1.256	.191	.554	.542	520	260
1 1/2	1.900	1.592	.145	.509	.498	330	170	1 1/2	1.900	1.476	.200	.673	.659	470	240
2	2.375	2.049	.154	.682	.668	280	140	2	2.375	1.913	.218	.932	.912	400	200
2 1/2	2.875	2.445	.203	1.076	1.053	300	150	2 1/2	2.875	2.289	.276	1.419	1.389	420	210
3	3.500	3.042	.216	1.409	1.379	260	130	3	3.500	2.864	.300	1.903	1.863	370	190
3 1/2	4.000	3.520	.226	1.697	1.661	240	120	3 1/2	4.000	3.326	.318	2.322	2.273	350	170
4	4.500	3.998	.237	2.006	1.963	220	110	4	4.500	3.786	.337	2.782	2.723	320	160
5	5.563	5.017	.258	2.726	2.668	190	100	5	5.563	4.767	.375	3.867	3.784	290	140
6	6.625	6.031	.280	3.535	3.460	180	90	6	6.625	5.709	.432	5.313	5.200	280	140
8	8.625	7.943	.322	5.305	5.190	160	80	8	8.625	7.565	.500	8.058	7.883	250	120
10	10.750	9.976	.365	7.532	7.368	140	70	10	10.750	9.492	.593	11.956	11.695	230	120
12	12.750	11.890	.406	9.949	9.733	130	70	12	12.750	11.294	.687	16.437	—	230	—
14	14.000	13.072	.437	11.810	—	130	—	14	14.000	12.410	.750	19.790	—	220	—
16	16.000	14.940	.500	15.416	—	130	—	16	16.000	14.214	.843	25.430	—	220	—
								18	18.000	16.014	.937	31.830	—	220	—

* For water at 73°F with solvent cemented joints. Threading not recommended for Schedule 40. Use 50% of indicated pressure rating (W.P.) for threaded pipe. For fluids other than water, see Chemical Resistance Guide.

CPVC Pipe

SCHEDULE 40 NSF **						SCHEDULE 80 NSF						
Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ Ft.	Max. W.P. PSI *	Nominal Pipe Size (in.)	O.D.	Average I.D.	Min. Wall	Nominal Wt./ Ft.	Max. W.P. PSI *	
											Plain End	Threaded
1/4	.540	.354	.088	.091	780	1/4	.540	.288	.119	.112	1130	565
3/8	.675	.483	.091	.122	620	3/8	.675	.407	.126	.154	920	460
1/2	.840	.608	.109	.180	590	1/2	.840	.528	.147	.225	850	425
3/4	1.050	.810	.113	.239	480	3/4	1.050	.724	.154	.305	690	345
1	1.315	1.033	.133	.352	450	1	1.315	.935	.179	.449	630	315
1 1/4	1.660	1.364	.140	.475	365	1 1/4	1.660	1.256	.191	.618	520	260
1 1/2	1.900	1.592	.145	.568	330	1 1/2	1.900	1.476	.200	.751	470	235
2	2.375	2.049	.154	.761	275	2	2.375	1.913	.218	1.040	400	200
2 1/2	2.875	2.445	.203	1.201	300	2 1/2	2.875	2.289	.276	1.584	420	210
3	3.500	3.042	.216	1.572	260	3	3.500	2.864	.300	2.124	370	185
3 1/2	4.000	3.520	.226	1.905	240	3 1/2	4.000	3.326	.318	2.607	350	175
4	4.500	3.998	.237	2.239	220	4	4.500	3.786	.337	3.105	320	160
6	6.625	6.031	.280	3.945	180	6	6.625	5.709	.432	5.929	280	140
8	8.625	7.943	.322	5.958	160	8	8.625	7.565	.500	9.051	250	125
10	10.750	9.976	.365	8.458	140	10	10.750	9.492	.593	13.429	230	115
12	12.750	11.890	.406	11.172	130	12	12.750	11.294	.687	18.458	230	115

* Water 73.4°F. For fluids other than water, see Chemical Resistance Guide.

** Pipe should not be threaded. Use flanged joints, unions, or grooved pipe couplings where disassembly is necessary. Operating above 140°F PVC and 200°F for CPVC are not recommended.

PVC PIPE		Temperature De-Rating Factors	CPVC PIPE	
Working Temperature (°F)	De-Rating Factor		Working Temperature (°F)	De-Rating Factor
73	1.00	PVC Pipe to be applied to 73.4°F working pressures with water for SDR, Sch. 40, 80, & 120 PVC pipe, either Type 1120 or 2110. CPVC Pipe to be applied to 73.4°F working pressures with water for Schedule 40 & 80 CPVC pipe. ** Pipe should not be threaded. Use flanged joints, unions, or grooved pipe couplings where disassembly is necessary. Operating above 140°F PVC and 200°F for CPVC are not recommended.	73	1.00
80	0.88		110	0.72
90	0.75		120	0.65
100	0.62		130	0.57
110	0.51		140 **	0.50
120	0.40		150 **	0.42
130 **	0.31		160 **	0.40
140 **	0.22		170 **	0.29
			180 **	0.25
			200 **	0.20

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ASTM Standards

(American Society for Testing and Materials)

ASTM Standard D-1784

This standard covers PVC and CPVC compounds used in the manufacture of plastic pipe, valves, and fittings. It provides a means for selecting and identifying compounds on the basis of a number of physical and chemical criteria. Conformance to a particular material classification in this standard requires meeting a number of minimum physical and chemical properties.

ASTM Standards D-2464 and F-437

These standards cover PVC (D-2464) and CPVC (F-437) Schedule 80 threaded pressure fittings. Thread dimensional specifications, wall thickness, burst, material quality, and identification requirements are specified.

ASTM Standards D-2467 and F-439

These standards cover Schedule 80 PVC (D-2467) and CPVC (F-439) Socket Type Pressure Fittings. Dimensions, burst strength, resin compound stipulation and scheme of product identification requirements are specified.

ASTM Standards D-4101 (Formerly D-2146)

This standard covers the polymeric content and physical characteristics of PP (polypropylene) Plastic Materials for injection molding and extrusion.

ASTM Standard D-2657

This standard covers the procedure for heat-fusion bonding of polyolefin materials.

ASTM Standard D-3222

This standard covers the polymerization method and physical properties of PVDF (polyvinylidene fluoride) fluoroplastic Materials for molding and extrusion.

ANSI B1.20.1 (was B2.1)

(American National Standards Institute)

This specification details the dimensions and tolerance for tapered pipe threads. This standard is referenced in the ASTM standard for threaded fittings mentioned above.

ANSI B16.5

This specification sets forth standards for bolt holes, bolt circle, and overall dimensions for steel 150# flanges.

Temperature Correction Factors

Operating Temperature °F	FACTORS			
	PVC	CPVC	PP	PVDF
70	1.00	1.00	1.00	1.00
80	0.90	0.96	0.97	0.95
90	0.75	0.92	0.91	0.87
100	0.62	0.85	0.85	0.80
110	0.50	0.77	0.80	0.75
115	0.45	0.74	0.77	0.71
120	0.40	0.70	0.75	0.68
125	0.35	0.66	0.71	0.66
130	0.30	0.62	0.68	0.62
140	0.22	0.55	0.65	0.58
150	N.R.	0.47	0.57	0.52
160	N.R.	0.40	0.50	0.49
170	N.R.	0.32	0.26	0.45
180	N.R.	0.25	*	0.42
200	N.R.	0.18	N.R.	0.36
210	N.R.	0.15	N.R.	0.33
240	N.R.	N.R.	N.R.	0.25
280	N.R.	N.R.	N.R.	0.18

* Recommended for intermittent drainage pressure not exceeding 20 psi.
N.R. — Not Recommended

Valves, Flanges and Unions

The maximum pressure rating for Chemtrol valves, flanges, and unions, regard-less of size, is 150 psi at 73°F. As with all other thermoplastic piping components, the maximum non - shock operating pressure is related to temperature. Above 100°F refer to the chart below.

Max. Operating Pressure (psi) vs. Temperature

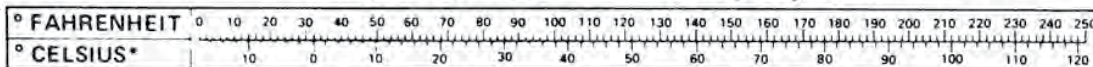
Operating Temperature °F	FACTORS			
	PVC	CPVC	PP	PVDF
100	150	150	150	150
110	135	140	140	150
120	110	130	130	150
130	75	120	118	150
140	50	110	105	150
150	N.R.	100	93	140
160	N.R.	90	80	133
170	N.R.	80	70	125
180	N.R.	70	50	115
190	N.R.	60	N.R.	106
200	N.R.	50	N.R.	97
250	N.R.	N.R.	N.R.	50
280	N.R.	N.R.	N.R.	25

N.R. — Not Recommended

Temperature Conversions

$$F = C \times 1.8 + 32$$

$$C = (F-32) \div 1.8$$



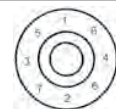
*Formerly known as Centigrade

°C	°F	°C	°F	°C	°F	°C	°F
-40.0	-40.0	-6.7	68.0	23.9	167.0	65.6	302.0
-37.2	-31.0	-3.9	77.0	26.7	176.0	71.1	320.0
-34.4	-22.0	-1.1	86.0	29.4	185.0	76.7	338.0
-31.7	-13.0	0	89.6	32.2	194.0	82.2	356.0
-28.9	-4.0	1.7	95.0	35.0	203.0	87.8	374.0
-26.1	5.0	4.4	104.0	37.8	212.0	93.3	392.0
-23.2	14.0	7.2	113.0	40.6	221.0	98.9	410.0
-20.6	23.0	10.0	122.0	43.3	230.0	104.4	428.0
-17.8	32.0	12.8	131.0	46.1	239.0	110.0	446.0
-15.0	41.0	15.6	140.0	48.9	248.0	115.6	464.0
-12.2	50.0	18.3	149.0	54.4	266.0	121.0	482.0
-9.4	59.0	21.1	158.0	60.0	284.0	149.0	572.0

Flange Sz.	Torque *
1/2-1 1/2"	10-15 ft. lb
2 - 4"	20-30 ft. lb
6 - 8"	33-50 ft. lb
10"	53-75 ft. lb
12"	80-110 ft. lb

* For a well lubricated bolt with flat washers under bolt head and nut.

The following tighten pattern is suggested for the flange bolts.



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Support Spacing (ft.) for PVC Pipe*

Horizontal pipe systems support spacings are greatly influenced by operating temperature. The charts show the recommended support spacing according to size, schedule, and operating temperatures. Do not clamp supports tightly — this restricts axial movement of the pipe. If short spacing is necessary, continuous supports may be more economical. Charts are based on liquids up to 1.00 specific gravity, but do not include concentrated loads, nor do they include allowance for aggressive reagents.

Pipe Size (in.)	SCHEDULE 40 Temperature °F					SCHEDULE 80 Temperature °F					SCHEDULE 120 Temperature °F				
	60°	80°	100°	120°	140°	60°	80°	100°	120°	140°	60°	80°	100°	120°	140°
1/4	4	3 1/2	3 1/2	2	2	4	4	3 1/2	2 1/2	2					
3/8	4	4	3 1/2	2 1/2	2	4 1/2	4 1/2	4	2 1/2	2 1/2					
1/2	4 1/2	4 1/2	4	2 1/2	2 1/2	5	4 1/2	4 1/2	3	2 1/2	5	5	4 1/2	3	2 1/2
3/4	5	4 1/2	4	2 1/2	2 1/2	5 1/2	5	4 1/2	3	2 1/2	5 1/2	5	4 1/2	3	3
1	5 1/2	5	4 1/2	3	2 1/2	6	5 1/2	5	3 1/2	3	6	5 1/2	5	3 1/2	3
1 1/4	5 1/2	5 1/2	5	3	3	6	6	5 1/2	3 1/2	3	6 1/2	6	5 1/2	3 1/2	3 1/2
1 1/2	6	5 1/2	5	3 1/2	3	6 1/2	6	5 1/2	3 1/2	3 1/2	6 1/2	6 1/2	6	4	3 1/2
2	6	5 1/2	5	3 1/2	3	7	6 1/2	6	4	3 1/2	7 1/2	7	6 1/2	4	3 1/2
2 1/2	7	6 1/2	6	4	3 1/2	7 1/2	7 1/2	6 1/2	4 1/2	4	8	7 1/2	7	4 1/2	4
3	7	7	6	4	3 1/2	8	7 1/2	7	4 1/2	4	8 1/2	8	7 1/2	5	4 1/2
3 1/2	7 1/2	7	6 1/2	4	4	8 1/2	8	7 1/2	5	4 1/2	9	8 1/2	7 1/2	5	4 1/2
4	7 1/2	7	6 1/2	4 1/2	4	9	8 1/2	7 1/2	5	4 1/2	9 1/2	9	8 1/2	5 1/2	5
5	8	7 1/2	7	4 1/2	4	9 1/2	9	8	5 1/2	5	10 1/2	10	9	6	5 1/2
6	8 1/2	8	7 1/2	5	4 1/2	10	9 1/2	9	6	5	11 1/2	10 1/2	9 1/2	6 1/2	6
8	9	8 1/2	8	5	4 1/2	11	10 1/2	9 1/2	6 1/2	5 1/2					
10	10	9	8 1/2	5 1/2	5	12	11	10	7	6					
12	11 1/2	10 1/2	9 1/2	6 1/2	5 1/2	13	12	10 1/2	7 1/2	6 1/2					
14	12	11	10	7	6	13 1/2	13	11	8	7					
16	12 1/2	11 1/2	10 1/2	7 1/2	6 1/2	14	13 1/2	11 1/2	8 1/2	7 1/2					
	SDR 41					SDR 26									
18	13	12	11	8	7	14 1/2	14	12	9	8					
20	13 1/2	12 1/2	11 1/2	8 1/2	7 1/2	15	14 1/2	12 1/2	9 1/2	8 1/2					
24	14	13	12	9	8	15 1/2	15	13	10	9					

Note: Although support spacing is shown at 140°F, consideration should be given to the use of CPVC or continuous support above 120°F. The possibility of temperature overrides beyond regular working temperatures and cost may make either of the alternatives more desirable. This chart based on continuous spans and for uninsulated line carrying fluids of specific gravity up to 1.00.

Support Spacing (ft.) for CPVC Pipe*

Pipe Size (in.)	SCHEDULE 40 Temperature °F						SCHEDULE 80 Temperature °F					
	73°	100°	120°	140°	160°	180°	73°	100°	120°	140°	160°	180°
1/2	5	4 1/2	4 1/2	4	2 1/2	2 1/2	5 1/2	5	4 1/2	4 1/2	3	2 1/2
3/4	5	5	4 1/2	4	2 1/2	2 1/2	5 1/2	5 1/2	5	4 1/2	3	2 1/2
1	5 1/2	5 1/2	5	4 1/2	3	2 1/2	6	6	5 1/2	5	3 1/2	3
1 1/4	5 1/2	5 1/2	5 1/2	5	3	3	6 1/2	6	6	5 1/2	3 1/2	3
1 1/2	6	6	5 1/2	5	3 1/2	3	7	6 1/2	6	5 1/2	3 1/2	3 1/2
2	6	6	5 1/2	5	3 1/2	3	7	7	6 1/2	6	4	3 1/2
2 1/2	7	7	6 1/2	6	4	3 1/2	8	7 1/2	7 1/2	6 1/2	4 1/2	4
3	7	7	7	6	4	3 1/2	8	8	7 1/2	7	4 1/2	4
3 1/2	7 1/2	7 1/2	7	6 1/2	4	4	8 1/2	8 1/2	8	7 1/2	5	4 1/2
4	7 1/2	7 1/2	7	6 1/2	4 1/2	4	8 1/2	9	8 1/2	7 1/2	5	4 1/2
6	8 1/2	8	7 1/2	7	5	4 1/2	10	9 1/2	9	8	5 1/2	5
8	9 1/2	9	8 1/2	7 1/2	5 1/2	5	11	10 1/2	10	9	6	5 1/2
10	10 1/2	10	9 1/2	8	6	5 1/2	11 1/2	11	10 1/2	9 1/2	6 1/2	6
12	11 1/2	10 1/2	10	8 1/2	6 1/2	6	12 1/2	12	11 1/2	10 1/2	7 1/2	6 1/2

Note: This chart based on continuous spans for uninsulated line carrying fluids of specific gravity up to 1.00.

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