

Table I. Specifications for Schedule 40 PVC/CPVC

Nominal Size ^a (in)	Outside Diameter ^a D _o (in)	Min Wall Thickness ^a (in)	Max Inside Diameter ^b D _i (in)	Coefficient of Thermal Expansion ^c (in/in/°F)	Max Sustained Temperature ^d (°F)	Unthreaded Water Pressure Rating at 73.4°F ^a (psi)	Threaded Water Pressure Rating at 73.4°F ^a (psi)	Unthreaded Water Pressure Rating at 110°F ^{b,d} (psi)	Threaded Water Pressure Rating at 110°F ^{b,d} (psi)
1/8	0.405	0.068	0.269			810		405	
1/4	0.540	0.088	0.364			780		390	
3/8	0.675	0.091	0.493			620		310	
1/2	0.840	0.109	0.622			600		300	
3/4	1.050	0.113	0.824			480		240	
1	1.315	0.133	1.049			450		225	
1-1/4	1.660	0.140	1.380			370		185	
1-1/2	1.900	0.145	1.610			330		165	
2	2.375	0.154	2.067			280		140	
2-1/2	2.875	0.203	2.469			300		150	
3	3.500	0.216	3.068			260		130	
3-1/2	4.000	0.226	3.548	0.000030	140	240		120	
4	4.500	0.237	4.026			220		110	
5	5.563	0.258	5.047			190		95	
6	6.625	0.280	6.065			180		90	
8	8.625	0.322	7.981			160		80	
10	10.750	0.365	10.020			140		70	
12	12.750	0.406	11.938			130		65	
14	14.000	0.437	13.126			130		65	
16	16.000	0.500	15.000			130		65	
18	18.000	0.562	16.876			130		65	
20	20.000	0.593	18.814			120		60	
24	24.000	0.687	22.626			120		60	

Schedule 40 PVC/CPVC pipe shall not be threaded. Use molded fittings if threads are required.

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Nominal Size ^a (in)	PVC Empty Weight ^e (lb/ft)	PVC Full Weight ^e (lb/ft)	CPVC Empty Weight ^e (lb/ft)	CPVC Full Weight ^e (lb/ft)	Modulus of Elasticity E_{110}^f (psi)	Moment of Inertia I^{bg} (in ⁴)	Max Unsupp. Length for 0.2% Max Deflection at 110°F ^{b,h} (ft)	Water Hammer Pressure Wave Velocity ^{bi} (ft/s)	Max Water Hammer Press. Surge for 1 ft/s Change in Velocity ^{bj} (psi)	Allowable Flexural Stress at 110°F S_{b110}^k (psi)	Max Bending Moment M^{bl} (in-lbs)	Min Ambient Bending Radius R_b^m (ft)	Min Hot Box Bending Radius R_h^n (ft)
1/8	0.04	0.07	0.05	0.07	336000	0.0011	1.7	2189	29	400	2.1	14.2	0.3
1/4	0.08	0.12	0.08	0.13		0.0033	2.1	2151	29		4.9	18.9	0.3
3/8	0.10	0.19	0.11	0.19		0.0073	2.4	1929	26		8.6	23.6	0.3
1/2	0.15	0.29	0.17	0.30		0.017	2.7	1888	25		16.3	29.4	0.3
3/4	0.20	0.44	0.22	0.45		0.037	3.1	1700	23		28.2	36.8	0.4
1	0.30	0.68	0.33	0.71		0.087	3.5	1643	22		53.1	46.0	0.5
1-1/4	0.41	1.06	0.45	1.10		0.19	4.0	1489	20		93.8	58.1	0.7
1-1/2	0.49	1.37	0.54	1.42		0.31	4.3	1411	19		130.5	66.5	0.8
2	0.66	2.12	0.72	2.18		0.67	4.8	1293	17		224.3	83.1	1.0
2-1/2	1.05	3.12	1.15	3.22		1.53	5.5	1353	18		425.6	100.6	1.3
3	1.37	4.58	1.50	4.70		3.02	6.1	1260	17		689.6	122.5	1.5
3-1/2	1.65	5.94	1.80	6.09		4.79	6.6	1203	16		957.5	140.0	1.8
4	1.95	7.47	2.13	7.65		7.23	7.0	1159	16		1285.8	157.5	2.0
5	2.65	11.32	2.89	11.56		15.16	7.8	1084	15		2180.4	194.7	2.5
6	3.44	15.96	3.75	16.28		28.14	8.5	1033	14		3398.3	231.9	3.0
8	5.17	26.86	5.64	27.33		72.49	9.8	969	13		6723.6	301.9	
10	7.33	41.52	8.00	42.19		160.73	11.1	923	12		11961.6	376.3	Pipe
12	9.69	58.22	10.58	59.11		300.21	12.2	893	12		18836.6	446.3	Over
14	11.46	70.13	12.51	71.18		428.61	12.9	884	12		24491.8	490.0	6" Dia
16	14.99	91.60	16.36	92.97		731.94	14.1	884	12		36597.1	560.0	Shall
18	18.95	115.93	20.69	117.66		1171.49	15.3	884	12		52066.0	630.0	Not Be
20	22.26	142.78	24.29	144.82		1703.71	16.2	860	12		68148.3	700.0	Heat
24	30.97	205.28	33.81	208.12		3421.28	18.1	845	11		114042.5	840.0	Bent

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Nominal Size ^a (in)	Min Operating Scouring Flow Rate at V=0.5 fps ^b (gpm)	Recommended Min Scouring Flow Rate at V=2 fps ^b (gpm)	Max Design Suction Flow Rate at V=4.5 fps ^b (gpm)	Max Design Discharge Flow Rate at V=6.5 fps ^b (gpm)	Max Code Suction Flow Rate at V=6 fps ^b (gpm)	Max Code Discharge Flow Rate at V=8 fps ^b (gpm)	Manning's n-Value ^o (dimensionless)	Half-Full Cross-Sectional Area ^b (in ²)	Half-Full Hydraulic Radius ^b (in)
1/8	0	0	1	1	1	1		0.03	0.07
1/4	0	1	1	2	2	3		0.05	0.09
3/8	0	1	3	4	4	5		0.10	0.12
1/2	0	2	4	6	6	8		0.15	0.16
3/4	1	3	7	11	10	13		0.27	0.21
1	1	5	12	18	16	22		0.43	0.26
1-1/4	2	9	21	30	28	37		0.75	0.35
1-1/2	3	13	29	41	38	51		1.02	0.40
2	5	21	47	68	63	84		1.68	0.52
2-1/2	7	30	67	97	90	119		2.39	0.62
3	12	46	104	150	138	184		3.70	0.77
3-1/2	15	62	139	200	185	247	0.011	4.94	0.89
4	20	79	179	258	238	317		6.37	1.01
5	31	125	281	405	374	499		10.00	1.26
6	45	180	405	585	540	720		14.45	1.52
8	78	312	702	1,014	936	1,247		25.01	2.00
10	123	492	1,106	1,598	1,475	1,966		39.43	2.51
12	174	698	1,570	2,268	2,093	2,791		55.97	2.98
14	211	844	1,898	2,742	2,531	3,374		67.66	3.28
16	275	1,102	2,479	3,580	3,305	4,406		88.36	3.75
18	349	1,394	3,137	4,532	4,183	5,577		111.84	4.22
20	433	1,733	3,899	5,632	5,199	6,932		139.00	4.70
24	627	2,506	5,639	8,146	7,519	10,026		201.04	5.66

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Nominal Size ^a (in)	Min Slope to Maintain Min 2 ft/s Scouring Velocity ^p (rise/run %)	<u>0.5% Slope (≈1/16" per ft)</u>		<u>1% Slope (≈1/8" per ft)</u>		<u>1.5% Slope (≈3/16" per ft)</u>		<u>2% Slope (≈1/4" per ft)</u>	
		Max Carrying Capacity ^q (gpm)	Velocity at Max Carrying Capacity ^b (ft/s)	Max Carrying Capacity ^q (gpm)	Velocity at Max Carrying Capacity ^b (ft/s)	Max Carrying Capacity ^q (gpm)	Velocity at Max Carrying Capacity ^b (ft/s)	Max Carrying Capacity ^q (gpm)	Velocity at Max Carrying Capacity ^b (ft/s)
1/8	Too Small to Use for Gravity Flow								
1/4									
3/8									
1/2									
3/4	5.0%								
1	4.0%								
1-1/4	2.5%							4.2	1.79
1-1/2	2.0%					5.5	1.72	6.3	1.99
2	1.5%			8.7	1.66	10.6	2.03	12.3	2.35
2-1/2	1.5%			13.9	1.87	17.1	2.29	19.7	2.64
3	1.0%	17.6	1.53	24.9	2.16	30.5	2.64	35.2	3.05
3-1/2	1.0%	25.9	1.68	36.7	2.38	44.9	2.91	51.8	3.36
4	1.0%	36.3	1.83	51.4	2.59	62.9	3.17	72.6	3.66
5	0.5%	66.3	2.13	93.8	3.01	114.9	3.69	132.7	4.26
6	0.5%	108.3	2.41	153.1	3.40	187.6	4.17	216.6	4.81
8	0.5%	225.2	2.89	318.5	4.08	390.0	5.00	450.4	5.78
10	0.5%	413.1	3.36	584.2	4.75	715.5	5.82	826.1	6.72
12	0.5%	659.0	3.78	931.9	5.34	1,141.3	6.54	1,317.9	7.56
14	0.5%	848.6	4.02	1,200.2	5.69	1,469.9	6.97	1,697.3	8.05
16	0.5%	1,211.4	4.40	1,713.2	6.22	2,098.2	7.62	2,422.8	8.80
18	0.5%	1,658.7	4.76	2,345.7	6.73	2,872.9	8.24	3,317.3	9.52
20	0.5%	2,216.4	5.12	3,134.5	7.23	3,839.0	8.86	4,432.9	10.23
24	0.5%	3,625.2	5.79	5,126.8	8.18	6,279.0	10.02	7,250.3	11.57

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Nominal Size ^a (in)	<u>2.5% Slope (≈5/16" per ft)</u>		<u>3% Slope (≈3/8" per ft)</u>		<u>4% Slope (≈1/2" per ft)</u>		<u>5% Slope (≈5/8" per ft)</u>		<u>6% Slope (≈3/4" per ft)</u>	
	Max Carrying Capacity ^q	Velocity at Max Carrying Capacity ^b	Max Carrying Capacity ^q	Velocity at Max Carrying Capacity ^b	Max Carrying Capacity ^q	Velocity at Max Carrying Capacity ^b	Max Carrying Capacity ^q	Velocity at Max Carrying Capacity ^b	Max Carrying Capacity ^q	Velocity at Max Carrying Capacity ^b
	(gpm)	(ft/s)	(gpm)	(ft/s)	(gpm)	(ft/s)	(gpm)	(ft/s)	(gpm)	(ft/s)
1/8									0.1	1.04
1/4									0.2	1.28
3/8									0.5	1.56
1/2									0.9	1.83
3/4					1.5	1.80	1.7	2.01	1.8	2.20
1			2.5	1.83	2.8	2.11	3.2	2.36	3.5	2.59
1-1/4	4.7	2.00	5.1	2.20	5.9	2.54	6.6	2.83	7.2	3.11
1-1/2	7.0	2.22	7.7	2.43	8.9	2.81	10.0	3.14	10.9	3.44
2	13.7	2.62	15.0	2.87	17.4	3.32	19.4	3.71	21.3	4.07
2-1/2	22.0	2.95	24.1	3.24	27.9	3.74	31.2	4.18	34.1	4.58
3	39.3	3.41	43.1	3.74	49.8	4.32	55.6	4.83	60.9	5.29
3-1/2	58.0	3.76	63.5	4.12	73.3	4.76	82.0	5.32	89.8	5.83
4	81.2	4.09	88.9	4.48	102.7	5.18	114.8	5.79	125.8	6.34
5	148.3	4.76	162.5	5.21	187.6	6.02	209.8	6.73	229.8	7.37
6	242.1	5.38	265.3	5.89	306.3	6.80	342.4	7.61	375.1	8.33
8	503.5	6.46	551.6	7.07	636.9	8.17	712.1	9.13	780.0	10.01
10	923.6	7.52	1,011.8	8.23	1,168.3	9.51	1,306.2	10.63	1,430.9	11.64
12	1,473.5	8.45	1,614.1	9.25	1,863.8	10.68	2,083.8	11.95	2,282.7	13.09
14	1,897.6	9.00	2,078.8	9.86	2,400.3	11.38	2,683.7	12.73	2,939.8	13.94
16	2,708.7	9.84	2,967.3	10.77	3,426.3	12.44	3,830.8	13.91	4,196.4	15.24
18	3,708.9	10.64	4,062.9	11.66	4,691.4	13.46	5,245.2	15.05	5,745.8	16.48
20	4,956.1	11.44	5,429.2	12.53	6,269.1	14.47	7,009.0	16.18	7,678.0	17.72
24	8,106.1	12.94	8,879.8	14.17	10,253.5	16.36	11,463.8	18.29	12,557.9	20.04

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^aASTM D1785-12 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120: Type I Grade I (ASTM D1784-11 Cell Class 12454-B) with a hydrostatic design stress of 2,000 psi (14 Mpa) designated as PVC1120.

^bDetermined by calculation using previous columns in the table.

^cPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 8.34. For example, a 100 ft pipe with $\Delta T = 10^\circ\text{F}$ will expand $(0.000030 \text{ in/in}/^\circ\text{F}) \cdot (100 \text{ ft}) \cdot (12 \text{ in/ft}) \cdot (10^\circ\text{F}) = 0.36 \text{ inches}$. "A good rule of thumb in the design of PVC piping systems is to allow 3/8 inches of length variation for every 100 ft of pipe for each 10°F change in temperature (5.4 mm / 10 m / 10°C)."

^dPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 5.12, Table 5.3: Thermal de-rating factor is 0.50 for temperature of 110°F which approximates the maximum temperature expected in any watershed.

^eEslon Thermoplastics, Engineering & Specifications Manual, 5th Edition, Page 6: Specific Gravity $SG_{\text{PVC}} = 1.42$, $SG_{\text{CPVC}} = 1.55$, $SG_{\text{H}_2\text{O}} = 1.0$. Calculated using diameter specifications.

^fPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 8.9, Table 8.3: Modulus of elasticity correction factor is 0.84 for temperature of 110°F . ASTM D1784-11 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds, Cell Class 12454-B: Modulus of elasticity $E_{73.4} = 400000 \text{ psi}$, $E_{110} = 0.84 \cdot E_{73.4} = 336000 \text{ psi}$.

^gMoment of inertia, $I = \pi / 64 \cdot (D_o^4 - D_i^4)$.

^hMax deflection of a simply supported beam, $\Delta_{\text{max}} = 5 \cdot w \cdot L^4 / (384 \cdot E \cdot I)$ where $\Delta_{\text{max}} = \text{limit } 0.2\% \text{ span length} = 0.2\% \cdot L$ and $w = \text{uniformly distributed load}$ (CPVC Full Weight used for slightly conservative analysis). Substituting, rearranging, and unit converting the equation: Max unsupported length for 0.2% max deflection, $L = (0.002 \cdot 384 \cdot E_{110} \cdot I \cdot (12 \text{ in/ft}) / (5 \cdot \text{CPVC Full Weight}))^{1/3} / (12 \text{ in/ft})$.

ⁱPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 5.16: Pressure wave velocity = $4660 / (1.0 + K \cdot D_i / (E_{110} \cdot \text{Min Wall Thickness}))^{1/2}$ where bulk modulus of water $K = 300000 \text{ psi}$.

^jPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 5.16: Pressure surge = Pressure Wave Velocity $\cdot \Delta V / ((2.3066587 \text{ ft of head/psi}) \cdot (32.174049 \text{ ft/sec}^2))$ where $\Delta V = 1 \text{ ft/s}$. For higher changes in velocity ΔV , multiply Pressure Surge accordingly (e.g., for $\Delta V = 3 \text{ ft/s}$ multiply table values by 3).

^kPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 8.5: Allowable flexural stress from longitudinal bending, $S_b = (\text{HDB} - S_t) \cdot \text{TD} / \text{SF}$ where hydrostatic design basis $\text{HDB} = 4000 \text{ psi}$ at 73.4°F (23°C) for Cell Class 12454, tensile stress from longitudinal thrust $S_t = \text{HDB} / 2 = 2000 \text{ psi}$, thermal de-rating factor $\text{TD} = 0.50$ for 110°F (43°C), and safety factor $\text{SF} = 2.5$ for bending of pressure class pipe. $S_b = (4000 \text{ psi} - 2000 \text{ psi}) \cdot 0.5 / 2.5 = 400 \text{ psi}$.

^lPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 8.7: Bending moment induced by longitudinal bending of pipes, $M = S_b \cdot I / c$ where $c = \text{distance from neutral axis to extreme fiber} = D_o / 2 \text{ inches}$.

^mPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 8.8: Minimum bending radius for pipe at ambient temperature, $R_b = E_{110} \cdot I / M / (12 \text{ in/ft})$.

ⁿNational Fire Protection Association, NFPA 70: 2014 National Electric Code, Chapter 9, Table 2, Page 70-756 addresses minimum bend radiuses measured to the centerline of the conduit for nominal sizes 1/2" through 6" diameter. This table uses the same 4" (0.3 ft) minimum for sizes below 1/2" diameter. Hot boxes (e.g., Current Tools, Greenlee, etc.) are intended for use with conduit only although we have had success using them for water pipe since our pressures are typically far below the pressure ratings noted above. Heat bending water pipe is done at the installer's sole risk and liability.

^oPVC Pipe Association, Handbook of PVC Pipe Design and Construction, 5th Edition, Page 9.81: "Studies in the laboratory, and more importantly, in actual use, have found the value of "n" for PVC to range from 0.007 to 0.011." Table uses the more conservative value of 0.011.

^pDetermined by looking at the velocities calculated at the right. The slope of the lowest velocity approximately 2 ft/s or greater was noted.

^qDetermined by calculation using Manning's equation. Values where the corresponding velocity is less than 2 ft/s minimum scouring velocity were grayed out and are not recommended for design.

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