

80

Table 4. Velocity and Friction Head Loss per 100 ft of Schedule 80 PVC/CPVC

Nominal Size ^a (in)	Flow Rate (gpm)																		
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	
1/8	V ^b (ft/s)																		
	h _f ^c (ft)																		
1/4	V ^b (ft/s)																		
	h _f ^c (ft)																		
3/8	V ^b (ft/s)																		
	h _f ^c (ft)																		
1/2	V ^b (ft/s)	6.85																	
	h _f ^c (ft)	36.79																	
3/4	V ^b (ft/s)	3.71	7.42																
	h _f ^c (ft)	8.27	29.86																
1	V ^b (ft/s)	2.23	4.46	6.69	8.92														
	h _f ^c (ft)	2.40	8.66	18.35	31.26														
1-1/4	V ^b (ft/s)	1.25	2.50	3.75	5.00	6.25	7.50	8.75											
	h _f ^c (ft)	0.59	2.12	4.49	7.65	11.57	16.21	21.57											
1-1/2	V ^b (ft/s)	0.91	1.82	2.72	3.63	4.54	5.45	6.35	7.26	8.17	9.08	9.99							
	h _f ^c (ft)	0.27	0.97	2.06	3.51	5.31	7.44	9.89	12.67	15.76	19.15	22.85							
2	V ^b (ft/s)	0.54	1.09	1.63	2.17	2.72	3.26	3.80	4.35	4.89	5.43	5.98	6.52	7.06	7.61	8.15	8.69	9.24	9.78
	h _f ^c (ft)	0.08	0.28	0.59	1.01	1.52	2.13	2.84	3.63	4.52	5.49	6.55	7.70	8.93	10.24	11.64	13.12	14.68	16.32
2-1/2	V ^b (ft/s)		0.76	1.14	1.51	1.89	2.27	2.65	3.03	3.41	3.78	4.16	4.54	4.92	5.30	5.68	6.06	6.43	6.81
	h _f ^c (ft)		0.12	0.25	0.42	0.63	0.89	1.18	1.51	1.88	2.28	2.72	3.20	3.71	4.25	4.83	5.45	6.09	6.77
3	V ^b (ft/s)			0.73	0.97	1.21	1.46	1.70	1.94	2.19	2.43	2.67	2.91	3.16	3.40	3.64	3.89	4.13	4.37
	h _f ^c (ft)			0.08	0.14	0.21	0.30	0.40	0.51	0.64	0.77	0.92	1.09	1.26	1.45	1.64	1.85	2.07	2.30
3-1/2	V ^b (ft/s)			0.54	0.72	0.90	1.08	1.26	1.44	1.62	1.80	1.99	2.17	2.35	2.53	2.71	2.89	3.07	3.25
	h _f ^c (ft)			0.04	0.07	0.10	0.15	0.19	0.25	0.31	0.38	0.45	0.53	0.61	0.70	0.80	0.90	1.01	1.12
4	V ^b (ft/s)				0.56	0.70	0.84	0.98	1.12	1.26	1.40	1.53	1.67	1.81	1.95	2.09	2.23	2.37	2.51
	h _f ^c (ft)				0.04	0.06	0.08	0.10	0.13	0.17	0.20	0.24	0.28	0.33	0.38	0.43	0.48	0.54	0.60
5	V ^b (ft/s)						0.53	0.62	0.71	0.79	0.88	0.97	1.06	1.15	1.23	1.32	1.41	1.50	1.59
	h _f ^c (ft)						0.03	0.03	0.04	0.05	0.07	0.08	0.09	0.11	0.12	0.14	0.16	0.18	0.20
6	V ^b (ft/s)								0.55	0.62	0.68	0.74	0.80	0.86	0.92	0.98	1.05	1.11	
	h _f ^c (ft)								0.02	0.03	0.03	0.04	0.04	0.05	0.06	0.07	0.07	0.08	
8	V ^b (ft/s)														0.53	0.56	0.60	0.63	
	h _f ^c (ft)														0.01	0.02	0.02	0.02	
10	V ^b (ft/s)																		
	h _f ^c (ft)																		
12	V ^b (ft/s)																		
	h _f ^c (ft)																		
14	V ^b (ft/s)																		
	h _f ^c (ft)																		
16	V ^b (ft/s)																		
	h _f ^c (ft)																		
18	V ^b (ft/s)																		
	h _f ^c (ft)																		
20	V ^b (ft/s)																		
	h _f ^c (ft)																		
24	V ^b (ft/s)																		
	h _f ^c (ft)																		

Use of this worksheet is agreement to these Terms of Use: <http://www.watershapeconsulting.com/tables/ToU.pdf>

Table 4. Velocity and Friction Head Loss per 100 ft of Schedule 80 PVC/CPVC

Nominal Size ^a (in)		Flow Rate (gpm)																	
		95	100	120	140	160	180	200	250	300	350	400	450	500	550	600	650	700	750
1/8	V ^b (ft/s)																		
	h _f ^c (ft)																		
1/4	V ^b (ft/s)																		
	h _f ^c (ft)																		
3/8	V ^b (ft/s)																		
	h _f ^c (ft)																		
1/2	V ^b (ft/s)																		
	h _f ^c (ft)																		
3/4	V ^b (ft/s)																		
	h _f ^c (ft)																		
1	V ^b (ft/s)																		
	h _f ^c (ft)																		
1-1/4	V ^b (ft/s)																		
	h _f ^c (ft)																		
1-1/2	V ^b (ft/s)																		
	h _f ^c (ft)																		
2	V ^b (ft/s)																		
	h _f ^c (ft)																		
2-1/2	V ^b (ft/s)	7.19	7.57	9.08															
	h _f ^c (ft)	7.49	8.23	11.54															
3	V ^b (ft/s)	4.61	4.86	5.83	6.80	7.77	8.74	9.71											
	h _f ^c (ft)	2.54	2.80	3.92	5.22	6.68	8.31	10.10											
3-1/2	V ^b (ft/s)	3.43	3.61	4.33	5.05	5.78	6.50	7.22	9.02										
	h _f ^c (ft)	1.24	1.36	1.90	2.53	3.24	4.04	4.91	7.42										
4	V ^b (ft/s)	2.65	2.79	3.35	3.91	4.46	5.02	5.58	6.98	8.37	9.77								
	h _f ^c (ft)	0.66	0.73	1.02	1.35	1.73	2.16	2.62	3.96	5.56	7.39								
5	V ^b (ft/s)	1.68	1.76	2.12	2.47	2.82	3.17	3.53	4.41	5.29	6.17	7.05	7.94	8.82	9.70				
	h _f ^c (ft)	0.22	0.24	0.33	0.44	0.57	0.71	0.86	1.30	1.82	2.42	3.10	3.85	4.69	5.59				
6	V ^b (ft/s)	1.17	1.23	1.48	1.72	1.97	2.22	2.46	3.08	3.69	4.31	4.92	5.54	6.15	6.77	7.38	8.00	8.62	9.23
	h _f ^c (ft)	0.09	0.10	0.14	0.18	0.24	0.29	0.36	0.54	0.76	1.01	1.29	1.61	1.95	2.33	2.74	3.18	3.64	4.14
8	V ^b (ft/s)	0.67	0.70	0.84	0.98	1.12	1.26	1.41	1.76	2.11	2.46	2.81	3.16	3.51	3.86	4.22	4.57	4.92	5.27
	h _f ^c (ft)	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.14	0.19	0.26	0.33	0.41	0.50	0.60	0.70	0.81	0.93	1.06
10	V ^b (ft/s)			0.54	0.63	0.71	0.80	0.89	1.12	1.34	1.56	1.79	2.01	2.23	2.46	2.68	2.90	3.13	3.35
	h _f ^c (ft)			0.01	0.02	0.02	0.03	0.03	0.05	0.06	0.09	0.11	0.14	0.17	0.20	0.23	0.27	0.31	0.35
12	V ^b (ft/s)				0.51	0.57		0.63	0.79	0.95	1.10	1.26	1.42	1.58	1.74	1.89	2.05	2.21	2.37
	h _f ^c (ft)				0.01	0.01		0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.09	0.10	0.12	0.13	0.15
14	V ^b (ft/s)							0.52	0.65	0.78	0.92	1.05	1.18	1.31	1.44	1.57	1.70	1.83	1.96
	h _f ^c (ft)							0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.05	0.06	0.07	0.08	0.10
16	V ^b (ft/s)								0.60	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.40	1.50	
	h _f ^c (ft)								0.01	0.01	0.02	0.02	0.02	0.02	0.03	0.03	0.04	0.04	0.05
18	V ^b (ft/s)									0.55	0.63	0.71	0.79	0.86	0.94	1.02	1.10	1.18	
	h _f ^c (ft)									0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.03
20	V ^b (ft/s)										0.51	0.57	0.63	0.70	0.76	0.83	0.89	0.95	
	h _f ^c (ft)										0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02
24	V ^b (ft/s)														0.53	0.57	0.61	0.66	
	h _f ^c (ft)														0.00	0.01	0.01	0.01	0.01

Use of this worksheet is agreement to these Terms of Use: <http://www.watershapeconsulting.com/tables/ToU.pdf>

80

Table 4. Velocity and Friction Head Loss per 100 ft of Schedule 80 PVC/CPVC

Nominal Size ^a (in)	Flow Rate (gpm)	Flow Rate																	
		800	850	900	950	1000	1200	1400	1600	1800	2000	2500	3000	3500	4000	4500	5000	5500	6000
1/8	V ^b (ft/s)																		
	h _f ^c (ft)																		
1/4	V ^b (ft/s)																		
	h _f ^c (ft)																		
3/8	V ^b (ft/s)																		
	h _f ^c (ft)																		
1/2	V ^b (ft/s)																		
	h _f ^c (ft)																		
3/4	V ^b (ft/s)																		
	h _f ^c (ft)																		
1	V ^b (ft/s)																		
	h _f ^c (ft)																		
1-1/4	V ^b (ft/s)																		
	h _f ^c (ft)																		
1-1/2	V ^b (ft/s)																		
	h _f ^c (ft)																		
2	V ^b (ft/s)																		
	h _f ^c (ft)																		
2-1/2	V ^b (ft/s)																		
	h _f ^c (ft)																		
3	V ^b (ft/s)																		
	h _f ^c (ft)																		
3-1/2	V ^b (ft/s)																		
	h _f ^c (ft)																		
4	V ^b (ft/s)																		
	h _f ^c (ft)																		
5	V ^b (ft/s)																		
	h _f ^c (ft)																		
6	V ^b (ft/s)	9.85																	
	h _f ^c (ft)	4.67																	
8	V ^b (ft/s)	5.62	5.97	6.32	6.67	7.03	8.43	9.84											
	h _f ^c (ft)	1.19	1.33	1.48	1.64	1.80	2.53	3.36											
10	V ^b (ft/s)	3.57	3.80	4.02	4.24	4.47	5.36	6.25	7.15	8.04	8.93								
	h _f ^c (ft)	0.40	0.44	0.49	0.54	0.60	0.84	1.12	1.43	1.78	2.16								
12	V ^b (ft/s)	2.53	2.68	2.84	3.00	3.16	3.79	4.42	5.05	5.68	6.31	7.89	9.47						
	h _f ^c (ft)	0.17	0.19	0.21	0.23	0.26	0.36	0.48	0.61	0.76	0.93	1.40	1.97						
14	V ^b (ft/s)	2.09	2.22	2.35	2.48	2.61	3.14	3.66	4.18	4.71	5.23	6.54	7.84	9.15					
	h _f ^c (ft)	0.11	0.12	0.13	0.15	0.16	0.23	0.30	0.39	0.48	0.59	0.89	1.24	1.66					
16	V ^b (ft/s)	1.59	1.69	1.79	1.89	1.99	2.39	2.79	3.19	3.59	3.99	4.98	5.98	6.98	7.97	8.97	9.97		
	h _f ^c (ft)	0.06	0.06	0.07	0.08	0.08	0.12	0.16	0.20	0.25	0.30	0.46	0.64	0.86	1.10	1.36	1.66		
18	V ^b (ft/s)	1.26	1.34	1.41	1.49	1.57	1.89	2.20	2.51	2.83	3.14	3.93	4.71	5.50	6.28	7.07	7.85	8.64	9.43
	h _f ^c (ft)	0.03	0.03	0.04	0.04	0.05	0.07	0.09	0.11	0.14	0.17	0.26	0.36	0.48	0.61	0.76	0.93	1.11	1.30
20	V ^b (ft/s)	1.02	1.08	1.14	1.21	1.27	1.52	1.78	2.03	2.29	2.54	3.17	3.81	4.44	5.08	5.71	6.35	6.98	7.62
	h _f ^c (ft)	0.02	0.02	0.02	0.03	0.03	0.04	0.05	0.07	0.08	0.10	0.15	0.21	0.29	0.37	0.46	0.55	0.66	0.78
24	V ^b (ft/s)	0.70	0.75	0.79	0.83	0.88	1.05	1.23	1.41	1.58	1.76	2.20	2.64	3.07	3.51	3.95	4.39	4.83	5.27
	h _f ^c (ft)	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.06	0.09	0.12	0.15	0.19	0.23	0.27	0.32

Use of this worksheet is agreement to these Terms of Use: <http://www.watershapeconsulting.com/tables/ToU.pdf>

Table 4. Velocity and Friction Head Loss per 100 ft of Schedule 80 PVC/CPVC

^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.

^bVelocity, $V = Q / A = Q_{\text{gpm}} / (\pi \cdot D_i^2 / 4) / (7.480519 \text{ gal/ft}^3) / (60 \text{ s/min}) \cdot (144 \text{ in}^2/\text{ft}^2) = 0.408498 \cdot Q_{\text{gpm}} / D_i^2$. Velocities above 10 ft/s are considered above normal (Plastics Pipe Institute Appendix I - Limiting Water Velocities in Thermoplastics Piping Systems) and additional analysis for pressure surges, water hammer, pipe abrasion, valve and pump operation should be considered and are not shown in the table. Velocities in pools, spas, and other watershapes shall be limited to 8 ft/s per ISPSC and are shown in gray. Velocities below 0.5 ft/s are too low for scouring purposes and are not shown. Velocities below the minimum 2 ft/s recommended scouring velocity are shown in gray.

^cHazen-Williams equation, $h_f = 10.536 \cdot L \cdot Q_{\text{gpm}}^{1.852} / (C^{1.852} \cdot D_i^{4.8655})$, where $L = 100 \text{ ft}$ and $C = 150$. The head loss values are slightly more conservative than those obtained using the Darcy-Weisbach equation which is not used due to the more complicated and iterative determination of the Darcy friction factor f_D . For example, 50 gpm in a 2" Sch. 80 PVC pipe is 5.49 ft using Hazen-Williams which is 5.58% higher than 5.20 ft using Darcy-Weisbach with $f_D = 0.018336$. The conservative error may be higher than 10% mostly due to the fact that Hazen-Williams is acceptable for water at about 60°F while Darcy-Weisbach accounts for the difference in kinematic viscosity within the Reynold's number component of the friction factor determination.

Use of this worksheet is agreement to these Terms of Use: <http://www.watershapeconsulting.com/tables/ToU.pdf>