FLOW VELOCITY & FRICTION LOSS

Friction Loss Through Pipe

The Hazen-Williams equation below is widely used to calculate friction loss for water through PVC and CPVC pipe

$$f = .2083 \times \left(\frac{100}{C}\right)^{1.852} \times \frac{G^{1.852}}{di^{4.8655}}$$

Where: f = friction head of feet of water per 100' for the specific pipe size and I.D.
C = a constant for internal pip roughness. 150 is the commonly accepted value for PVC and CPVC pipe.
G = flow rate of gallons per minute (U.S gallons).
di = inside diameter of pipe in inches.

Friction Loss Through Fittings

Friction loss through fittings is expressed in equivalent feet of the same pipe size and schedule for the system flow rate. Schedule 40 head loss per 100' values are usually used for other wall thicknesses and standard iron pipe size O.D.'s.

Average Friction Loss for PVC and CPVC Fittings in Equivalent Feet of Straight Run Pipe

Item	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12	14	16	18	20	24
Tee Run	1.0	1.4	1.7	2.3	2.7	4.0	4.9	6.1	7.9	12.3	14.0	17.5	20.0	25.0	27.0	32.0	35.0	42.0
Tee Branch	3.8	4.9	6.0	7.3	8.4	12.0	14.7	16.4	22.0	32.7	49.0	57.0	67.0	78.0	88.0	107.0	118.0	137.0
90° Ell	1.5	2.0	2.5	3.8	4.0	5.7	6.9	7.9	11.4	16.7	21.0	26.0	32.0	37.0	43.0	53.0	58.0	67.0
45° Ell	.8	1.1	1.4	1.8	2.1	2.6	3.1	4.0	5.1	8.0	10.6	13.5	15.5	18.0	20.0	23.0	25.0	30.0

Note: *Values 10"-24": Approximate values from Nomograph.*

Pressure Drop In Valves & Strainers

Pressure drop calculations can be made for valves and strainers for different fluids, flow rates, and sizes using the CV values and the following equation:

Where:

$$P = \frac{(G)^2(Sg)}{(C_v)^2}$$

P = Pressure drop in PSI; feet of water = $\frac{PSI}{.4332}$

G = Gallons per minute
C_V = Gallons per minute water per 1 PSI pressure drop
Sg = Specific gravity of liquid (water = 1)

C_V Values for Select Spears® Valves and Strainers

Nominal Size ⇨	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12
True Union 2000 Ball Valve[1]	29	63	120	243	357	599	856	1416	2865	1952	--	--	--
Single Entry Ball Valve[1]	38	76	146	292	412	720	--	1660	3104	--	--	--	--
True Union 2000 Ball Check Valve	6.3	17	25	65	86	130	200	275	500	800	--	--	--
Butterfly Valve (90° - Full Open)	--	--	--	--	81	109	192	345	411	1125	2249	4440	6309
Y-Check Valve	6.7	12.6	22.9	33.8	50.7	79.2	--	235	387	--	--	--	--
Y-Strainer (12 Mesh-Clean)	5.4	7.8	13.9	32.9	41.6	50.0	--	74.6	169.0	--	--	--	--
Basket Strainer (Clean)	4.5	10	15	30	46	72	110	172	270	630	750	893	1063

1- Full Port Ball Valve Cv based on equivalent length of Schedule 80 pipe

Water Velocities

Velocities for water in feet per second at different GPM's and pipe inside diameters can be calculated as follows:

$$V = .3208 \frac{G}{A}$$

Where:
V = velocity in feet per second
G = gallons per minute
A = inside cross sectional area in square inches

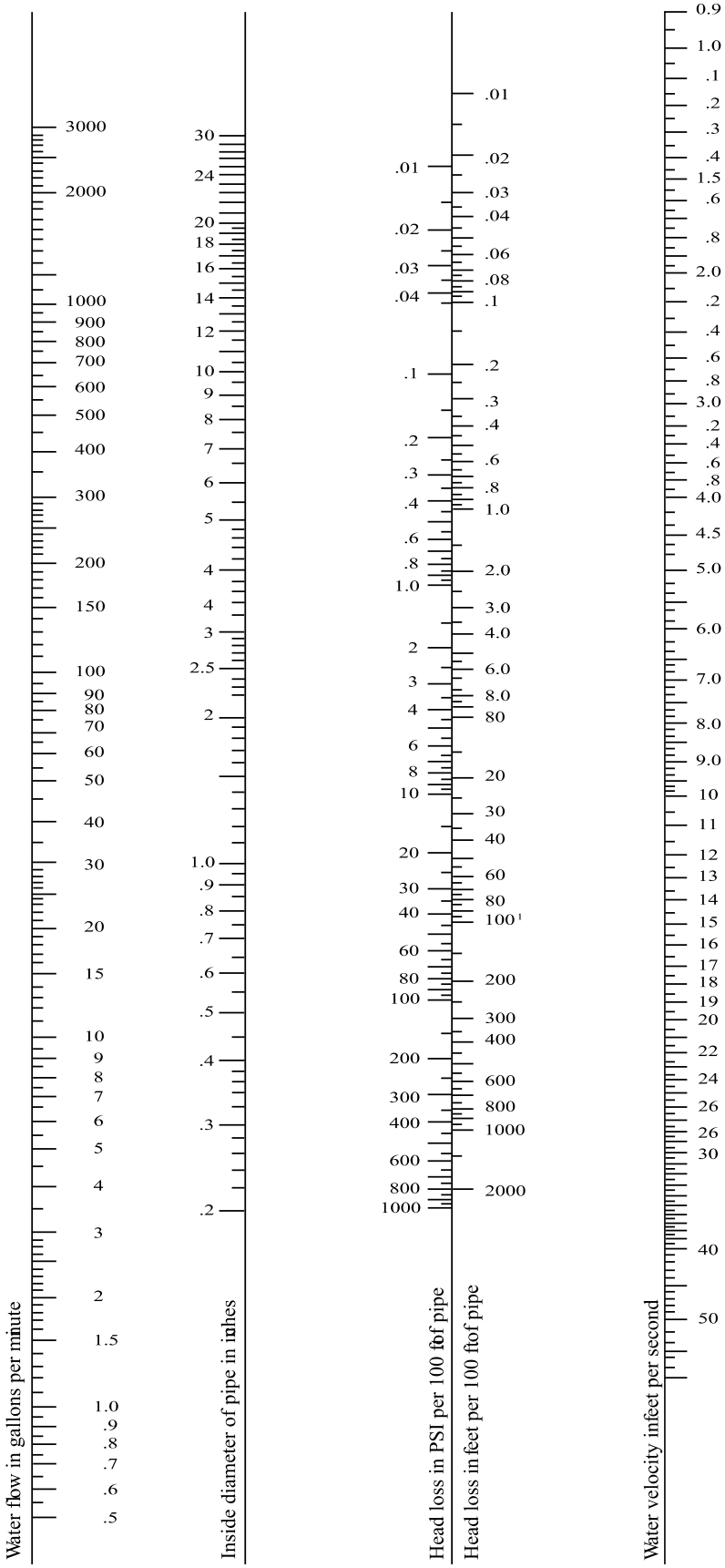
CAUTION: Flow velocities in excess of 5.0 feet per second are not recommended for closed-end systems. Contact Spears® Technical Services for additional information.

Suitable for Oil-Free air handling to 25 psi, not for distribution of compressed air or gas
Spears® Manufacturing Company
Effective 02/01/2020 See MSRP-1 Sheet or Check Spears® On-line Catalog @ www.spearsmfg.com for Pricing

Flow Velocity & Friction Loss

Head Loss Chatacteristics of Water Flow Through Rigid Plastic Pipe - Nomograph

The nonograph provides approximate values for water flow, head loss and water velocity for a wide range of plastic pipe sizes. Two known variables must be used to obtain the other variables by lining up the values on the scales using a ruler or a straight edge. Flow velocities in excess of 5.0 feet per second are not recommended.



Made in the U.S.A.

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Flow Velocity & Friction Loss

FLOW VELOCITY & FRICTION LOSS

SCHEDULE 40

Flow Rate (Gallons/ Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft.Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft.Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft.Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons/ Minute)
GPM	**1/8"**			**1/4"**			**3/8"**			**1/2"**			**3/4"**			**1"**			**1-1/4"**			**GPM**
0.25	1.64	6.54	2.83	0.86	1.36	0.59	0.46	0.29	0.12													0.25
0.50	3.27	23.60	10.23	1.72	4.90	2.12	0.91	1.04	0.45													0.50
0.75	4.91	50.00	21.68	2.59	10.38	4.50	1.37	2.20	0.96													0.75
1	6.55	85.18	36.93	3.45	17.68	7.66	1.82	3.75	1.63	1.13	1.16	0.50	0.63	0.28	0.12	0.39	0.09	0.04	0.22	0.02	0.01	1
2	13.09	307.52	133.31	6.90	63.82	27.67	3.65	13.55	5.88	2.25	4.19	1.82	1.26	1.03	0.44	0.77	0.31	0.13	0.44	0.08	0.03	2
5				17.25	348.29	150.98	9.11	73.96	32.06	5.63	22.88	9.92	3.16	5.60	2.43	1.93	1.69	0.73	1.10	0.43	0.19	5
7							12.76	137.93	59.79	7.88	42.66	18.49	4.42	10.44	4.53	2.70	3.14	1.36	1.55	0.81	0.35	7
10										11.26	82.59	35.80	6.31	20.21	8.76	3.86	6.08	2.64	2.21	1.57	0.68	10
15													9.47	42.82	18.56	5.78	12.89	5.59	3.31	3.32	1.44	15
20													12.63	72.95	31.63	7.71	21.96	9.52	4.42	5.65	2.45	20
25																9.64	33.20	14.39	5.52	8.55	3.71	25
30																11.57	46.54	20.17	6.62	11.98	5.19	30
35																			7.73	15.94	6.91	35
40																			8.83	20.41	8.85	40
45																			9.94	25.39	11.00	45
50																			11.04	30.86	13.38	50

GPM	1-1/2"			2"			2-1/2"			3"			4"			5"			6"			GPM
2	0.32	0.04	0.02																			**2**
5	0.81	0.20	0.09	0.49	0.06	0.03																**5**
7	1.13	0.38	0.16	0.68	0.11	0.05	0.48	0.05	0.02													**7**
10	1.62	0.73	0.32	0.97	0.21	0.09	0.68	0.09	0.04	0.44	0.03	0.01										**10**
15	2.42	1.55	0.67	1.46	0.45	0.20	1.02	0.19	0.08	0.66	0.07	0.03										**15**
20	3.23	2.64	1.15	1.95	0.77	0.34	1.37	0.33	0.14	0.88	0.11	0.05	0.51	0.03	0.01							**20**
25	4.04	4.00	1.73	2.44	1.17	0.51	1.71	0.49	0.21	1.10	0.17	0.07	0.64	0.05	0.02							**25**
30	4.85	5.60	2.43	2.92	1.64	0.71	2.05	0.69	0.30	1.32	0.24	0.10	0.77	0.06	0.03	0.49	0.02	0.01				**30**
35	5.65	7.45	3.23	3.41	2.18	0.94	2.39	0.92	0.40	1.54	0.32	0.14	0.89	0.08	0.04	0.57	0.03	0.01				**35**
40	6.46	9.54	4.14	3.90	2.79	1.21	2.73	1.18	0.51	1.76	0.41	0.18	1.02	0.11	0.05	0.65	0.04	0.02				**40**
45	7.27	11.87	5.15	4.39	3.47	1.51	3.07	1.46	0.63	1.99	0.51	0.22	1.15	0.13	0.06	0.73	0.04	0.02				**45**
50	8.08	14.43	6.25	4.87	4.22	1.83	3.41	1.78	0.77	2.21	0.61	0.27	1.28	0.16	0.07	0.81	0.05	0.02	0.56	0.02	0.01	**50**
60	9.69	20.22	8.77	5.85	5.92	2.56	4.10	2.49	1.08	2.65	0.86	0.37	1.53	0.23	0.10	0.97	0.08	0.03	0.67	0.03	0.01	**60**
70				6.82	7.87	3.41	4.78	3.32	1.44	3.09	1.15	0.50	1.79	0.30	0.13	1.14	0.10	0.04	0.79	0.04	0.02	**70**
75				7.31	8.94	3.88	5.12	3.77	1.63	3.31	1.30	0.56	1.92	0.34	0.15	1.22	0.11	0.05	0.84	0.05	0.02	**75**
80				7.80	10.08	4.37	5.46	4.25	1.84	3.53	1.47	0.64	2.04	0.39	0.17	1.30	0.13	0.06	0.90	0.05	0.02	**80**
90				8.77	12.53	5.43	6.15	5.28	2.29	3.97	1.82	0.79	2.30	0.48	0.21	1.46	0.16	0.07	1.01	0.07	0.03	**90**
100				9.74	15.23	6.60	6.83	6.42	2.78	4.41	2.22	0.96	2.55	0.59	0.25	1.62	0.19	0.08	1.12	0.08	0.03	**100**
125				12.18	23.03	9.98	8.54	9.70	4.21	5.52	3.35	1.45	3.19	0.89	0.38	2.03	0.29	0.13	1.40	0.12	0.05	**125**
150							10.24	13.60	5.90	6.62	4.70	2.04	3.83	1.24	0.54	2.43	0.41	0.18	1.68	0.17	0.07	**150**
175										7.72	6.25	2.71	4.47	1.65	0.72	2.84	0.55	0.24	1.96	0.22	0.10	**175**
200										8.82	8.00	3.47	5.11	2.12	0.92	3.25	0.70	0.30	2.25	0.29	0.12	**200**
250										11.03	12.10	5.24	6.39	3.20	1.39	4.06	1.06	0.46	2.81	0.43	0.19	**250**
300													7.66	4.49	1.95	4.87	1.49	0.65	3.37	0.61	0.26	**300**
350													8.94	5.97	2.59	5.68	1.98	0.86	3.93	0.81	0.35	**350**
400													10.22	7.64	3.31	6.49	2.54	1.10	4.49	1.03	0.45	**400**
450																7.30	3.15	1.37	5.05	1.29	0.56	**450**
500																8.11	3.83	1.66	5.61	1.56	0.68	500

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

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Flow Velocity & Friction Loss

FLOW VELOCITY & FRICTION LOSS

SCHEDULE 40

Flow Rate (Gallons/ Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons/ Minute)
GPM	**8"**			**10"**			**12"**			**14"**			**16"**			**18"**			**20"**			**24"**			**GPM**
100	0.65	0.02	0.01																						**100**
125	0.81	0.03	0.01																						**125**
150	0.97	0.04	0.02																						**150**
175	1.13	0.06	0.03																						**175**
200	1.29	0.08	0.03	0.82	0.02	0.01																			**200**
250	1.62	0.11	0.05	1.03	0.04	0.02																			**250**
300	1.94	0.16	0.07	1.23	0.05	0.02																			**300**
350	2.27	0.21	0.09	1.44	0.07	0.03	1.01	0.03	0.01																**350**
400	2.59	0.27	0.12	1.64	0.09	0.04	1.16	0.04	0.02	0.96	0.02	0.01	0.73	0.01	0.01										**400**
450	2.91	0.34	0.15	1.85	0.11	0.05	1.30	0.05	0.02	1.08	0.03	0.01	0.82	0.02	0.01										**450**
500	3.24	0.41	0.18	2.05	0.14	0.06	1.44	0.06	0.02	1.19	0.04	0.02	0.91	0.02	0.01										**500**
750	4.85	0.87	0.38	3.08	0.29	0.12	2.17	0.12	0.05	1.79	0.08	0.03	1.37	0.04	0.02	1.08	0.02	0.01							**750**
1000	6.47	1.48	0.64	4.10	0.49	0.21	2.89	0.21	0.09	2.39	0.13	0.06	1.83	0.07	0.03	1.45	0.04	0.02	1.16	0.02	0.01				**1000**
1250				5.13	0.74	0.32	3.61	0.31	0.14	2.99	0.20	0.09	2.29	0.10	0.04	1.81	0.06	0.03	1.45	0.03	0.01				**1250**
1500				6.15	1.03	0.45	4.33	0.44	0.19	3.58	0.28	0.12	2.74	0.14	0.06	2.17	0.08	0.04	1.74	0.05	0.02	1.21	0.02	0.01	**1500**
2000							5.78	0.75	0.33	4.78	0.47	0.20	3.66	0.25	0.11	2.89	0.14	0.06	2.32	0.08	0.04	1.61	0.03	0.01	**2000**
2500							7.22	1.13	0.49	5.97	0.71	0.31	4.57	0.37	0.16	3.61	0.21	0.09	2.91	0.12	0.05	2.01	0.05	0.02	**2500**
3000										7.17	1.00	0.43	5.49	0.52	0.23	4.34	0.29	0.13	3.49	0.17	0.08	2.41	0.07	0.03	**3000**
3500													6.40	0.70	0.30	5.06	0.39	0.17	4.07	0.23	0.10	2.81	0.09	0.04	**3500**
4000																5.78	0.50	0.22	4.65	0.30	0.13	3.21	0.12	0.05	**4000**
4500																6.50	0.62	0.27	5.23	0.37	0.16	3.62	0.15	0.06	**4500**
5000																			5.81	0.45	0.19	4.02	0.18	0.08	**5000**
5500																			6.39	0.53	0.23	4.42	0.22	0.09	**5500**
6000																			6.97	0.63	0.27	4.82	0.25	0.11	**6000**
7000																						5.62	0.34	0.15	**7000**
7500																						6.03	0.39	0.17	**7500**
8000																						6.43	0.43	0.19	**8000**
8500																						6.83	0.49	0.21	**8500**

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

FLOW VELOCITY & FRICTION LOSS

SCHEDULE 80

Flow Rate (Gallons/ Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons/ Minute)
GPM	**1/8"**			**1/4"**			**3/8"**			**1/2"**			**3/4"**			**1"**			**1-1/4"**			**GPM**
0.25	2.67	21.47	9.31	1.29	3.57	1.55	0.63	0.63	0.27													**0.25**
0.50	5.35	77.52	33.60	2.59	12.88	5.58	1.25	2.27	0.98													**0.50**
0.75	8.02	164.25	71.20	3.88	27.29	11.83	1.88	4.80	2.08													**0.75**
1	10.69	279.84	121.31	5.17	46.49	20.15	2.51	8.18	3.55	1.48	2.24	0.97	0.78	0.48	0.21	0.47	0.14	0.06	0.26	0.03	0.01	**1**
2	21.39	1010.21	437.93	10.35	167.84	72.76	5.01	29.54	12.81	2.96	8.08	3.50	1.56	1.73	0.75	0.93	0.49	0.21	0.52	0.12	0.05	**2**
5				25.87	915.95	397.07	12.53	161.23	69.89	7.39	44.12	19.12	3.91	9.45	4.10	2.33	2.67	1.16	1.30	0.64	0.28	**5**
7							17.54	300.66	130.34	10.35	82.27	35.66	5.48	17.62	7.64	3.26	4.98	2.16	1.81	1.20	0.52	**7**
10										14.78	159.26	69.04	7.82	34.11	14.79	4.66	9.65	4.18	2.59	2.32	1.00	**10**
15													11.74	72.27	31.33	6.99	20.44	8.86	3.89	4.91	2.13	**15**
20													15.65	123.13	53.38	9.33	34.82	15.09	5.18	8.36	3.62	**20**
25																11.66	52.64	22.82	6.48	12.64	5.48	**25**
30																13.99	73.78	31.98	7.77	17.71	7.68	**30**
35																16.32	98.16	42.55	9.07	23.56	10.21	**35**
40																18.65	125.70	54.49	10.37	30.17	13.08	**40**
45																			11.66	37.53	16.27	**45**
50																			12.96	45.62	19.77	**50**
60																			15.55	63.94	27.72	**60**
70																			18.14	85.06	36.87	**70**
75																			19.43	96.66	41.90	**75**
80																			20.73	108.93	47.22	**80**

GPM	**1-1/2"**			**2"**			**2-1/2"**			**3"**			**4"**			**5"**			**6"**			**GPM**
1	0.19	0.01	0.01	0.11	0.00	0.00	0.08	0.00	0.00	0.05	0.00	0.00										**1**
2	0.38	0.05	0.02	0.22	0.02	0.01	0.16	0.01	0.00	0.10	0.00	0.00										**2**
5	0.96	0.29	0.13	0.56	0.08	0.04	0.39	0.03	0.01	0.25	0.01	0.01										**5**
7	1.34	0.54	0.24	0.78	0.15	0.07	0.55	0.06	0.03	0.35	0.02	0.01										**7**
10	1.92	1.05	0.46	1.12	0.30	0.13	0.78	0.12	0.05	0.50	0.04	0.02										**10**
15	2.87	2.23	0.97	1.67	0.63	0.27	1.17	0.26	0.11	0.75	0.09	0.04										**15**
20	3.83	3.80	1.65	2.23	1.07	0.47	1.56	0.45	0.19	1.00	0.15	0.07	0.57	0.04	0.02							**20**
25	4.79	5.74	2.49	2.79	1.63	0.70	1.95	0.68	0.29	1.24	0.23	0.10	0.71	0.06	0.03							**25**
30	5.75	8.04	3.49	3.35	2.28	0.99	2.34	0.95	0.41	1.49	0.32	0.14	0.85	0.08	0.04	0.54	0.03	0.01				**30**
35	6.71	10.70	4.64	3.91	3.03	1.31	2.73	1.26	0.55	1.74	0.43	0.18	1.00	0.11	0.05	0.63	0.04	0.02				**35**
40	7.66	13.71	5.94	4.46	3.88	1.68	3.11	1.62	0.70	1.99	0.54	0.24	1.14	0.14	0.06	0.72	0.05	0.02				**40**
45	8.62	17.05	7.39	5.02	4.83	2.09	3.50	2.01	0.87	2.24	0.68	0.29	1.28	0.17	0.08	0.81	0.06	0.02				**45**
50	9.58	20.72	8.98	5.58	5.87	2.54	3.89	2.45	1.06	2.49	0.82	0.36	1.42	0.21	0.09	0.90	0.07	0.03	0.63	0.03	0.01	**50**
60	11.50	29.04	12.59	6.69	8.22	3.56	4.67	3.43	1.49	2.99	1.15	0.50	1.71	0.30	0.13	1.08	0.10	0.04	0.75	0.04	0.02	**60**
70	13.41	38.64	16.75	7.81	10.94	4.74	5.45	4.56	1.98	3.48	1.54	0.67	1.99	0.39	0.17	1.26	0.13	0.06	0.88	0.05	0.02	**70**
75	14.37	43.90	19.03	8.37	12.43	5.39	5.84	5.18	2.25	3.73	1.74	0.76	2.14	0.45	0.19	1.35	0.15	0.06	0.94	0.06	0.03	**75**
80	15.33	49.48	21.45	8.93	14.01	6.07	6.23	5.84	2.53	3.98	1.97	0.85	2.28	0.51	0.22	1.44	0.16	0.07	1.00	0.07	0.03	**80**
90	17.24	61.54	26.68	10.04	17.42	7.55	7.01	7.26	3.15	4.48	2.45	1.06	2.56	0.63	0.27	1.62	0.20	0.09	1.13	0.09	0.04	**90**
100	19.16	74.80	32.42	11.16	21.18	9.18	7.79	8.83	3.83	4.98	2.97	1.29	2.85	0.76	0.33	1.80	0.25	0.11	1.25	0.10	0.04	**100**
125	23.95	113.07	49.02	13.95	32.02	13.88	9.73	13.34	5.78	6.22	4.49	1.95	3.56	1.16	0.50	2.24	0.38	0.16	1.57	0.16	0.07	**125**
150	28.74	158.49	68.71	16.74	44.88	19.45	11.68	18.70	8.11	7.47	6.30	2.73	4.27	1.62	0.70	2.69	0.53	0.23	1.88	0.22	0.10	**150**
175				19.53	59.70	25.88	13.63	24.88	10.79	8.71	8.38	3.63	4.98	2.16	0.93	3.14	0.70	0.30	2.19	0.29	0.13	**175**
200				22.32	76.45	33.14	15.57	31.86	13.81	9.96	10.73	4.65	5.70	2.76	1.20	3.59	0.90	0.39	2.51	0.37	0.16	**200**
250				27.90	115.58	50.10	19.47	48.17	20.88	12.44	16.22	7.03	7.12	4.17	1.81	4.49	1.36	0.59	3.13	0.57	0.25	**250**
300							23.36	67.52	29.27	14.93	22.74	9.86	8.55	5.85	2.54	5.39	1.90	0.83	3.76	0.79	0.34	**300**
350													9.97	7.78	3.37	6.29	2.53	1.10	4.38	1.05	0.46	**350**
400													11.39	9.96	4.32	7.18	3.24	1.41	5.01	1.35	0.59	**400**
450													12.82	12.39	5.37	8.08	4.04	1.75	5.64	1.68	0.73	**450**
500																8.98	4.90	2.13	6.26	2.04	0.89	**500**

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

Suitable for Oil-Free air handling to 25 psi, not for distribution of compressed air or gas

FLOW VELOCITY & FRICTION LOSS

SCHEDULE 80

Flow Rate (Gallons/ Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons/Minute)
GPM		**8"**			**10"**			**12"**			**14"**			**16"**			**18"**			**20"**			**24"**		**GPM**
125	0.89	0.04	0.02																						**125**
150	1.07	0.06	0.02																						**150**
175	1.25	0.07	0.03																						**175**
200	1.43	0.10	0.04	0.91	0.03	0.01																			**200**
250	1.78	0.14	0.06	1.13	0.05	0.02																			**250**
300	2.14	0.20	0.09	1.36	0.07	0.03																			**300**
350	2.50	0.27	0.12	1.59	0.09	0.04	1.12	0.04	0.02																**350**
400	2.85	0.34	0.15	1.81	0.11	0.05	1.28	0.05	0.02	1.06	0.03	0.01	0.81	0.02	0.01										**400**
450	3.21	0.43	0.19	2.04	0.14	0.06	1.44	0.06	0.03	1.19	0.04	0.02	0.91	0.02	0.01										**450**
500	3.57	0.52	0.23	2.27	0.17	0.07	1.60	0.07	0.03	1.33	0.05	0.02	1.01	0.02	0.01										**500**
750	5.35	1.10	0.48	3.40	0.36	0.16	2.40	0.16	0.07	1.99	0.10	0.04	1.52	0.05	0.02	1.19	0.03	0.01							**750**
1000	7.13	1.87	0.81	4.53	0.62	0.27	3.20	0.27	0.12	2.65	0.17	0.07	2.02	0.09	0.04	1.59	0.05	0.02	1.29	0.03	0.01				**1000**
1250				5.66	0.94	0.41	4.00	0.40	0.17	3.31	0.25	0.11	2.53	0.13	0.06	1.99	0.07	0.03	1.61	0.04	0.02				**1250**
1500				6.80	1.32	0.57	4.80	0.57	0.24	3.98	0.36	0.15	3.03	0.18	0.08	2.39	0.10	0.04	1.93	0.06	0.03	1.34	0.03	0.01	**1500**
2000							6.40	0.96	0.42	5.30	0.61	0.26	4.04	0.31	0.14	3.18	0.18	0.08	2.57	0.10	0.05	1.78	0.04	0.02	**2000**
2500										6.63	0.92	0.40	5.05	0.48	0.21	3.98	0.27	0.12	3.22	0.16	0.07	2.23	0.06	0.03	**2500**
3000										7.95	1.29	0.56	6.06	0.67	0.29	4.78	0.37	0.16	3.86	0.22	0.10	2.67	0.09	0.04	**3000**
3500													7.07	0.89	0.38	5.57	0.50	0.22	4.50	0.30	0.13	3.12	0.12	0.05	**3500**
4000																6.37	0.64	0.28	5.15	0.38	0.16	3.56	0.15	0.07	**4000**
4500																7.16	0.79	0.34	5.79	0.47	0.20	4.01	0.19	0.08	**4500**
5000																			6.43	0.57	0.25	4.45	0.23	0.10	**5000**
5500																			7.08	0.68	0.30	4.90	0.28	0.12	**5500**
6000																			7.72	0.80	0.35	5.34	0.33	0.14	**6000**
7000																						6.23	0.44	0.19	**7000**
7500																						6.68	0.49	0.21	**7500**
8000																						7.12	0.56	0.24	**8000**
8500																						7.57	0.62	0.27	**8500**

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

Flow Velocity & Friction Loss

FLOW VELOCITY & FRICTION LOSS

SCHEDULE 120

Flow Rate (Gallons/ Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons/ Minute)
GPM	1/2"			3/4"			1"			1-1/4"			1-1/2"			2"			2-1/2"				3"		GPM
1	1.77	3.50	1.52	0.86	0.60	0.26	0.51	0.17	0.07	0.28	0.04	0.02	0.20	0.02	0.01	0.12	0.00	0.00	0.08	0.00	0.00	0.05	0.00	0.00	1
2	3.54	12.62	5.47	1.72	2.16	0.94	1.03	0.62	0.27	0.56	0.14	0.06	0.40	0.06	0.03	0.24	0.02	0.01	0.16	0.01	0.00	0.11	0.00	0.00	2
5	8.86	68.86	29.85	4.29	11.78	5.11	2.57	3.40	1.47	1.41	0.78	0.34	1.01	0.35	0.15	0.60	0.10	0.04	0.41	0.04	0.02	0.27	0.01	0.01	5
7	12.41	128.41	55.67	6.00	21.97	9.52	3.60	6.33	2.75	1.97	1.46	0.63	1.41	0.65	0.28	0.84	0.18	0.08	0.57	0.07	0.03	0.38	0.03	0.01	7
10	17.72	248.59	107.76	8.58	42.53	18.43	5.15	12.26	5.31	2.82	2.83	1.23	2.02	1.26	0.54	1.20	0.36	0.15	0.82	0.14	0.06	0.54	0.05	0.02	10
15	4"			12.87	90.11	39.06	7.72	25.98	11.26	4.23	6.00	2.60	3.03	2.66	1.15	1.80	0.75	0.33	1.22	0.29	0.13	0.81	0.11	0.05	15
20	0.64	0.05	0.02	17.16	153.52	66.55	10.30	44.25	19.18	5.64	10.23	4.43	4.04	4.54	1.97	2.40	1.28	0.56	1.63	0.50	0.22	1.07	0.18	0.08	20
25	0.80	0.08	0.03				12.87	66.90	29.00	7.05	15.46	6.70	5.04	6.86	2.97	3.00	1.94	0.84	2.04	0.76	0.33	1.34	0.27	0.12	25
30	0.96	0.11	0.05				15.45	93.77	40.65	8.46	21.67	9.39	6.05	9.61	4.17	3.60	2.72	1.18	2.45	1.06	0.46	1.61	0.38	0.17	30
35	1.12	0.14	0.06				18.02	124.75	54.08	9.87	28.83	12.50	7.06	12.79	5.54	4.20	3.61	1.57	2.85	1.41	0.61	1.88	0.51	0.22	35
40	1.28	0.19	0.08				20.60	159.75	69.25	11.28	36.92	16.01	8.07	16.37	7.10	4.80	4.63	2.01	3.26	1.80	0.78	2.15	0.65	0.28	40
45	1.44	0.23	0.10	5"						12.69	45.92	19.91	9.08	20.37	8.83	5.40	5.76	2.50	3.67	2.24	0.97	2.42	0.81	0.35	45
50	1.60	0.28	0.12	0.69	0.04	0.02				14.09	55.82	24.20	10.09	24.75	10.73	6.00	7.00	3.03	4.08	2.73	1.18	2.69	0.99	0.43	50
60	1.92	0.39	0.17	0.83	0.05	0.02				16.91	78.24	33.92	12.11	34.70	15.04	7.20	9.81	4.25	4.89	3.82	1.66	3.22	1.39	0.60	60
70	2.24	0.52	0.23	0.97	0.07	0.03				19.73	104.09	45.12	14.12	46.16	20.01	8.40	13.05	5.66	5.71	5.09	2.21	3.76	1.84	0.80	70
75	2.40	0.59	0.26	1.04	0.08	0.03				21.14	118.27	51.27	15.13	52.45	22.74	9.00	14.82	6.43	6.11	5.78	2.51	4.03	2.10	0.91	75
80	2.56	0.67	0.29	1.11	0.09	0.04				22.55	133.29	57.78	16.14	59.11	25.62	9.60	16.71	7.24	6.52	6.51	2.82	4.30	2.36	1.02	80
90	2.88	0.83	0.36	1.25	0.11	0.05				25.37	165.78	71.87	18.16	73.52	31.87	10.81	20.78	9.01	7.34	8.10	3.51	4.84	2.94	1.27	90
100	3.20	1.01	0.44	1.38	0.13	0.06	6"						20.18	89.36	38.74	12.01	25.26	10.95	8.15	9.85	4.27	5.37	3.57	1.55	100
125	4.00	1.53	0.66	1.73	0.20	0.09	0.99	0.05	0.02				25.22	135.09	58.56	15.01	38.18	16.55	10.19	14.89	6.45	6.72	5.40	2.34	125
150	4.80	2.14	0.93	2.08	0.28	0.12	1.19	0.07	0.03				30.26	189.35	82.08	18.01	53.52	23.20	12.23	20.87	9.05	8.06	7.57	3.28	150
175	5.60	2.85	1.24	2.42	0.37	0.16	1.38	0.10	0.04							21.01	71.20	30.86	14.27	27.76	12.04	9.40	10.07	4.36	175
200	6.40	3.65	1.58	2.77	0.48	0.21	1.58	0.12	0.05							24.01	91.17	39.52	16.30	35.55	15.41	10.75	12.89	5.59	200
250	8.00	5.52	2.39	3.46	0.72	0.31	1.98	0.18	0.08							30.01	137.83	59.75	20.38	53.75	23.30	13.43	19.49	8.45	250
300	9.60	7.74	3.36	4.15	1.01	0.44	2.37	0.26	0.11																300
350	11.20	10.30	4.46	4.84	1.34	0.58	2.77	0.34	0.15																350
400	12.80	13.19	5.72	5.54	1.72	0.74	3.16	0.44	0.19																400
450	14.40	16.40	7.11	6.23	2.14	0.93	3.56	0.55	0.24																450
500				6.92	2.60	1.13	3.95	0.67	0.29																500
750				10.38	5.50	2.38	5.93	1.14	0.61																750
1,000				13.84	9.37	4.06	7.91	2.40	1.04																1,000
1,250							9.88	3.63	1.57																1,250
1,500							11.86	5.09	2.21																1,500
2,000							15.81	8.67	3.76																2,000

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Suitable for Oil-Free air handling to 25 psi, not for distribution of compressed air or gas

Effective 02/01/2020 See MSRP-1 Sheet or Check Spears® On-line Catalog @ www.spearsmfg.com for Pricing

FLOW VELOCITY & FRICTION LOSS

SDR 11

Flow Rate (Gallons/ Minute)	Velocity Feet Per Second	Head Loss Feet of Water Per 100 Ft.	Pressure Loss PSI Per 100 Ft.	Velocity Feet Per Second	Head Loss Feet of Water Per 100 Ft.	Pressure Loss PSI Per 100 Ft.	Velocity Feet Per Second	Head Loss Feet of Water Per 100 Ft.	Pressure Loss PSI Per 100 Ft.	Velocity Feet Per Second	Head Loss Feet of Water Per 100 Ft.	Pressure Loss PSI Per 100 Ft.	Velocity Feet Per Second	Head Loss Feet of Water Per 100 Ft.	Pressure Loss PSI Per 100 Ft.	Velocity Feet Per Second	Head Loss Feet of Water Per 100 Ft.	Pressure Loss PSI Per 100 Ft.	Flow Rate (Gallons/ Minute)
GPM	**1/2"**			**3/4"**			**1"**			**1-1/4"**			**1-1/2"**			**2"**			**GPM**
1	1.71	3.19	1.38	0.80	0.50	0.22	0.48	0.15	0.06										**1**
2	3.42	11.53	5.00	1.60	1.82	0.79	0.96	0.53	0.23										**2**
3	5.13	24.43	10.59	2.40	3.85	1.67	1.44	1.12	0.49										**3**
4	6.83	41.62	18.04	3.20	6.55	2.84	1.93	1.91	0.83										**4**
5	8.54	62.91	27.27	4.00	9.91	4.29	2.41	2.89	1.25										**5**
6	10.25	88.18	38.23	4.79	13.89	6.02	2.89	4.05	1.76										**6**
7	11.96	117.32	50.86	5.59	18.47	8.01	3.37	5.39	2.34										**7**
8	13.67	150.23	65.13	6.39	23.66	10.26	3.85	6.90	2.99										**8**
9	15.38	186.85	81.00	7.19	29.42	12.76	4.33	8.58	3.72										**9**
10	17.08	227.11	98.45	7.99	35.76	15.50	4.82	10.43	4.52	3.23	3.94	1.71	2.31	1.75	0.76	1.35	0.49	0.21	**10**
15				11.99	75.78	32.85	7.22	22.11	9.58	4.84	8.35	3.62	3.47	3.71	1.61	2.03	1.03	0.45	**15**
20				15.98	129.11	55.97	9.63	37.67	16.33	6.46	14.23	6.17	4.63	6.33	2.74	2.70	1.76	0.76	**20**
25							12.04	56.94	24.69	8.07	21.51	9.33	5.78	9.56	4.15	3.38	2.66	1.15	**25**
30							14.45	79.82	34.60	9.68	30.15	13.07	6.94	13.40	5.81	4.05	3.73	1.62	**30**
35							16.86	106.19	46.03	11.30	40.11	17.39	8.09	17.83	7.73	4.73	4.96	2.15	**35**
40										12.91	51.37	22.27	9.25	22.83	9.90	5.40	6.35	2.75	**40**
45										14.52	63.89	27.70	10.41	28.40	12.31	6.08	7.89	3.42	**45**
50										16.14	77.66	33.66	11.56	34.52	14.96	6.75	9.60	4.16	**50**
55										17.75	92.65	40.16	12.72	41.18	17.85	7.43	11.45	4.96	**55**
60													13.88	48.38	20.97	8.10	13.45	5.83	**60**
70													16.19	64.37	27.90	9.46	17.89	7.76	**70**
80																10.61	22.91	9.93	**80**
90																12.16	28.50	12.35	**90**
100																13.51	34.64	15.02	**100**
125																16.89	52.37	22.70	**125**

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

FLOW VELOCITY & FRICTION LOSS

SDR 13.5

Flow Rate (Gallons/ Minute)	cubic ft/sec	Velocity (ft/s)	Friction Head Loss (ft water/ 100ft)	Friction Pressure (psi/ 100ft)	Velocity (ft/s)	Friction Head Loss (ft water/ 100ft)	Friction Pressure (psi/ 100ft)	Velocity (ft/s)	Friction Head Loss (ft water/ 100ft)	Friction Pressure (psi/ 100ft)	Velocity (ft/s)	Friction Head Loss (ft water/ 100ft)	Friction Pressure (psi/ 100ft)	Velocity (ft/s)	Friction Head Loss (ft water/ 100ft)	Friction Pressure (psi/ 100ft)	Velocity (ft/s)	Friction Head Loss (ft water/ 100ft)	Friction Pressure (psi/ 100ft)	Velocity (ft/s)	Friction Head Loss (ft water/ 100ft)	Friction Pressure (psi/ 100ft)	Velocity (ft/s)	Friction Head Loss (ft water/ 100ft)	Friction Pressure (psi/ 100ft)	Flow Rate (Gallons/ Minute)
GPM		1/2"			3/4"			1"			1-1/4"			1-1/2"			2"			2-1/2"			3"			GPM
1	0.002	0.85	1.03	0.45	0.54	0.34	0.15																			1
2	0.004	1.69	2.05	0.89	1.07	0.68	0.29	0.68	0.40	0.17	0.42	0.13	0.06	0.32	0.065	0.028	0.20	0.03	0.013							2
5	0.011	4.22	11.58	5.01	2.68	3.82	1.65	1.69	1.24	0.54	1.05	0.39	0.17	0.80	0.20	0.088	0.51	0.075	0.033	0.35	0.038	0.016	0.24	0.02	0.009	5
7	0.016	5.91	21.24	9.20	3.75	7.01	3.03	2.36	2.28	0.99	1.47	0.72	0.31	1.12	0.37	0.16	0.72	0.125	0.054	0.49	0.53	0.023	0.33	0.03	0.012	7
10	0.022	8.44	40.46	17.52	5.35	13.34	5.78	3.37	4.33	1.87	2.10	1.37	0.59	1.60	0.71	0.31	1.02	0.24	0.10	0.70	0.09	0.039	0.47	0.04	0.017	10
15	0.033	4"			8.03	28.27	12.24	5.06	9.18	3.97	3.15	2.91	1.26	2.40	1.50	0.65	1.53	0.50	0.22	1.04	0.20	0.087	0.70	0.08	0.035	15
20	0.045	0.57	0.04	0.017	10.70	48.17	20.86	6.74	15.64	6.77	4.21	4.96	2.91	3.20	2.55	1.10	2.04	0.85	0.37	1.39	0.34	0.15	0.94	0.13	0.056	20
25	0.056	0.71	0.06	0.026	5"			8.43	23.65	10.24	5.26	7.49	3.24	4.00	3.85	1.67	2.55	1.29	0.56	1.74	0.51	0.22	1.17	0.19	082	25
30	0.067	0.85	0.08	0.035	0.56	0.03	0.013	10.11	33.15	14.35	6.31	10.50	4.55	4.80	5.40	2.34	3.05	1.80	0.78	2.09	0.71	0.31	1.41	0.27	0.12	30
35	0.078	0.99	0.11	0.048	0.65	0.04	0.017				7.36	13.97	6.05	5.60	7.19	3.11	3.57	2.40	1.04	2.44	0.95	0.41	1.64	0.36	0.16	35
40	0.089	1.14	0.14	0.060	0.74	0.05	0.022				8.41	17.90	7.75	6.40	9.20	3.98	4.08	3.07	1.33	2.78	1.21	0.52	1.88	0.46	0.20	40
45	0.100	1.28	0.17	0.074	0.84	0.06	0.026	6"			9.46	22.26	9.64	7.20	11.44	4.95	4.59	3.82	1.65	3.13	1.51	0.65	2.11	0.58	0.25	45
50	0.111	1.42	0.21	0.091	0.93	0.07	0.030	0.66	0.03	0.013	10.52	27.05	11.71	8.00	13.91	6.02	5.10	4.64	2.01	3.48	1.83	0.79	2.35	0.70	0.30	50
60	0.134	1.70	0.29	0.13	1.12	0.10	0.043	0.79	0.04	0.017				9.60	19.50	8.44	6.12	6.50	2.81	4.18	2.57	1.11	2.82	0.98	0.42	60
70	0.156	1.99	0.38	0.16	1.30	0.14	0.061	0.92	0.06	0.026							7.14	8.65	3.75	4.87	3.42	1.48	3.29	1.31	0.57	70
75	0.167	2.13	0.44	0.19	1.40	0.16	0.069	0.98	0.07	0.030							7.65	9.83	4.26	5.22	3.88	1.68	3.52	1.49	0.65	75
80	0.178	2.27	0.49	0.21	1.49	0.18	0.078	1.05	0.08	0.035							8.16	11.08	4.80	5.57	4.37	1.89	3.76	1.68	0.73	80
90	0.201	2.56	0.61	0.26	1.67	0.22	0.095	1.18	0.09	0.039							9.18	13.78	5.97	6.27	5.44	2.36	4.23	2.09	0.90	90
100	0.223	2.84	0.74	0.32	1.86	0.27	0.12	1.31	0.11	0.048							10.20	16.75	7.25	6.96	6.61	2.86	4.70	2.54	1.10	100
125	0.279	3.55	1.13	0.49	2.33	0.40	0.18	1.64	0.17	0.074										8.70	10.01	4.33	5.88	3.84	1.66	125
150	0.334	4.26	1.58	0.68	2.79	0.56	0.24	1.97	0.24	0.10										10.44	14.01	6.07	7.04	5.37	2.33	150
175	0.390	4.97	2.10	0.91	3.26	0.75	0.33	2.30	0.32	0.14													8.22	7.15	3.10	175
200	0.446	5.68	2.69	1.16	3.72	0.96	0.42	2.62	0.41	0.18													9.39	9.15	3.96	200
250	0.557	7.10	4.07	1.76	4.66	1.46	0.63	3.28	0.62	0.27													11.74	13.86	6.00	250
300	0.668	8.52	5.69	2.46	5.58	2.03	0.88	3.93	0.87	0.38																300
350	0.780	9.94	7.58	3.29	6.52	2.70	1.17	4.59	1.16	0.50																350
400	0.891	11.36	9.70	4.20	7.44	3.46	1.50	5.24	1.48	0.64																400
450	1.003				8.37	4.31	1.87	5.90	1.84	0.80																450
500	1.114				9.30	5.24	2.27	6.56	2.23	0.97																500
750								9.83	4.73	2.05																750
1000	2.228							13.11	8.06	3.49																1000

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

FLOW VELOCITY & FRICTION LOSS

SDR 21

Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons per Minute)
GPM	**1/2"**			**3/4"**			**1"**			**1-1/4"**			**1-1/2"**			**2"**			**2-1/2"**			**3"**			**GPM**
1				0.49	0.16	0.07	0.30	0.05	0.02	0.19	0.01	0.01	0.14	0.01	0.00	0.09	0.00	0.00	0.06	0.00	0.00	0.04	0.00	0.00	**1**
2				0.99	0.56	0.24	0.60	0.17	0.07	0.37	0.05	0.02	0.28	0.03	0.01	0.18	0.01	0.00	0.12	0.00	0.00	0.08	0.00	0.00	**2**
5				2.46	3.06	1.33	1.49	0.91	0.39	0.93	0.29	0.12	0.71	0.15	0.06	0.45	0.05	0.02	0.31	0.02	0.01	0.21	0.01	0.00	**5**
7				3.45	5.71	2.48	2.09	1.69	0.73	1.30	0.53	0.23	0.99	0.27	0.12	0.63	0.09	0.04	0.43	0.04	0.02	0.29	0.01	0.01	**7**
10				4.93	11.06	4.80	2.99	3.27	1.42	1.86	1.03	0.45	1.41	0.53	0.23	0.90	0.18	0.08	0.61	0.07	0.03	0.41	0.03	0.01	**10**
15	**4"**			7.39	23.44	10.16	4.48	6.93	3.00	2.79	2.18	0.95	2.12	1.12	0.49	1.35	0.37	0.16	0.92	0.15	0.06	0.62	0.06	0.02	**15**
20	0.50	0.03	0.01	9.86	39.94	17.31	5.97	11.81	5.12	3.72	3.72	1.61	2.83	1.91	0.83	1.80	0.64	0.28	1.23	0.25	0.11	0.83	0.10	0.04	**20**
25	0.62	0.04	0.02	**5"**			7.47	17.85	7.74	4.65	5.63	2.44	3.53	2.89	1.25	2.25	0.97	0.42	1.53	0.38	0.16	1.03	0.14	0.06	**25**
30	0.75	0.06	0.03	0.49	0.02	0.01	8.96	25.02	10.85	5.5	7.89	3.42	4.24	4.05	1.75	2.70	1.35	0.59	1.84	0.53	0.23	1.24	0.20	0.09	**30**
35	0.87	0.08	0.03	0.57	0.03	0.01	10.45	33.28	14.43	6.51	10.49	4.55	4.94	5.38	2.33	3.15	1.80	0.78	2.15	0.71	0.31	1.44	0.27	0.12	**35**
40	1.00	0.10	0.04	0.65	0.04	0.02				7.43	13.44	5.83	5.65	6.89	2.99	3.60	2.31	1.00	2.45	0.90	0.39	1.65	0.34	0.15	**40**
45	1.12	0.13	0.05	0.73	0.04	0.02	**6"**			8.36	16.71	7.25	6.36	8.57	3.72	4.05	2.87	1.24	2.76	1.12	0.49	1.86	0.43	0.19	**45**
50	1.25	0.15	0.07	0.82	0.05	0.02	0.58	0.02	0.01	9.29	20.31	8.81	7.06	10.42	4.52	4.50	3.49	1.51	3.06	1.37	0.59	2.06	0.52	0.23	**50**
60	1.50	0.21	0.09	0.98	0.08	0.03	0.69	0.03	0.01				8.48	14.60	6.33	5.41	4.89	2.12	3.68	1.91	0.83	2.48	0.73	0.32	**60**
70	1.75	0.29	0.12	1.14	0.10	0.04	0.81	0.04	0.02				9.89	19.43	8.42	6.31	6.50	2.82	4.29	2.55	1.10	2.89	0.97	0.42	**70**
75	1.87	0.32	0.14	1.22	0.12	0.05	0.86	0.05	0.02				10.59	22.08	9.57	6.76	7.39	3.20	4.60	2.89	1.25	3.09	1.10	0.48	**75**
80	2.00	0.37	0.16	1.31	0.13	0.06	0.92	0.06	0.02							7.21	8.32	3.61	4.90	3.26	1.41	3.30	1.25	0.54	**80**
90	2.24	0.46	0.20	1.47	0.16	0.07	1.04	0.07	0.03	**8"**						8.11	10.35	4.49	5.52	4.06	1.76	3.71	1.55	0.67	**90**
100	2.49	0.55	0.24	1.63	0.20	0.09	1.15	0.08	0.04	0.68	0.02	0.01				9.01	12.58	5.46	6.13	4.93	2.14	4.13	1.88	0.82	**100**
125	3.12	0.84	0.36	2.04	0.30	0.13	1.44	0.13	0.06	0.85	0.04	0.02							7.66	7.46	3.23	5.16	2.85	1.23	**125**
150	3.74	1.17	0.51	2.45	0.42	0.18	1.73	0.18	0.08	1.02	0.05	0.02							9.19	10.45	4.53	6.19	3.99	1.73	**150**
175	4.36	1.56	0.68	2.86	0.56	0.24	2.01	0.24	0.10	1.19	0.07	0.03							10.73	13.90	6.03	7.22	5.31	2.30	**175**
200	4.99	2.00	0.87	3.26	0.71	0.31	2.30	0.30	0.13	1.36	0.08	0.04										8.25	6.80	2.95	**200**
250	6.24	3.02	1.31	4.08	1.08	0.47	2.88	0.46	0.20	1.70	0.13	0.06										10.31	10.27	4.45	**250**
300	7.48	4.23	1.84	4.90	1.51	0.65	3.45	0.65	0.28	2.04	0.18	0.08													**300**
350	8.73	5.63	2.44	5.71	2.01	0.87	4.03	0.86	0.37	2.38	0.24	0.10													**350**
400	9.98	7.21	3.13	6.53	2.57	1.12	4.61	1.10	0.48	2.71	0.30	0.13													**400**
450	11.22	8.97	3.89	7.35	3.20	1.39	5.18	1.37	0.59	3.05	0.38	0.16													**450**
500				8.16	3.89	1.69	5.76	1.66	0.72	3.39	0.46	0.20													**500**
750							8.64	3.52	1.53	5.09	0.97	0.42													**750**
1000										6.79	1.66	0.72													**1000**
1250										8.48	2.51	1.09													**1250**

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Flow Velocity & Friction Loss

FLOW VELOCITY & FRICTION LOSS

SDR 26

Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons per Minute)
GPM	1"			1-1/4"			1-1/2"			2"			2-1/2"			3"			4"			5"			6"			GPM
1	0.30	0.04	0.02	0.18	0.01	0.01	0.14	0.01	0.00	0.09	0.00	0.00	0.06	0.00	0.00	0.04	0.00	0.00										1
2	0.59	0.16	0.07	0.36	0.05	0.02	0.27	0.02	0.01	0.17	0.01	0.00	0.12	0.00	0.00	0.08	0.00	0.00										2
5	1.48	0.88	0.38	0.89	0.26	0.11	0.68	0.13	0.06	0.43	0.04	0.02	0.29	0.02	0.01	0.20	0.01	0.00										5
7	2.07	1.65	0.71	1.25	0.48	0.21	0.95	0.25	0.11	0.61	0.08	0.04	0.41	0.03	0.01	0.28	0.01	0.01										7
10	2.96	3.19	1.38	1.79	0.94	0.41	1.36	0.48	0.21	0.86	0.16	0.07	0.59	0.06	0.03	0.40	0.02	0.01										10
15	4.44	6.76	2.93	2.68	1.98	0.86	2.04	1.02	0.44	1.30	0.34	0.15	0.88	0.13	0.06	0.59	0.05	0.02										15
20	5.91	11.52	4.99	3.57	3.38	1.46	2.72	1.73	0.75	1.73	0.58	0.25	1.18	0.23	0.10	0.79	0.09	0.04	0.48	0.03	0.01							20
25	7.39	17.41	7.55	4.47	5.10	2.21	3.40	2.62	1.14	2.16	0.87	0.38	1.47	0.34	0.15	0.99	0.13	0.06	0.60	0.04	0.02							25
30	8.87	24.40	10.58	5.36	7.15	3.10	4.07	3.67	1.59	2.59	1.23	0.53	1.76	0.48	0.21	1.19	0.18	0.08	0.72	0.05	0.02	0.47	0.02	0.01				30
35	10.35	32.46	14.07	6.25	9.52	4.13	4.75	4.89	2.12	3.03	1.63	0.71	2.06	0.64	0.28	1.39	0.24	0.11	0.84	0.07	0.03	0.55	0.03	0.01				35
40	11.83	41.57	18.02	7.14	12.19	5.28	5.43	6.26	2.71	3.46	2.09	0.90	2.35	0.82	0.35	1.58	0.31	0.14	0.96	0.09	0.04	0.63	0.03	0.01				40
45				8.04	15.16	6.57	6.11	7.78	3.37	3.89	2.60	1.13	2.65	1.02	0.44	1.78	0.39	0.17	1.08	0.11	0.05	0.70	0.04	0.02				45
50				8.93	18.43	7.99	6.79	9.46	4.10	4.32	3.16	1.37	2.94	1.24	0.54	1.98	0.47	0.20	1.19	0.14	0.06	0.78	0.05	0.02	0.55	0.02	0.01	50
60				10.72	25.83	11.20	8.15	13.26	5.75	5.19	4.42	1.92	3.53	1.73	0.75	2.38	0.66	0.29	1.43	0.19	0.08	0.94	0.07	0.03	0.66	0.03	0.01	60
70							9.51	17.64	7.65	6.05	5.88	2.55	4.12	2.30	1.00	2.77	0.88	0.38	1.67	0.26	0.11	1.10	0.09	0.04	0.77	0.04	0.02	70
75							10.19	20.05	8.69	6.49	6.69	2.90	4.41	2.62	1.13	2.97	1.00	0.43	1.79	0.29	0.13	1.17	0.10	0.05	0.83	0.04	0.02	75
80							10.87	22.59	9.79	6.92	7.54	3.27	4.70	2.95	1.28	3.17	1.13	0.49	1.91	0.33	0.14	1.25	0.12	0.05	0.88	0.05	0.02	80
90	8"						12.22	28.10	12.18	7.78	9.37	4.06	5.29	3.67	1.59	3.57	1.40	0.61	2.15	0.41	0.18	1.41	0.15	0.06	0.99	0.06	0.03	90
100	0.65	0.02	0.01				13.58	34.16	14.81	8.65	11.39	4.94	5.88	4.46	1.93	3.96	1.71	0.74	2.39	0.50	0.22	1.56	0.18	0.08	1.10	0.08	0.03	100
125	0.81	0.03	0.01							10.81	17.22	7.47	7.35	6.74	2.92	4.95	2.58	1.12	2.99	0.75	0.33	1.96	0.27	0.12	1.38	0.11	0.05	125
150	0.98	0.04	0.02										8.82	9.45	4.10	5.94	3.62	1.57	3.58	1.06	0.46	2.35	0.38	0.16	1.65	0.16	0.07	150
175	1.14	0.06	0.03	10"									10.29	12.57	5.45	6.93	4.81	2.09	4.18	1.41	0.61	2.74	0.50	0.22	1.93	0.21	0.09	175
200	1.30	0.08	0.03	0.84	0.03	0.01										7.92	6.16	2.67	4.78	1.80	0.78	3.13	0.64	0.28	2.21	0.27	0.12	200
250	1.63	0.11	0.05	1.05	0.04	0.02										9.91	9.31	4.04	5.97	2.72	1.18	3.91	0.97	0.42	2.76	0.42	0.18	250
300	1.95	0.16	0.07	1.26	0.06	0.02	12"									11.89	13.06	5.66	7.17	3.81	1.65	4.69	1.36	0.59	3.31	0.58	0.25	300
350	2.28	0.21	0.09	1.47	0.07	0.03	1.04	0.03	0.01	14"			16"						8.36	5.07	2.20	5.48	1.81	0.79	3.86	0.77	0.34	350
400	2.60	0.27	0.12	1.68	0.09	0.04	1.19	0.04	0.02	0.99	0.03	0.01	0.76	0.01	0.01				9.56	6.50	2.82	6.26	2.32	1.01	4.41	0.99	0.43	400
450	2.93	0.34	0.15	1.88	0.12	0.05	1.34	0.05	0.02	1.11	0.03	0.01	0.85	0.02	0.01				10.75	8.08	3.50	7.04	2.89	1.25	4.96	1.23	0.53	450
500	3.25	0.41	0.18	2.09	0.14	0.06	1.49	0.06	0.03	1.23	0.04	0.02	0.95	0.02	0.01	18"						7.82	3.51	1.52	5.52	1.50	0.65	500
750	4.88	0.88	0.38	3.14	0.30	0.13	2.23	0.13	0.06	1.85	0.08	0.04	1.42	0.04	0.02	1.12	0.02	0.01	20"						8.27	3.17	1.38	750
1000	6.51	1.50	0.65	4.19	0.51	0.22	2.98	0.22	0.10	2.47	0.14	0.06	1.89	0.07	0.03	1.49	0.04	0.02	1.21	0.03	0.01				11.03	5.41	2.34	1000
1250	8.13	2.26	0.98	5.23	0.78	0.34	3.72	0.34	0.15	3.09	0.21	0.09	2.36	0.11	0.05	1.87	0.06	0.03	1.51	0.04	0.02	24"						1250
1500	9.76	3.17	1.38	6.28	1.09	0.47	4.47	0.47	0.21	3.70	0.30	0.13	2.84	0.16	0.07	2.24	0.09	0.04	1.81	0.05	0.02	1.26	0.02	0.01				1500
2000				8.38	1.85	0.80	5.95	0.81	0.35	4.94	0.51	0.22	3.78	0.27	0.12	2.99	0.15	0.07	2.42	0.09	0.04	1.68	0.04	0.02				2000
2500							7.44	1.22	0.53	6.17	0.77	0.34	4.73	0.40	0.18	3.73	0.23	0.10	3.02	0.14	0.06	2.10	0.06	0.02				2500
3000										7.41	1.08	0.47	5.67	0.57	0.25	4.48	0.32	0.14	3.63	0.19	0.08	2.52	0.08	0.03				3000
3500													6.62	0.75	0.33	5.23	0.42	0.18	4.23	0.25	0.11	2.94	0.10	0.05				3500
4000																5.97	0.54	0.24	4.84	0.33	0.14	3.36	0.13	0.06				4000
4500																6.72	0.68	0.29	5.44	0.41	0.18	3.78	0.17	0.07				4500
5000																			6.05	0.49	0.21	4.20	0.20	0.09				5000
5500																			6.65	0.59	0.25	4.62	0.24	0.10				5500
6000																			7.26	0.69	0.30	5.04	0.28	0.12				6000
7000																						5.88	0.38	0.16				7000
7500																						6.30	0.43	0.19				7500
8000																						6.72	0.48	0.21				8000
8500																						7.14	0.54	0.24				8500

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

Flow Velocity & Friction Loss

FLOW VELOCITY & FRICTION LOSS

SDR 32.5

Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons per Minute)
GPM	6"			8"			10"			12"			14"			16"			18"			**GPM**
20	0.21	0.00	0.00	0.13	0.00	0.00	0.08	0.00	0.00	0.06	0.00	0.00	0.05	0.00	0.00	0.04	0.00	0.00	0.03	0.00	0.00	**20**
40	0.43	0.02	0.01	0.25	0.00	0.00	0.16	0.00	0.00	0.11	0.00	0.00	0.10	0.00	0.00	0.07	0.00	0.00	0.06	0.00	0.00	**40**
60	0.64	0.02	0.01	0.38	0.00	0.00	0.24	0.00	0.00	0.17	0.00	0.00	0.14	0.00	0.00	0.11	0.00	0.00	0.09	0.00	0.00	**60**
80	0.85	0.05	0.02	0.50	0.02	0.01	0.32	0.00	0.00	0.23	0.00	0.00	0.19	0.00	0.00	0.15	0.00	0.00	0.12	0.00	0.00	**80**
100	1.06	0.07	0.03	0.63	0.02	0.01	0.40	0.00	0.00	0.29	0.00	0.00	0.24	0.00	0.00	0.18	0.00	0.00	0.14	0.00	0.00	**100**
150	1.60	0.14	0.06	0.94	0.05	0.02	0.61	0.02	0.01	0.43	0.00	0.00	0.36	0.00	0.00	0.27	0.00	0.00	0.22	0.00	0.00	**150**
200	2.13	0.25	0.11	1.26	0.07	0.03	0.81	0.02	0.01	0.57	0.00	0.00	0.48	0.00	0.00	0.36	0.00	0.00	0.29	0.00	0.00	**200**
250	2.66	0.37	0.16	1.57	0.12	0.05	1.01	0.05	0.02	0.72	0.02	0.01	0.60	0.00	0.00	0.46	0.00	0.00	0.36	0.00	0.00	**250**
300	3.19	0.53	0.23	1.88	0.14	0.06	1.21	0.05	0.02	0.86	0.02	0.01	0.71	0.02	0.01	0.55	0.00	0.00	0.43	0.00	0.00	**300**
350	3.72	0.72	0.31	2.20	0.21	0.09	1.41	0.07	0.03	1.01	0.02	0.01	0.83	0.02	0.01	0.64	0.00	0.00	0.50	0.00	0.00	**350**
400	4.26	0.90	0.39	2.51	0.25	0.11	1.62	0.09	0.04	1.15	0.05	0.02	0.95	0.02	0.01	0.73	0.02	0.01	0.58	0.00	0.00	**400**
450	4.79	1.13	0.49	2.82	0.32	0.14	1.82	0.12	0.05	1.29	0.05	0.02	1.07	0.02	0.01	0.82	0.02	0.01	0.65	0.00	0.00	**450**
500	5.32	1.36	0.59	3.14	0.37	0.16	2.02	0.14	0.06	1.44	0.05	0.02	1.19	0.05	0.02	0.91	0.02	0.01	0.72	0.00	0.00	**500**
550	5.85	1.64	0.71	3.45	0.46	0.20	2.22	0.16	0.07	1.58	0.07	0.03	1.31	0.05	0.02	1.00	0.02	0.01	0.79	0.02	0.01	**550**
600	6.38	1.91	0.83	3.77	0.53	0.23	2.42	0.18	0.08	1.72	0.07	0.03	1.43	0.05	0.02	1.09	0.02	0.01	0.86	0.02	0.01	**600**
650	6.91	2.24	0.97	4.08	0.62	0.27	2.63	0.21	0.09	1.87	0.09	0.04	1.55	0.07	0.03	1.19	0.02	0.01	0.94	0.02	0.01	**650**
700	7.45	2.56	1.11	4.39	0.72	0.31	2.83	0.25	0.11	2.01	0.12	0.05	1.67	0.07	0.03	1.28	0.05	0.02	1.01	0.02	0.01	**700**
750	7.98	2.91	1.26	4.71	0.81	0.35	3.03	0.28	0.12	2.15	0.12	0.05	1.79	0.07	0.03	1.37	0.05	0.02	1.08	0.02	0.01	**750**
800	8.51	3.28	1.42	5.02	0.90	0.39	3.23	0.30	0.13	2.30	0.14	0.06	1.91	0.09	0.04	1.46	0.05	0.02	1.15	0.02	0.01	**800**
850	9.04	3.67	1.59	5.33	1.01	0.44	3.43	0.35	0.15	2.44	0.16	0.07	2.02	0.09	0.04	1.55	0.05	0.02	1.22	0.02	0.01	**850**
900				5.65	1.13	0.49	3.64	0.39	0.17	2.59	0.16	0.07	2.14	0.12	0.05	1.64	0.05	0.02	1.30	0.02	0.01	**900**
950				5.96	1.25	0.54	3.84	0.44	0.19	2.73	0.18	0.08	2.26	0.12	0.05	1.73	0.07	0.03	1.37	0.05	0.02	**950**
1000				6.28	1.36	0.59	4.04	0.46	0.20	2.87	0.21	0.09	2.38	0.14	0.06	1.82	0.07	0.03	1.44	0.05	0.02	**1000**
1050				6.59	1.50	0.65	4.24	0.51	0.22	3.02	0.23	0.10	2.50	0.14	0.06	1.92	0.07	0.03	1.51	0.05	0.02	**1050**
1100				6.90	1.64	0.71	4.45	0.55	0.24	3.16	0.25	0.11	2.62	0.16	0.07	2.01	0.09	0.04	1.59	0.05	0.02	**1100**
1150							4.65	0.60	0.26	3.30	0.25	0.11	2.74	0.16	0.07	2.10	0.09	0.04	1.66	0.05	0.02	**1150**
1200							4.85	0.67	0.29	3.45	0.28	0.12	2.86	0.18	0.08	2.19	0.09	0.04	1.73	0.05	0.02	**1200**
1250							5.05	0.72	0.31	3.59	0.30	0.13	2.98	0.21	0.09	2.28	0.09	0.04	1.80	0.07	0.03	**1250**
1300							5.25	0.76	0.33	3.73	0.32	0.14	3.10	0.21	0.09	2.37	0.12	0.05	1.87	0.07	0.03	**1300**
1350							5.46	0.83	0.36	3.88	0.35	0.15	3.22	0.23	0.10	2.46	0.12	0.05	1.95	0.07	0.03	**1350**
1400							5.66	0.88	0.38	4.02	0.39	0.17	3.33	0.23	0.10	2.55	0.12	0.05	2.02	0.07	0.03	**1400**
1450							5.86	0.95	0.41	4.17	0.42	0.18	3.45	0.25	0.11	2.64	0.14	0.06	2.09	0.07	0.03	**1450**
1500							6.06	0.99	0.43	4.31	0.44	0.19	3.57	0.28	0.12	2.74	0.14	0.06	2.16	0.09	0.04	**1500**
1600							6.47	1.13	0.49	4.60	0.48	0.21	3.81	0.30	0.13	2.92	0.16	0.07	2.31	0.09	0.04	**1600**
1700							6.87	1.25	0.54	4.88	0.55	0.24	4.05	0.35	0.15	3.10	0.18	0.08	2.45	0.09	0.04	**1700**
1800										5.17	0.60	0.26	4.29	0.39	0.17	3.28	0.21	0.09	2.59	0.12	0.05	**1800**
1900										5.46	0.67	0.29	4.53	0.42	0.18	3.47	0.23	0.10	2.74	0.12	0.05	**1900**
2000										5.74	0.74	0.32	4.76	0.46	0.20	3.65	0.25	0.11	2.88	0.14	0.06	**2000**
2100										6.03	0.81	0.35	5.00	0.51	0.22	3.83	0.28	0.12	3.03	0.16	0.07	**2100**
2200										6.32	0.88	0.38	5.24	0.55	0.24	4.01	0.30	0.13	3.17	0.16	0.07	**2200**
2300										6.61	0.97	0.42	5.48	0.60	0.26	4.20	0.32	0.14	3.31	0.18	0.08	**2300**
2400										6.89	1.04	0.45	5.72	0.65	0.28	4.38	0.35	0.15	3.46	0.18	0.08	**2400**
2500										7.18	1.11	0.48	5.95	0.72	0.31	4.56	0.37	0.16	3.60	0.21	0.09	**2500**
2600										7.47	1.20	0.52	6.19	0.76	0.33	4.74	0.39	0.17	3.75	0.23	0.10	**2600**
2700										7.76	1.29	0.56	6.43	0.81	0.35	4.92	0.44	0.19	3.89	0.23	0.10	**2700**
2800										8.04	1.38	0.60	6.67	0.88	0.38	5.11	0.46	0.20	4.04	0.25	0.11	**2800**
2900										8.33	1.48	0.64	6.91	0.92	0.40	5.29	0.48	0.21	4.18	0.28	0.12	**2900**
3000										8.62	1.57	0.68	7.15	0.99	0.43	5.47	0.51	0.22	4.32	0.30	0.13	**3000**
3100										8.90	1.66	0.72	7.38	1.06	0.46	5.65	0.55	0.24	4.47	0.30	0.13	**3100**
3200										9.19	1.78	0.77	7.62	1.13	0.49	5.84	0.58	0.25	4.61	0.32	0.14	**3200**
3300													7.86	1.18	0.51	6.02	0.62	0.27	4.76	0.35	0.15	**3300**
3400													8.10	1.25	0.54	6.20	0.65	0.28	4.90	0.37	0.16	**3400**
3500													8.34	1.31	0.57	6.38	0.69	0.30	5.04	0.39	0.17	**3500**
3600													8.57	1.38	0.60	6.57	0.74	0.32	5.19	0.42	0.18	**3600**
3700													8.81	1.45	0.63	6.75	0.76	0.33	5.33	0.44	0.19	**3700**
3800																6.93	0.81	0.35	5.48	0.46	0.20	**3800**
3900																7.11	0.85	0.37	5.62	0.48	0.21	**3900**
4000																7.30	0.88	0.38	5.76	0.51	0.22	**4000**
4100																7.48	0.92	0.40	5.91	0.53	0.23	**4100**
4200																7.66	0.97	0.42	6.05	0.55	0.24	**4200**
4300																			6.20	0.58	0.25	**4300**
4400																			6.34	0.60	0.26	**4400**
4500																			6.49	0.62	0.27	**4500**
4600																			6.63	0.65	0.28	**4600**
4700																			6.77	0.67	0.29	**4700**

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

FLOW VELOCITY & FRICTION LOSS

SDR 41										
Flow Rate (Gallons per Minute)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Velocity (ft/sec.)	Friction Loss (Ft. Water/ 100ft)	Friction Loss (psi/ 100ft)	Flow Rate (Gallons per Minute)
GPM	18"									GPM
750	1.05	0.02	0.01							750
1000	1.40	0.04	0.02	20"						1000
1250	1.75	0.05	0.02	1.42	0.03	0.01	24"			1250
1500	2.10	0.08	0.03	1.70	0.05	0.02	1.18	0.02	0.01	1500
2000	2.81	0.13	0.06	2.27	0.08	0.03	1.58	0.03	0.01	2000
2500	3.51	0.20	0.08	2.84	0.12	0.05	1.97	0.05	0.02	2500
3000	4.21	0.27	0.12	3.41	0.16	0.07	2.37	0.07	0.03	3000
3500	4.91	0.36	0.16	3.98	0.22	0.09	2.76	0.09	0.04	3500
4000	5.61	0.47	0.20	4.55	0.28	0.12	3.16	0.12	0.05	4000
4500	6.31	0.58	0.25	5.11	0.35	0.15	3.55	0.14	0.06	4500
5000				5.68	0.42	0.18	3.95	0.17	0.08	5000
5500				6.25	0.50	0.22	4.34	0.21	0.09	5500
6000				6.82	0.59	0.26	4.73	0.24	0.11	6000
7000							5.52	0.32	0.14	7000
7500							5.92	0.37	0.16	7500
8000							6.31	0.42	0.18	8000
8500							6.71	0.47	0.20	8500

NOTE: Spears® recommends that Flow Velocities be maintained at or below 5 feet per second in large diameter piping systems (i.e. 6" diameter and larger) to minimize the potential for hydraulic shock. Refer to Spears® engineering section entitled "Hydraulic Shock" for additional information. Friction loss data based on utilizing mean wall dimensions to determine average ID; actual ID may vary.

Suitable for Oil-Free air handling to 25 psi, not for distribution of compressed air or gas
Spears® Manufacturing Company
Effective 02/01/2020 See MSRP-1 Sheet or Check Spears® On-line Catalog @ www.spearsmfg.com for Pricing

Hydraulic Shock

Hydraulic shock is the rapid increase in pressure due to a shock wave produced by a sudden change in system fluid velocity. If uncontrolled or insufficient pressure rated piping is used, these pressure surges can easily burst pipe and break valves or fittings. The term "water hammer" commonly used is derived from the sounds produced, but it is the hydraulic shock vibrations that can be damaging to piping systems. This is typically the result of sudden starting or stopping of a flowing column of liquid, such as water. Energy from the momentum of water in motion is converted to pressure when the flow is abruptly halted. A shock wave is produced that travels through the piping until it is stopped and bounces back to the original obstruction. This instantaneous shock to the system can lead to excessively high pressures. Hydraulic shock is frequently produced by rapid valve opening and closing, pumps starting and stopping, or even from a high speed wall of water hitting a change of direction fitting, such as an elbow. The effect is greater as piping systems is longer, the velocity change is greater and closing time is shorter.

Evaluating Hydraulic Shock Pressure Surges

An indication of the maximum surge pressure relative to velocity changes is essential in estimating the pressure rating requirements in designing a piping system. The following chart gives the maximum surge pressure at velocities of 1, 5 and 10 feet per second for different sizes of pipe, based on instantaneous valve closure in a PVC system. While listed, 10 feet per second is not recommended and is shown for comparative purposes. Velocity is best held to a maximum of 5 feet per second in plastic systems.

Schedule 40 Pipe Pressure Surge (psi) at Different Velocities

Size ⇨	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12
1 ft/sec	27.3	24.6	23.8	21.6	20.5	18.8	19.7	18.4	16.9	15.1	14.2	13.5	13.0
5 ft/Sec	136.3	123.2	119.1	108.1	102.6	94.2	98.5	91.8	84.5	75.4	70.8	67.4	65.2
10 ft/sec	272.7	246.3	238.2	216.3	205.1	188.3	196.9	183.5	169.0	150.9	141.6	134.8	130.5

Schedule 80 Pipe Pressure Surge (psi) at Different Velocities

Size ⇨	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3	4	6	8	10	12
1 ft/sec	32.2	29.2	28.0	25.5	24.3	22.6	23.2	21.8	20.3	18.9	17.8	17.3	17.1
5 ft/Sec	161	145.8	139.9	127.7	121.7	113.1	115.8	109.1	101.6	94.4	88.8	86.6	85.5
10 ft/sec	322	291.7	279.9	255.4	243.4	226.2	231.7	218.1	203.1	188.9	177.6	173.1	171.0

SDR Pipe Pressure Surge (psi) at Different Velocities

SDR ⇨	13.5	14	17	18	21	25	26	32.5	41
1 ft/sec	20.2	19.8	17.9	17.4	16.0	14.7	14.4	12.8	11.4
5 ft/Sec	101.0	99.1	89.5	86.9	80.2	---	71.9	64.1	57.0
10 ft/sec	201.9	198.1	179.0	173.8	160.4	146.7	143.7	128.2	113.9

Controlling Hydraulic Shock in System Design & Operation

Since hydraulic shock is a function of speed, mass and time, there are several ways to prevent, minimize or eliminate system damage by limiting or controlling the magnitude of pressure surges.

• **Limit Fluid Velocity -** One of the safest surge control techniques in plastic systems is to limit fluid velocities to a maximum of 5 ft./second. Attempt to balance system operation flow demands and the magnitude of velocity variations.

• **Control Valve Closing Time -** Avoid rapid opening and closing. Pneumatic or electric actuation may be considered for greater control. Use of multi-turn or gear operated valves may also be beneficial in slowing valve opening and closing. When all valves and controls are properly sized and adjusted, surges generated by changes in pump flows and demands can be reduced to non-harmful levels.

• **Control Pump Operation -** Operate the system to maintain uniform pump flow rates. Use slow starting pumps where long runs and larger diameters are downstream. Where possible, partially close discharge valves to minimize volume when starting pumps, until lines are completely filled. Air chambers or surge relief tanks in conjunction with pressure regulating and surge relief valves can be used at pumping stations.

• **Check Valves -** Installing a check valve in pump discharge lines will aid in keeping the line full. Be careful in selecting check valves. Check valves operate on flow reversal and can be rapid closing. Spring or lever assisted swing check valves can reduce hydraulic shock by avoiding "slamming" the valve closed.