FRICTION HEAD LOSS
SCHEDULE 40 IPS
PVC PRESSURE PIPE OR FLEXIBLE PE PIPE

FRICTION HEAD LOSS IN FEET OF WATER PER 100 FT. OF PIPE

SIZE	1/2" PIPE 0.622" INSIDE DIA.		3/4" PIPE 0.824" INSIDE DIA.		1" PIPE 1.049" INSIDE DIA.		1 1/4" PIPE 1.380" INSIDE DIA.		1 1/2" PIPE 1.610" INSIDE DIA.		2" PIPE 2.067" INSIDE DIA.		2 1/2" PIPE 2.469" INSIDE DIA.		3" PIPE 3.068" INSIDE DIA.		SIZE
GALLONS PER MINUTE	VELOCITY FEET PER SECOND	HEAD LOSS FEET	VELOCITY FEET PER SECOND	HEAD LOSS FEET	VELOCITY FEET PER SECOND	HEAD LOSS FEET	VELOCITY FEET PER SECOND	HEAD LOSS FEET	VELOCITY FEET PER SECOND	HEAD LOSS FEET	VELOCITY FEET PER SECOND	HEAD LOSS FEET	VELOCITY FEET PER SECOND	HEAD LOSS FEET	VELOCITY FEET PER SECOND	HEAD LOSS FEET	GALLONS PER MINUTE
1	1.056	0.991	0.602	0.252	0.371	0.078											1
2	2.112	3.576	1.203	0.910	0.743	0.281	0.429	0.074									2
3	3.168	7.577	1.805	1.929	1.114	0.596	0.644	0.157	0.473	0.074							3
4	4.224	12.909	2.407	3.286	1.485	1.015	0.858	0.267	0.630	0.126							4
5	5.279	19.515	3.008	4.967	1.856	1.535	1.073	0.404	0.788	0.191							5
6	6.335	27.354	3.610	6.962	2.227	2.151	1.287	0.566	0.946	0.268	0.574	0.079					6
8	8.447	46.602	4.813	11.862	2.970	3.664	1.716	0.965	1.261	0.456	0.765	0.135	0.536	0.057			8
10	10.559	70.450	6.016	17.932	3.712	5.540	2.145	1.459	1.576	0.689	0.956	0.204	0.670	0.086			10
15	4" PIPE		9.025	37.997	5.568	11.738	3.218	3.091	2.364	1.460	1.434	0.433	1.005	0.182	0.651	0.063	15
20	4.026" INSIDE DIA.				7.425	19.998	4.290	5.266	3.152	2.488	1.912	0.738	1.340	0.311	0.868	0.108	20
25	VELOCITY FEET PER SECOND	HEAD LOSS FEET			9.281	30.232	5.363	7.961	3.940	3.761	2.390	1.115	1.675	0.470	1.085	0.163	25
30					11.137	42.375	6.435	11.159	4.728	5.271	2.868	1.563	2.010	0.658	1.302	0.229	30
35	0.882	0.081					7.508	14.846	5.516	7.013	3.346	2.079	2.345	0.876	1.519	0.304	35
40	1.008	0.104					8.580	19.011	6.304	8.980	3.825	2.663	2.681	1.121	1.736	0.390	40
45	1.134	0.129					9.653	23.645	7.092	11.169	4.303	3.312	3.016	1.395	1.953	0.485	45
50	1.260	0.157					10.725	28.740	7.880	13.575	4.781	4.025	3.351	1.695	2.170	0.589	50
60	1.512	0.220	6" PIPE						9.456	19.028	5.737	5.642	4.021	2.376	2.604	0.826	60
70	1.764	0.293	6.065" INSIDE DIA.						11.032	25.315	6.693	7.506	4.691	3.161	3.038	1.099	70
80	2.016	0.375	VELOCITY FEET PER SECOND	HEAD LOSS FEET							7.649	9.612	5.361	4.048	3.472	1.407	80
90	2.268	0.467									8.605	11.955	6.031	5.035	3.906	1.750	90
100	2.520	0.567	1.111	0.077							9.561	14.531	6.701	6.120	4.340	2.127	100
125	3.150	0.857	1.388	0.117							11.952	21.966	8.376	9.252	5.425	3.216	125
150	3.780	1.201	1.666	0.164									10.052	12.968	6.510	4.507	150
175	4.410	1.598	1.943	0.218											7.595	5.996	175
200	5.041	2.047	2.221	0.279											8.680	7.679	200
225	5.671	2.546	2.499	0.347											9.765	9.550	225
250	6.301	3.094	2.776	0.421											10.850	11.608	250
275	6.931	3.692	3.054	0.503													275
300	7.561	4.337	3.332	0.591													300
325	8.191	5.030	3.609	0.685													325
350	8.821	5.770	3.887	0.786													350
375	9.451	6.556	4.165	0.893													375
400	10.081	7.389	4.442	1.006													400
425			4.720	1.126													425
450			4.997	1.252													450
475			5.275	1.383													475
500			5.553	1.521													500
550			6.108	1.815													550
600			6.663	2.132													600
650			7.218	2.473													650
700			7.774	2.837													700
750			8.329	3.223													750
800			8.884	3.633													800

RECOMMENDED OPERATING CONDITIONS SHOWN ABOVE HEAVY LINES IN CHART

WATER HAMMER (shock waves) in pipe systems can result from sudden changes in flow, such as pumps starting and stopping, automatic control valves opening and closing, exhausting air from the system, or other flow restricting action. When a sudden change in flow occurs, the velocity energy of the flowing water is suddenly changed to pressure at that location. This excess pressure is called SURGE PRESSURE and is greater with larger changes in velocity. To help minimize SURGE PRESSURES, the maximum velocity of the water in the pipe line should be limited.

USE CAUTION IF VELOCITIES EXCEED 5 FEET PER SECOND, ESPECIALLY SUCTION VELOCITIES.

VELOCITIES SHOULD NOT EXCEED 8 FEET PER SECOND IN COLD WATER SYSTEMS.

Velocity calculated using the formula...

$$V = \frac{0.4085 \times Q}{D^2}$$

V = flow velocity in feet per second
Q = flow rate in gallons per minute
D = inside diameter of pipe in inches

Head loss calculated using Hazen-Williams formula with C=150...

$$F = \frac{0.2083\,(100/C)^{1.852} \times Q^{1.852}}{D^{4.8655}}$$

F = friction head loss in feet of water per 100 feet of pipe
C = coefficient for roughness of the interior pipe surface
Q = flow rate in gallons per minute
D = inside diameter of pipe in inches

AVERAGE FRICTION LOSS FOR PIPE FITTINGS IN EQUIVALENT FEET OF STRAIGHT RUN PIPE

ITEM	PIPE SIZE									
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"	6"
TEE (THRU FLOW)	1.0	1.4	1.7	2.3	2.7	4.0	4.9	6.1	7.9	12.3
TEE (BRANCH FLOW)	3.8	4.9	6.0	7.3	8.4	12.0	14.7	16.4	22.0	32.7
90° ELL	1.5	2.0	2.5	3.8	4.0	5.7	6.9	7.9	11.4	16.7
45° ELL	0.8	1.1	1.4	1.8	2.1	2.6	3.1	4.0	5.1	8.0