

of pump used and the economics of small pipe size and high pump head versus large pipe and low pump head. Noise is also an important factor. Velocities are usually limited to a maximum of 4 fps for pipe sizes less than 2-in. to reduce the possibility of noise. Velocities up to 10 fps are frequently used in piping larger than 6-in. Average friction drops of 1.0 to 4.0 ft of water per 100 ft of pipe (120 to 480 milinches per ft of pipe) are commonly used in sizing piping systems. The actual friction loss for a particular section of pipe may vary considerably from the average loss for the

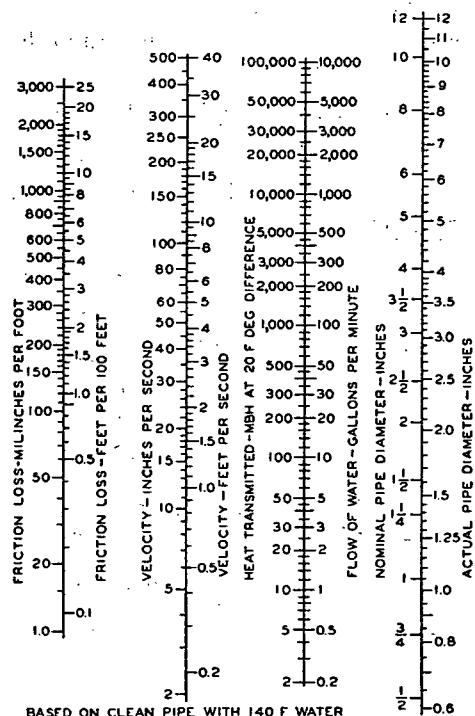


FIG. 3. FRICTION LOSS DUE TO FLOW OF WATER IN IRON PIPE².
(Based on clean pipe and 140°F water)

system due to the limitations of commercial pipe sizes. For example, if the average friction loss is 2.0 ft of water per 100 ft of pipe (240 milinches per ft), the actual friction loss in particular sections of pipe may vary from 1.0 to 3.0 ft per 100 ft (120 to 360 milinches per ft).

One method of sizing pipe is based on preliminary selection of a pump. The head which the pump can produce is divided by the equivalent length of the longest circuit to obtain an average design friction loss.

The equivalent length of a system or circuit is the length of pipe in series flow in the circuit, plus the length of pipe equivalent in resistance to the fittings and also the equipment in series flow in the circuit. For preliminary calculation the equivalent length is sometimes assumed to be 1.5 times the measured length.

TABLE I. CARRYING CAPACITY OF STANDARD BLACK PIPES WITH TEMPERATURE DROP OF 20°F DEG*

AVAILABLE HEAD-Feet													PIPE SIZE—NOMINAL INCHES																									
EQUIVALENT LENGTH OF SYSTEM, FEET													FRICTION LOSS																									
30	25	22	20	18	16	15	14	13	12	11	10	9	8	7	6	Ft/100	Mi/Ft																					
5000	4000	3500	3000	2600	2400	2200	2000	1800	1600	1400	1200	1000	800	600	500	1/2	60	GPM	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12						
6000	4400	3800	3200	2800	2600	2400	2200	2000	1800	1600	1400	1200	1000	800	600	180	60	GPM	0.57	1.3	2.3	4.8	7.1	14	24	42	64	88	165	270	570	1050	1800	50				
5000	3800	3300	2800	2400	2200	2000	1800	1600	1400	1200	1000	800	600	500	400	120	90	GPM	0.6	0.8	0.9	1.3	2.1	4.1	6.2	9.4	14	20	31	47	73	130	240	400	600			
4000	3200	2800	2400	2000	1800	1600	1400	1200	1000	800	600	500	400	300	200	90	60	GPM	0.72	1.6	1.9	3.1	5.2	9.1	16	28	44	67	100	160	270	500	900	1500	2500			
3000	2500	2200	2000	1800	1600	1500	1400	1300	1200	1100	1000	900	800	700	600	500	1	120	GPM	0.75	0.9	1.1	1.3	1.6	2.0	2.3	2.6	3.0	3.3	3.8	4.7	5.6	6.3	7.5	8.8	10.0		
2000	1600	1400	1200	1100	1000	900	800	700	600	500	400	300	200	100	50	150	150	GPM	0.9	1.1	1.3	1.5	1.8	2.2	2.6	3.0	3.4	3.8	4.4	5.5	6.3	7.5	8.8	10.0	11.5	13.0		
1500	1200	1000	800	700	600	500	400	300	200	100	50	20	10	5	2	180	180	GPM	1.0	1.3	1.4	1.6	1.9	2.3	2.7	3.1	3.5	4.0	4.6	5.2	6.2	7.3	8.5	9.8	11.0	12.5		
1000	800	700	600	500	400	300	200	100	50	20	10	5	2	1	0.5	240	240	GPM	1.1	1.5	1.6	1.8	2.1	2.5	2.9	3.3	3.7	4.2	4.8	5.5	6.3	7.3	8.4	9.6	10.8	12.0		
500	400	350	300	260	240	220	200	180	160	140	120	100	80	60	40	360	360	GPM	1.2	1.6	1.7	1.9	2.2	2.6	3.0	3.4	3.8	4.3	4.9	5.6	6.4	7.4	8.5	9.7	11.0	12.5	14.0	
250	200	175	150	125	110	100	90	80	70	60	50	40	30	20	10	480	480	GPM	1.3	1.8	1.9	2.1	2.4	2.8	3.2	3.6	4.0	4.5	5.1	5.8	6.6	7.6	8.7	9.9	11.2	12.5	14.0	
125	100	88	76	64	56	50	45	40	35	30	25	20	15	10	5	600	600	GPM	1.4	2.0	2.1	2.3	2.6	3.0	3.4	3.8	4.2	4.7	5.3	6.0	6.9	7.9	9.0	10.2	11.5	13.0	14.5	
62.5	50	44	38	32	28	25	22	20	18	16	14	12	10	8	6	720	720	GPM	1.5	2.1	2.2	2.4	2.8	3.2	3.6	4.0	4.4	4.9	5.5	6.2	7.1	8.1	9.2	10.4	11.7	13.0	14.5	
31.25	25	22	19	16	14	12	11	10	9	8	7	6	5	4	3	900	900	GPM	1.6	2.3	2.4	2.6	3.0	3.4	3.8	4.2	4.6	5.1	5.7	6.4	7.3	8.3	9.4	10.6	11.9	13.2	14.5	16.0
15.625	12.5	11	9.5	8	7	6	5	4	3	2	1	0.5	0.2	0.1	0.05	1080	1080	GPM	1.7	2.5	2.6	2.8	3.2	3.6	4.0	4.4	4.8	5.3	5.9	6.6	7.5	8.5	9.6	10.8	12.1	13.4	14.5	16.0
7.8125	6.25	5.5	4.75	4	3.5	3	2.5	2	1.5	1	0.5	0.2	0.1	0.05	0.02	1440	1440	GPM	1.8	2.7	2.8	3.0	3.4	3.8	4.2	4.6	5.0	5.5	6.1	6.8	7.7	8.7	9.8	11.0	12.3	13.6	14.5	16.0
3.90625	3.125	2.75	2.375	2	1.75	1.5	1.25	1	0.75	0.5	0.25	0.125	0.0625	0.03125	0.015625	1800	1800	GPM	1.9	2.9	3.0	3.2	3.6	4.0	4.4	4.8	5.2	5.6	6.2	7.0	7.9	9.0	10.2	11.4	12.7	13.6	14.5	16.0
1.953125	1.5625	1.375	1.1875	1	0.875	0.75	0.625	0.5	0.375	0.25	0.125	0.0625	0.03125	0.015625	0.0078125	2160	2160	GPM	2.0	3.1	3.2	3.4	3.8	4.2	4.6	5.0	5.4	5.8	6.4	7.2	8.1	9.2	10.4	11.6	12.9	13.6	14.5	16.0
0.9765625	0.78125	0.6875	0.59375	0.5	0.4375	0.375	0.3125	0.25	0.1875	0.125	0.0625	0.03125	0.015625	0.0078125	0.00390625	2520	2520	GPM	2.1	3.3	3.4	3.6	4.0	4.4	4.8	5.2	5.6	6.0	6.6	7.4	8.3	9.4	10.6	11.8	13.1	13.6	14.5	16.0
0.48828125	0.390625	0.34375	0.296875	0.25	0.21875	0.1875	0.15625	0.125	0.09375	0.0625	0.03125	0.015625	0.0078125	0.00390625	0.001953125	3000	3000	GPM	2.2	3.5	3.6	3.8	4.2	4.6	5.0	5.4	5.8	6.2	6.8	7.6	8.6	9.7	10.9	12.1	13.4	13.6	14.5	16.0
0.244140625	0.1953125	0.171875	0.1484375	0.125	0.109375	0.09375	0.078125	0.0625	0.046875	0.03125	0.015625	0.0078125	0.00390625	0.001953125	0.0009765625	3600	3600	GPM	2.3	3.7	3.8	4.0	4.4	4.8	5.2	5.6	6.0	6.4	7.0	7.8	8.8	9.9	11.1	12.3	13.6	13.6	14.5	16.0
0.1220703125	0.09765625	0.0859375	0.07421875	0.0625	0.0546875	0.046875	0.0390625	0.03125	0.0234375	0.015625	0.0078125	0.00390625	0.001953125	0.0009765625	0.00048828125	4320	4320	GPM	2.4	4.0	4.1	4.2	4.6	5.0	5.4	5.8	6.2	6.6	7.2	8.0	9.0	10.1	11.3	12.5	13.6	13.6	14.5	16.0
0.06103515625	0.048828125	0.04296875	0.037109375	0.03125	0.02734375	0.0234375	0.01953125	0.015625	0.01171875	0.0078125	0.00390625	0.001953125	0.0009765625	0.00048828125	0.000244140625	5184	5184	GPM	2.5	4.2	4.3	4.4	4.8	5.2	5.6	6.0	6.4	6.8	7.4	8.2	9.2	10.3	11.5	12.7	13.6	13.6	14.5	16.0
0.030517578125	0.0244140625	0.021484375	0.018546875	0.015625	0.013671875	0.01171875	0.009765625	0.0078125	0.005890625	0.00390625	0.001953125	0.0009765625	0.00048828125	0.000244140625	0.0001220703125	6240	6240	GPM	2.6	4.4	4.5	4.6	5.0	5.4	5.8	6.2	6.6	7.0	7.6	8.4	9.4	10.5	11.7	12.9	13.6	13.6	14.5	16.0
0.0152587890625	0.01220703125	0.0107421875	0.0092734375	0.0078125	0.0068359375	0.005890625	0.0049453125	0.00390625	0.00296875	0.001953125	0.0009765625	0.00048828125	0.000244140625	0.0001220703125	6.1e-05	7500	7500	GPM	2.7	4.6	4.7	4.8	5.2	5.6	6.0	6.4	6.8	7.2	7.8	8.6	9.6	10.7	11.9	13.1	13.6	13.6	14.5	16.0
7.63e-05	0.006103515625	0.0053734375	0.0046453125	0.00390625	0.0034375	0.00296875	0.0025	0.00203125	0.0015625	0.001171875	0.00078125	0.000390625	0.0001953125	9.8e-05	9000	9000	GPM	2.8	4.8	4.9	5.0	5.4	5.8	6.2	6.6	7.0	7.4	8.0	8.8	9.8	10.9	12.1	13.3	13.6	13.6	14.5	16.0	
3.81e-05	0.0030517578125	0.0026871875	0.00232265625	0.001953125	0.00171875	0.001484375	0.00125	0.001015625	0.000859375	0.000703125	0.000546875	0.000390625	0.0001953125	4.9e-05	10800	10800	GPM	2.9	5.0	5.1	5.2	5.6	6.0	6.4	6.8	7.2	7.6	8.2	9.0	10.0	11.1	12.3	13.5	13.6	13.6	14.5	16.0	
1.90e-05	0.00152587890625	0.00134375	0.001171875	0.001	0.000859375	0.000703125	0.0005890625	0.00049453125	0.000409375	0.00031453125	0.00021953125	0.00011953125	6e-05	13200	13200	GPM	3.0	5.2	5.3	5.4	5.8	6.2	6.6	7.0	7.4	7.8	8.4	9.2	10.2	11.3	12.5	13.7	13.6	13.6	14.5	16.0		
9.5e-06	0.000762939453125	0.000671875	0.0005890625	0.0005	0.0004296875	0.0003546875	0.000296875	0.0002390625	0.0001953125	0.00015625	0.0001171875	6.1e-05	15840	15840	GPM	3.1	5.4	5.5	5.6	6.0	6.4	6.8	7.2	7.6	8.0	8.4	8.8	9.4	10.3	11.4	12.6	13.8	13.6	13.6	14.5	16.0		
4.76e-06	0.0003814697265625	0.0003359375	0.00029453125	0.00025	0.00021484375	0.0001796875	0.0001484375	0.0001171875	9.3e-05	7.4e-05	5.9e-05	4.7e-05	3.8e-05	3e-05	2.4e-05	19200	19200	GPM	3.2	5.6	5.7	5.8	6.2	6.6	7.0	7.4	7.8	8.2	8.8	9.6	10.6	11.7	12.9	14.0	13.6	13.6	14.5	16.0
2.38e-06	0.00019073486328125	0.00016796875	0.000147265625	0.000125	0.000107421875	8.98e-05	7.42e-05	6.19e-05	5.09e-05	4.17e-05	3.35e-05	2.68e-05	2.15e-05	1.71e-05	1.36e-05	23040	23040	GPM	3.3	5.8	5.9	6.0	6.4	6.8	7.2	7.6	8.0	8.4	9.0	9.8	10.8	11.9	13.0	14.1	13.6	13.6	14.5	16.0
1.19e-06	0.000095367431640625	0.000083984375	0.0000736328125	0.0000625	0.0000537109375	0.00004490625	0.000037109375	0.000030546875	0.000025	0.0000203125	0.0000162890625	0.0000129390625	0.0000103515625	8.2e-06	5.6e-06	27600	27600	GPM	3.4	6.0	6.1	6.2	6.6	7.0	7.4	7.8	8.2	8.6	9.2	10.0	11.0	12.1	13.2	14.3	13.6	13.6	14.5	16.0
5.95e-07	0.0000476837158203125	0.0000419921875	0.00003681640625	0.00003125	0.0000268546875	0.000022453125	0.000018546875	0.000015234375	0.00001234375	0.00001	0.0000078125	0.0000061953125	0.0000049453125	3.9e-06	3.1e-06	33600	33600	GPM	3.5	6.2	6.3	6.4	6.8	7.2	7.6	8.0	8.4	8.8	9.4	10.2	11.2	12.3	13.4	14.5	13.6	13.6	14.5	16.0
2.97e-07	0.00002384185791015625	0.00002099609375	0.000018408203125	0.000015625	0.00001342734375	0.0000112265625	9.27e-06	7.59e-06	6.19e-06	5.09e-06	4.17e-06	3.35e-06	2.68e-06	2.15e-06	1.71e-06	40320	40320	GPM	3.6	6.4	6.5	6.6	7.0	7.4	7.8	8.2	8.6	9.0	9.6	10.4	11.4	12.5	13.6	14.5	13.6	13.6	14.5	16.0
1.48e-07	0.0000119209289																																					

* May be Used for Preliminary Sizing of Type L Copper Tube.