

particular section of pipe may vary considerably from the average loss for the 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).

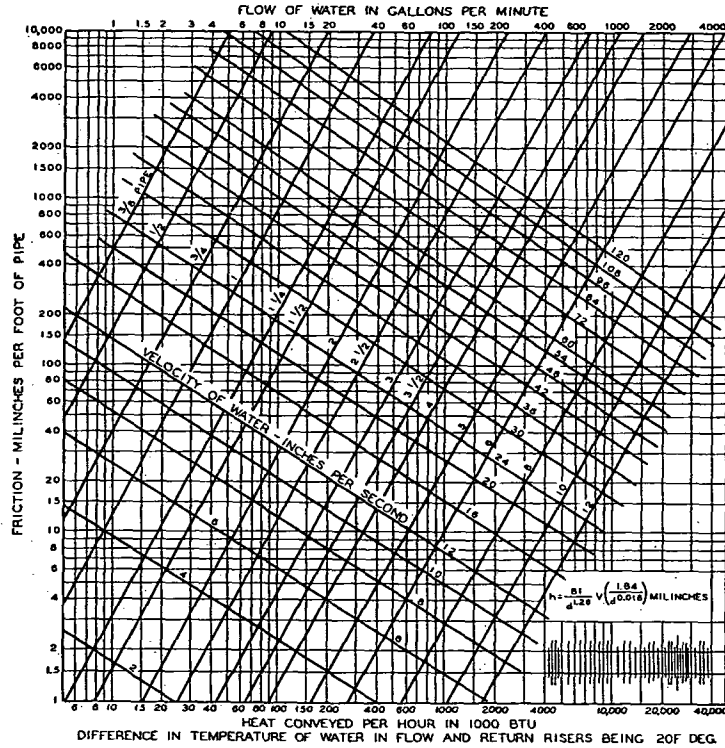
One method of sizing pipe is based on preliminary selection of a pump. The head which the pump can produce is divided by the equivalent length of the longest circuit to obtain an average design friction loss.

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 1 can be used for pipe sizing by this method. It provides the designer with a means for quickly assessing the relative effects, economic and otherwise, of various pumps on the system in terms of pipe size.

After sizing the piping on the basis of a preliminary design friction loss the actual friction loss at design rate of flow



Lower scale of chart is based on 20-deg temperature difference between flow and return risers. To find friction when temperature drop is other than 20 deg, multiply the actual heat conveyed by (20 ÷ actual temp. drop) and read the corresponding friction.

Ft per 100 ft	0.5	1	2	3	4	5
Milinches per ft	60	120	240	360	480	600

Fig. 5.... Friction Loss due to Flow of Water in Iron Pipe

Hot Water Heating Systems

Table 1.... 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															Flow																															
30	25	22	20	18	16	15	14	13	12	11	10	9	8	7	6	5	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	8	10	12															
Friction Loss															Friction Loss																															
ft/100 ft															ft/100 ft																															
															GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM	GPM		
															0.57	0.68	0.79	0.90	1.01	1.12	1.23	1.34	1.45	1.56	1.67	1.78	1.89	1.99	2.10	2.21	2.32	2.43	2.54	2.65	2.76	2.87	2.98	3.09	3.20	3.31	3.42	3.53	3.64	3.75	3.86	3.97
															0.68	0.80	0.92	1.04	1.16	1.28	1.40	1.52	1.64	1.76	1.88	1.99	2.11	2.23	2.35	2.47	2.59	2.71	2.83	2.95	3.07	3.19	3.31	3.43	3.55	3.67	3.79	3.91	4.03	4.15	4.27	4.39
															0.79	0.92	1.05	1.18	1.31	1.44	1.57	1.69	1.82	1.95	2.08	2.21	2.34	2.47	2.59	2.72	2.85	2.98	3.11	3.24	3.37	3.50	3.63	3.76	3.89	4.02	4.15	4.28	4.41	4.54	4.67	4.80
															0.90	1.04	1.18	1.32	1.46	1.60	1.74	1.88	2.02	2.16	2.30	2.44	2.58	2.72	2.86	2.99	3.13	3.27	3.41	3.55	3.69	3.83	3.97	4.11	4.25	4.39	4.53	4.67	4.81	4.95	5.09	5.23
															1.01	1.16	1.31	1.46	1.61	1.76	1.91	2.06	2.21	2.36	2.51	2.66	2.81	2.96	3.11	3.26	3.41	3.56	3.71	3.86	4.01	4.16	4.31	4.46	4.61	4.76	4.91	5.06	5.21	5.36	5.51	5.66
															1.12	1.28	1.44	1.60	1.76	1.92	2.08	2.24	2.40	2.56	2.72	2.88	3.04	3.20	3.36	3.52	3.68	3.84	4.00	4.16	4.32	4.48	4.64	4.80	4.96	5.12	5.28	5.44	5.60	5.76	5.92	6.08
															1.23	1.40	1.57	1.74	1.91	2.08	2.25	2.42	2.59	2.76	2.93	3.10	3.27	3.44	3.61	3.78	3.95	4.12	4.29	4.46	4.63	4.80	4.97	5.14	5.31	5.48	5.65	5.82	5.99	6.16	6.33	6.50
															1.34	1.52	1.70	1.88	2.06	2.24	2.42	2.60	2.78	2.96	3.14	3.32	3.50	3.68	3.86	4.04	4.22	4.40	4.58	4.76	4.94	5.12	5.30	5.48	5.66	5.84	6.02	6.20	6.38	6.56	6.74	6.92
															1.45	1.64	1.83	2.02	2.21	2.40	2.59	2.78	2.97	3.16	3.35	3.54	3.73	3.92	4.11	4.30	4.49	4.68	4.87	5.06	5.25	5.44	5.63	5.82	6.01	6.20	6.39	6.58	6.77	6.96	7.15	7.34
															1.56	1.76	1.96	2.16	2.36	2.56	2.76	2.96	3.16	3.36	3.56	3.76	3.96	4.16	4.36	4.56	4.76	4.96	5.16	5.36	5.56	5.76	5.96	6.16	6.36	6.56	6.76	6.96	7.16	7.36	7.56	7.76
															1.67	1.88	2.09	2.30	2.51	2.72	2.93	3.14	3.35	3.56	3.77	3.98	4.19	4.40	4.61	4.82	5.03	5.24	5.45	5.66	5.87	6.08	6.29	6.50	6.71	6.92	7.13	7.34	7.55	7.76	7.97	
															1.78	2.00	2.22	2.44	2.66	2.88	3.10	3.32	3.54	3.76	3.98	4.20	4.42	4.64	4.86	5.08	5.30	5.52	5.74	5.96	6.18	6.40	6.62	6.84	7.06	7.28	7.50	7.72	7.94	8.16	8.38	
															1.89	2.12	2.35	2.58	2.81	3.04	3.27	3.50	3.73	3.96	4.19	4.42	4.65	4.88	5.11	5.34	5.57	5.80	6.03	6.26	6.49	6.72	6.95	7.18	7.41	7.64	7.87	8.10	8.33	8.56	8.79	
															2.00	2.24	2.48	2.72	2.96	3.20	3.44	3.68	3.92	4.16	4.40	4.64	4.88	5.12	5.36	5.60	5.84	6.08	6.32	6.56	6.80	7.04	7.28	7.52	7.76	8.00	8.24	8.48	8.72	8.96	9.20	
															2.11	2.36	2.61	2.86	3.11	3.36	3.61	3.86	4.11	4.36	4.61	4.86	5.11	5.36	5.61	5.86	6.11	6.36	6.61	6.86	7.11	7.36	7.61	7.86	8.11	8.36	8.61	8.86	9.11	9.36	9.61	
															2.22	2.48	2.74	3.00	3.26	3.52	3.78	4.04	4.30	4.56	4.82	5.08	5.34	5.60	5.86	6.12	6.38	6.64	6.90	7.16	7.42	7.68	7.94	8.20	8.46	8.72	8.98	9.24	9.50	9.76	10.02	
															2.33	2.60	2.87	3.14	3.41	3.68	3.95	4.22	4.49	4.76	5.03	5.30	5.57	5.84	6.11	6.38	6.65	6.92	7.19	7.46	7.73	8.00	8.27	8.54	8.81	9.08	9.35	9.62	9.89	10.16	10.43	
															2.44	2.72	3.00	3.28	3.56	3.84	4.12	4.40	4.68	4.96	5.24	5.52	5.80	6.08	6.36	6.64	6.92	7.20	7.48	7.76	8.04	8.32	8.60	8.88	9.16	9.44	9.72	10.00	10.28	10.56	10.84	
															2.55	2.84	3.13	3.42	3.71	4.00	4.29	4.58	4.87	5.16	5.45	5.74	6.03	6.32	6.61	6.90	7.19	7.48	7.77	8.06	8.35	8.64	8.93	9.22	9.51	9.80	10.09	10.38	10.67	10.96	11.25	
															2.66	2.96	3.26	3.56	3.86	4.16	4.46	4.76	5.06	5.36	5.66	5.96	6.26	6.56	6.86	7.16	7.46	7.76	8.06	8.36	8.66	8.96	9.26	9.56	9.86	10.16	10.46	10.76	11.06	11.36	11.66	
															2.77	3.08	3.39	3.70	4.01	4.32	4.63	4.94	5.25	5.56	5.87	6.18	6.49	6.80	7.11	7.42	7.73	8.04	8.35	8.66	8.97	9.28	9.59	9.90	10.21	10.52	10.83	11.14	11.45	11.76	12.07	
															2.88	3.20	3.52	3.84	4.16	4.48	4.80	5.12	5.44	5.76	6.08	6.40	6.72	7.04	7.36	7.68	8.00	8.32	8.64	8.96	9.28	9.60	9.92	10.24	10.56	10.88	11.20	11.52	11.84	12.16	12.48	
															2.99	3.32	3.65	3.98	4.31	4.64	4.97	5.30	5.63	5.96	6.29	6.62	6.95	7.28	7.61	7.94	8.27	8.60	8.93	9.26	9.59	9.92	10.25	10.58	10.91	11.24	11.57	11.90	12.23	12.56	12.89	
															3.10	3.44	3.78	4.12	4.46	4.80	5.14	5.48	5.82	6.16	6.50	6.84	7.18	7.52	7.86	8.20	8.54	8.88	9.22	9.56	9.90	10.24	10.58	10.92	11.26	11.60	11.94	12.28	12.62	12.96	13.30	
															3.21	3.56	3.91	4.26	4.61	4.96	5.31	5.66	6.01	6.36	6.71	7.06	7.41	7.76	8.11	8.46	8.81	9.16	9.51	9.86	10.21	10.56	10.91	11.26	11.61	11.96	12.31	12.66	13.01	13.36	13.71	
															3.32	3.68	4.04	4.40	4.76	5.12	5.48	5.84	6.20	6.56	6.92	7.28	7.64	8.00	8.36	8.72	9.08	9.44	9.80	10.16	10.52	10.88	11.24	11.60	11.96	12.32	12.68	13.04	13.40	13.76	14.12	
															3.43	3.80	4.17	4.54	4.91	5.28	5.65	6.02	6.39	6.76	7.13	7.50	7.87	8.24	8.61	8.98	9.35	9.72	10.09	10.46	10.83	11.20	11.57	11.94	12.31	12.68	13.05	13.42	13.79	14.16	14.53	
															3.54	3.92	4.30	4.68	5.06	5.44	5.82	6.20	6.58	6.96	7.34	7.72	8.10	8.48	8.86	9.24	9.62	10.00	10.38	10.76	11.14	11.52	11.90	12.28	12.66	13.04	13.42	13.80	14.18	14.56	14.94	
															3.65	4.04	4.43	4.82	5.21	5.60	5.99	6.38	6.77	7.16	7.55	7.94	8.33	8.72	9.11	9.50	9.89	10.28	10.67	11.06	11.45	11.84	12.23	12.62	13.01	13.40	13.79	14.18	14.57	14.96	15.35	
															3.76	4.16	4.56	4.96	5.36	5.76	6.16	6.56	6.96	7.36	7.76	8.16	8.56	8.96	9.36	9.76	10.16	10.56	10.96	11.36	11.76	12.16	12.56	12.96	13.36	13.76	14.16	14.56	14.96	15.36	15.76	
															3.87	4.28	4.69	5.10	5.51	5.92	6.33	6.74	7.15	7.56	7.97	8.38	8.79	9.20	9.61	10.02	10.43	10.84	11.25	11.66	12.07	12.48	12.89	13.30	13.71	14.12	14.53	14.94	15.35	15.76	16.17	
															3.98	4.40	4.82	5.24	5.66	6.08	6.50	6.92	7.34	7.76	8.18	8.60	9.02	9.44	9.86	10.28	10.70	11.12	11.54	11.96	12.38	12.80	13.22	13.64	14.06	14.48	14.90	15.32	15.74	16.16	16.58	
															4.09	4.52	4.95	5.38	5.81	6.24	6.67	7.10	7.53	7.96	8.39	8.82	9.25	9.68	10.11	10.54	10.97	11.40	11.83	12.26	12.69	13.12	13.55	13.98	14.41	14.84	15.27	15.70	16.13	16.56	16.99	
															4.20	4.64	5.08	5.52	5.96	6.40	6.84	7.28	7.72	8.16	8.60	9.04	9.48	9.92	10.36	10.80	11.24	11.68	12.12	12.56	13.00	13.44	13.88	14.32	14.76	15.20	15.64	16.08	16.52	16.96	17.40	
															4.31	4.76	5.21	5.66	6.11	6.56	7.01	7.46	7.91	8.36	8.81	9.26	9.71	10.16	10.61	11.06	11.51	11.96	12.41	12.86	13.31	13.76	14.21	14.66	15.11	15.56	16.01	16.46	16.91	17.36	17.81	
															4.42	4.88	5.34	5.80	6.26	6.72	7.18	7.64	8.10	8.56	9.02	9.48	9.94	10.40	10.86	11.32	11.78	12.24	12.70	13.16	13.62	14.08	14.54	15.00	15.46	15.92	16.38	16.84	17.30	17.76	18.22	
															4.53	5.00	5.47	5.94	6.41	6.88	7.35	7.82	8.29	8.76	9.23	9.70	10.17	10.64	11.11	11.58	12.05	12.52	12.99	13.46	13.93	14.40	14.87	15.34	15.81	16.28	16.75	17.22	17.69	18.16	18.63	
															4.64	5.12	5.60	6.08	6.56	7.04	7.52	8.00	8.48	8.96	9.44	9.92	10.40	10.88	11.36	11.84	12.32	12.80	13.28	13.76	14.24	14.72	15.20	15.68	16.16	16.64	17.12	17.60	18.08	18.56	19.04	
															4.75	5.24	5.73	6.22	6.71	7.20	7.69	8.18	8.67	9.16	9.65	10.14	10.63	11.12	11.61	12.10	12.59	13.08	13.57	14.06	14.55	15.04	15.53	16.02	16.51	17.00	17.49	17.98	18.47	18.96	19.45	
															4.86	5.36	5.86	6.36	6.86	7.36	7.86	8.36	8.86	9.36	9.86																					