FRICTION SECTION

The size of pipe and pipe fittings for any installation should be large enough to keep friction losses reasonably low. The velocity should be kept within 10 ft./sec. for good practical results. There are, however, many other factors to consider such as the length and cost of pipe vs cost of pump power. The cost factor can be especially important on installations involving long pipe runs and numerous valves and fittings.

PIPE & FITTINGS

All charts are based on friction losses for clean steel pipe on schedule 40 and show average values for new pipe including adjustment of 15% for commercial installation.

To obtain approximate values for other types of pipe use multiplier correction factor of 0.9 for smooth pipe, — for 15 year old pipe use 1.43. At best, these are rough estimates.

FRICTION LOSS FOR WATER IN FEET PER 100 FT. PIPE

Schedule 40

SIZES ½" THRU 1¼" — CLEAN STEEL PIPE

Flow US GPM	Size ½" Velocity Ft./Sec.	Friction Head in Ft.	Size ¾" Vel.	Size ¾" Frict.	Size 1" Vel.	Size 1" Frict.	Size 1¼" Vel.	Size 1¼" Frict.
2	2.43	5.50	—	—	—	—	—	—
3	3.65	11.50	—	—	—	—	—	—
4	4.85	19.67	2.77	4.84	—	—	—	—
5	6.07	29.67	3.46	7.27	—	—	—	—
6	7.29	41.98	4.15	10.20	2.56	3.08	—	—
8	9.72	72.11	5.52	17.25	3.42	5.22	—	—
10	12.14	110.29	6.92	26.45	4.27	7.98	—	—
12	14.61	156.40	8.30	37.99	5.12	11.06	2.96	2.85
14	17.02	210.45	9.68	50.02	5.98	14.72	3.45	3.77
16	19.44	270.35	11.07	64.75	6.83	18.98	3.94	4.83
18	—	—	12.42	80.85	7.68	23.69	4.44	6.00
20	—	—	13.80	99.01	8.53	23.69	4.93	7.29
22	—	—	15.18	119.60	9.40	34.73	5.43	8.72
24	—	—	16.56	140.30	10.25	40.94	5.92	10.26
26	—	—	17.94	164.45	11.10	47.84	6.42	11.93
28	—	—	19.32	188.60	11.95	55.09	6.91	13.69
30	—	—	—	—	12.77	62.79	7.41	15.64
35	—	—	—	—	14.95	89.30	8.64	20.93
40	—	—	—	—	17.02	109.25	9.87	27.02
45	—	—	—	—	19.21	136.85	11.10	33.70
50	—	—	—	—	21.39	167.90	12.31	41.40
55	—	—	—	—	—	—	13.57	49.68
60	—	—	—	—	—	—	13.90	38.65
65	—	—	—	—	—	—	15.99	80.04
70	—	—	—	—	—	—	17.25	79.12
75	—	—	—	—	—	—	18.52	90.51
80	—	—	—	—	—	—	19.78	102.58

FRICTION LOSS IN FEET OF LIQUID PER

SIZES 1½" – 2½"

PIPE SIZE	VELOCITY FT/SEC	U.S. GPM	VISCOSITY S.S.U. 31.5	35	40	50	60	80	100	150	200	300	500
1½"	.94	6	.3	.5	.6	.5	.7	1.0	1.4	2.1	2.9	4.3	7.0
	1.26	8	.7	.8	.9	1.0	.9	1.4	1.8	2.8	3.8	5.6	9.3
	1.57	10	.9	1.2	1.4	1.5	1.2	1.7	2.2	3.5	4.8	7.0	11.7
	1.89	12	1.4	1.6	1.8	2.1	2.3	2.1	2.6	4.1	5.8	8.4	14.0
	2.36	15	2.1	2.4	2.6	3.1	3.3	2.4	3.3	5.2	7.1	10.6	17.5
	3.15	20	3.3	4.0	4.4	5.1	5.5	6.2	4.5	6.9	9.5	14.0	23.3
	3.80	25	5.2	6.0	6.7	7.5	8.1	9.1	9.8	8.6	11.8	17.5	29.2
	4.72	30	7.2	8.3	9.1	10.2	11.2	12.5	13.5	10.4	14.3	21.0	35.0
	6.30	40	12.4	14.0	15.2	17.3	18.4	20.5	22.0	24.8	19.1	28.1	46.7
	7.87	50	18.9	21.0	22.8	25.5	27.3	30.2	32.3	36.5	39.3	35.0	58.3
	9.44	60	26.7	29.8	32.1	35.2	38.0	41.6	44.6				
	11.02	70	35.9	39.4	42.4	46.2	50.1	54.9	58.4				
	12.59	80	46.3	50.6	54.1	59.3	63.4	69.2	73.9				
	14.71	90	58.5	63.3	67.3	72.9	78.3	85.8	91.1				
	15.74	100	71.5	77.1	82.1	89.0	94.3	103.3	109.1				
2"	2.55	25	1.5	1.8	2.0	2.3	2.5	2.8	2.1	3.2	4.3	6.4	10.8
	3.06	30	2.1	2.5	2.8	3.1	3.5	3.8	4.1	3.8	5.2	7.7	12.9
	3.57	35	2.8	3.2	3.6	4.1	4.5	5.1	5.4	4.5	6.0	9.1	15.1
	4.08	40	3.6	4.1	4.6	5.2	5.6	6.2	7.0	5.1	6.9	10.4	17.3
	5.11	50	5.4	6.2	6.8	7.7	8.3	9.1	9.9	11.2	8.6	12.9	21.5
	6.13	60	7.6	8.5	9.4	10.6	11.4	12.8	13.7	15.4	16.8	15.5	25.9
	7.15	70	10.2	11.5	12.4	13.8	15.0	16.7	17.9	20.2	21.7	18.1	30.1
	8.17	80	13.1	14.6	15.9	17.7	19.1	20.9	22.4	25.2	27.4	20.7	34.5
	9.19	90	16.3	18.2	19.7	22.1	23.5	25.9	27.5	31.1	33.7	37.6	38.8
	10.21	100	20.0	22.2	23.9	26.5	28.1	30.9	33.2	37.0	40.5	44.6	43.0
	11.23	110	24.3	26.6	28.3	31.6	33.4	36.7	38.5	43.6	47.4	53.5	47.4
	12.25	120	28.6	31.4	33.4	36.9	39.2	43.1	45.5	51.2	53.2	61.8	51.6
	13.28	130	33.4	36.3	38.5	42.8	45.1	49.7	52.8	58.7	63.1	71.1	56.0
	14.30	140	39.9	41.9	44.0	48.8	51.6	56.5	59.9	66.7	72.1	80.8	60.3
	15.32	150	43.9	47.7	50.3	55.1	58.7	63.6	67.4	75.3	81.1	91.1	104.5
	16.34	160	49.5	53.9	56.8	61.6	65.8	71.4	75.8	84.8	91.1	102.0	
	17.36	170	55.8	60.0	63.6	69.1	73.5	79.8	83.8	92.9	101.4		
	18.38	180	62.4	67.0	71.2	76.5	82.1	88.2	92.5	100.2	110.6		
	19.40	190	69.2	74.6	79.1	84.3	91.1	97.3	101.7	113.4			
	20.42	200	76.6	82.3	86.9	92.9	97.9	106.6	112.4				
2½"	1.96	30	.9	1.0	1.2	1.4	1.5	1.6	1.3	1.8	2.5	3.8	6.3
	2.29	35	1.2	1.4	1.5	1.7	2.0	2.2	2.3	2.2	3.0	4.5	7.5
	2.61	40	1.5	1.7	2.0	2.2	2.4	2.6	2.9	2.5	3.3	5.1	8.5
	2.94	45	1.8	2.2	2.4	2.8	3.0	3.3	3.6	2.9	3.8	5.8	9.5
	3.27	50	2.2	2.6	2.9	3.2	3.6	3.9	4.3	3.1	4.3	6.3	10.6
	3.92	60	3.1	3.6	3.9	4.5	4.8	5.4	5.9	6.6	5.1	7.6	12.7
	4.58	70	4.1	4.8	5.2	6.0	6.4	7.1	7.6	8.5	5.9	8.9	14.8
	5.23	80	5.4	6.1	6.6	7.5	8.1	9.0	9.5	10.8	11.6	10.1	16.9
	5.88	90	6.8	7.6	8.2	9.2	10.0	10.9	11.8	13.2	14.4	11.4	19.1
	6.54	100	8.3	9.2	9.9	11.0	12.0	13.2	14.1	15.8	17.0	12.7	21.2
	7.18	110	9.9	10.9	11.8	13.0	13.9	15.5	16.8	18.9	20.2	22.3	23.2
	7.84	120	11.7	12.9	13.9	15.3	16.4	18.2	19.4	21.6	23.6	26.0	25.4
	8.48	130	13.6	15.0	16.0	17.8	19.1	20.8	22.3	24.8	26.7	30.2	27.5
	9.15	140	15.6	17.3	18.4	20.2	21.6	24.0	25.4	28.4	30.7	34.4	29.6
	9.81	150	17.8	19.6	20.8	22.8	24.4	26.9	28.8	32.1	35.1	38.3	31.7
	10.46	160	20.1	22.0	23.3	25.8	27.4	30.1	32.3	35.9	38.9	43.0	33.8
	11.11	170	22.5	24.6	26.0	28.5	30.7	33.4	35.9	39.7	42.9	47.7	35.9
	11.76	180	25.2	27.5	29.1	31.9	34.2	37.0	39.7	44.2	47.4	53.0	61.0
	12.42	190	27.9	30.5	32.2	35.2	37.7	40.9	43.5	48.3	52.2	59.1	67.5
	13.07	200	30.9	33.6	35.4	38.4	41.1	45.0	48.0	52.6	56.7	63.3	72.2
	14.38	220	37.0	40.4	42.4	46.0	49.1	53.0	55.9	62.1	67.4	75.7	86.5
	15.69	240	43.8	47.8	50.1	53.9	56.8	62.0	65.9	72.8	78.4	87.4	99.6
	16.99	260	51.2	55.4	60.4	62.4	6.61	71.4	75.9	84.2	89.9	99.7	
	18.30	280	59.0	63.9	66.7	72.5	75.6	81.7	87.2				
	19.61	300	67.4	72.7	75.8	81.1	86.0	92.3	97.6				

Values to the right of the solid line are for any pipe (laminar flow). Values to the left apply only to clean steel pipe (turbulent flow).

Chart friction loss shows average value for clean steel pipe

100′ STEEL PIPE

SIZES 3″ — 6″ — VISCOSITY S.S.U.

VELOCITY FT/SEC	U.S. GPM	31.5	35	40	50	60	80	100	150	200	300	500	SIZE PIPE
2.27	50	.8	.9	1.0	1.2	1.3	1.4	1.5	1.4	1.7	2.6	4.5	
2.72	60	1.0	1.3	1.4	1.6	1.7	2.0	2.1	1.6	2.2	3.2	5.3	
3.18	70	1.5	1.7	1.8	2.1	2.3	2.5	2.8	3.1	2.5	3.7	6.2	
3.63	80	1.8	2.2	2.3	2.6	2.9	3.2	3.5	3.9	2.9	4.3	7.1	
4.09	90	2.4	2.6	2.9	3.2	3.6	3.9	4.1	4.7	5.2	4.8	7.9	
4.54	100	2.8	3.2	3.5	3.9	4.3	4.7	5.1	5.8	6.1	5.3	8.9	
5.45	120	3.9	4.5	4.8	5.4	5.9	6.6	6.9	7.8	8.4	6.4	10.7	
6.35	140	5.3	5.9	6.4	7.6	7.8	8.4	9.1	10.2	10.9	12.4	12.4	
7.26	160	6.7	7.6	8.2	9.1	9.7	10.6	11.3	12.8	13.8	15.5	14.1	
8.17	180	8.4	9.4	10.0	11.2	12.0	13.1	14.0	15.8	17.0	18.9	16.0	
9.08	200	10.2	11.5	12.2	13.5	14.4	15.8	16.8	18.7	20.6	22.8	17.7	
10.22	225	12.9	14.3	15.2	16.7	17.8	19.4	20.7	23.5	25.6	27.8	32.1	
11.36	250	15.8	17.4	18.4	20.1	21.6	23.5	25.1	27.8	30.0	33.5	38.2	3″
12.50	275	18.9	20.7	22.0	23.9	26.0	27.9	29.7	32.8	35.8	39.4	45.5	
13.64	300	22.2	24.4	25.9	28.1	30.0	32.3	34.3	38.1	41.5	45.8	52.4	
14.78	325	25.9	28.4	30.0	32.5	34.5	37.4	39.7	43.8	47.8	52.7	60.6	
15.92	350	29.9	32.5	34.5	37.3	39.6	42.9	45.5	50.1	53.7	60.1	68.2	
17.06	375	34.3	37.0	39.2	42.2	44.6	48.8	51.5	56.7	60.7	67.4	77.3	
18.20	400	39.0	41.7	44.3	47.6	50.1	54.7	57.3	63.3	68.1	75.4	86.4	
19.34	425	43.8	46.8	49.7	53.2	56.1	60.8	63.3	70.4	75.4	83.7	95.9	
20.48	450	49.1	52.3	55.2	59.2	62.4	67.5	71.2	77.6	83.7	92.2	106.7	
21.62	475	54.4	58.0	61.2	65.7	68.9	74.3	78.4	85.6	92.1	102.2		
22.76	500	60.3	63.8	67.5	72.1	75.7	81.3	86.3					
23.90	525	66.0	70.0	74.1	79.1	82.8	88.6	94.4					
25.04	550	72.1	76.5	80.8	86.0	90.0	96.4	102.4					
1.53	60	.3	.3	.3	.5	.5	6	.6	.6	.7	1.0	1.8	
1.79	70	.3	.5	.5	.6	.6	.7	.8	.6	.8	1.3	2.1	
2.04	80	.5	.6	.7	.7	.8	.9	.9	.7	.9	1.5	2.4	
2.30	90	.6	.7	.8	.9	.9	1.0	1.2	1.3	1.0	1.6	2.8	
2.55	100	.7	.8	.9	1.0	1.2	1.3	1.4	1.6	1.3	1.8	3.0	
3.06	120	1.0	1.2	1.3	1.5	1.6	1.7	2.0	2.2	2.3	2.2	3.6	
3.57	140	1.4	1.6	1.7	2.0	2.1	2.3	2.5	2.8	3.1	2.5	4.3	
4.08	160	1.7	2.0	2.2	2.4	2.6	2.9	3.1	3.5	3.8	2.9	4.8	
4.60	180	2.2	2.5	2.6	3.0	3.2	3.6	3.8	4.4	4.7	5.3	5.4	
5.11	200	2.6	3.0	3.2	3.7	3.9	4.3	4.6	5.2	5.6	6.3	6.0	
5.62	220	3.1	3.6	3.8	4.3	4.6	5.1	5.4	6.1	6.6	7.5	6.6	
6.13	240	3.7	4.1	4.5	5.1	5.4	6.0	6.3	7.1	7.5	8.6	7.2	
6.64	260	4.3	4.8	5.2	5.8	6.2	6.8	7.2	8.2	8.9	9.9	7.8	
7.15	280	4.9	5.5	6.0	6.7	7.1	7.8	8.2	9.3	10.0	11.2	8.4	4″
7.66	300	5.6	6.3	6.8	7.5	8.1	8.7	9.3	10.5	11.4	12.7	14.6	
8.94	350	7.6	8.4	9.0	9.9	10.5	11.6	12.3	13.6	14.7	16.4	19.1	
10.21	400	9.8	10.8	11.5	12.5	13.3	14.6	15.5	17.1	18.6	20.7	23.9	
11.49	450	12.2	13.5	14.3	15.5	16.6	18.1	19.2	21.2	22.8	25.5	29.2	
12.77	500	15.0	16.3	17.4	18.9	20.0	21.7	23.1	25.4	27.3	30.5	35.1	
14.04	550	18.1	19.6	20.7	22.4	23.7	25.8	27.5	30.2	32.2	36.0	41.4	
15.32	600	21.3	23.0	24.4	26.3	27.8	30.2	32.0	35.1	37.7	41.9	48.0	
16.59	650	24.8	26.6	28.3	30.6	32.2	34.8	36.7	40.6	43.5	48.2	55.2	
17.87	700	28.6	30.7	32.5	35.2	37.0	39.8	42.0	46.2	49.8	54.5	62.8	
19.15	750	32.8	35.1	36.9	40.0	42.1	45.0	47.6	52.3	56.1	61.3	70.8	
20.42	800	37.3	39.7	41.6	45.1	47.3	50.5	53.5	58.7	62.8	65.6	79.0	
3.11	275	.7	.7	.8	.9	.9	1.0	1.2	1.3	1.4	1.6	1.6	
3.40	300	.7	.8	.9	1.0	1.2	1.3	1.4	1.5	1.6	1.8	1.7	
3.96	350	1.0	1.2	1.3	1.4	1.5	1.6	1.7	2.0	2.1	2.4	2.1	
4.55	400	1.3	1.5	1.6	1.7	1.8	2.1	2.2	2.4	2.6	3.0	2.3	
5.11	450	1.6	1.8	2.0	2.2	2.3	2.5	2.8	3.0	3.3	3.7	4.3	
5.68	500	2.0	2.2	2.4	2.6	2.8	3.1	3.3	3.6	3.9	4.4	5.1	
6.25	550	2.3	2.5	2.8	3.1	3.3	3.6	3.9	4.3	4.6	5.2	6.0	
6.81	600	2.6	3.0	3.3	3.6	3.8	4.1	4.5	4.9	5.4	6.0	6.8	
7.38	650	3.1	3.6	3.8	4.1	4.5	4.8	5.2	5.8	6.2	6.9	8.1	
7.85	700	3.6	4.0	4.4	4.7	5.1	5.5	5.9	6.6	7.0	7.9	9.1	
8.50	750	4.1	4.6	4.9	5.4	5.8	6.2	6.6	7.5	7.9	8.9	10.2	6″
9.08	800	4.7	5.2	5.5	6.1	6.4	7.0	7.4	8.3	8.9	9.9	11.3	
10.00	900	5.9	6.4	6.8	7.6	7.9	8.6	9.2	10.2	10.9	12.1	13.8	
11.34	1000	7.1	7.8	8.4	9.1	9.7	10.5	11.0	12.2	13.2	14.5	16.6	
12.48	1100	8.6	9.3	10.0	10.9	11.5	12.5	13.1	14.4	15.6	17.0	19.7	
13.61	1200	10.1	11.0	11.7	12.8	13.5	14.5	15.3	16.8	18.2	19.9	23.0	
15.90	1400	13.6	14.7	15.5	16.8	17.8	19.2	20.4	22.2	23.7	26.5	29.7	
18.10	1600	17.6	18.9	19.9	21.5	22.9	24.5	25.8	28.1	29.9	33.1	37.1	
20.41	1800	22.2	23.7	24.8	26.7	28.3	30.4	32.0	34.4	37.0	40.3	45.9	
22.69	2000	27.3	29.1	30.4	32.7	34.0	36.8	38.4	41.9	44.5	48.9	55.3	

including adjustment of 15% for commercial installations.

SIZE 8" – 12"

PIPE SIZE	VELOCITY FT/SEC	U.S. GPM	VISCOSITY S.S.U. 31.5	35	40	50	60	80	100	150	200	300	500
8"	3.19	500	.5	.6	.6	.7	.8	.8	.9	1.0	1.0	1.3	1.0
	3.84	600	.7	.8	.9	.9	1.0	1.2	1.3	1.4	1.5	1.6	2.0
	4.46	700	.9	1.0	1.2	1.3	1.4	1.5	1.6	1.8	2.0	2.2	2.5
	5.10	800	1.2	1.4	1.5	1.6	1.7	2.0	2.1	2.3	2.4	2.8	3.1
	5.75	900	1.5	1.7	1.8	2.0	2.2	2.3	2.5	2.8	3.0	3.3	3.8
	6.38	1000	1.8	2.1	2.2	2.4	2.5	2.9	3.0	3.3	3.6	4.0	4.6
	7.66	1200	2.5	2.9	3.1	3.3	3.6	3.9	4.1	4.6	4.9	5.4	6.2
	8.95	1400	3.5	3.8	4.1	4.4	4.7	5.1	5.5	6.0	6.4	7.1	8.2
	10.21	1600	4.5	4.8	5.2	5.6	6.0	6.4	6.8	7.6	8.2	9.0	10.2
	11.50	1800	5.5	6.0	6.4	7.0	7.5	8.1	8.5	9.3	10.0	11.0	12.7
	12.78	2000	6.8	7.4	7.7	8.5	9.0	9.7	10.2	11.3	12.1	13.3	15.2
	14.05	2200	8.1	8.7	9.3	10.1	10.6	11.5	12.1	13.3	14.3	15.8	17.8
	15.32	2400	9.5	10.4	10.9	11.8	12.4	13.5	14.1	15.5	16.7	18.3	20.8
	16.59	2600	11.3	12.1	12.7	13.7	14.4	15.5	16.3	17.8	19.3	21.0	23.9
	17.86	2800	12.9	13.9	14.6	15.6	16.6	17.8	18.7	20.5	22.0	24.2	27.1
10"	3.67	900	.5	.6	.6	.7	.7	.8	.8	.9	1.0	1.2	1.4
	4.08	1000	.6	.7	.7	.8	.8	.9	1.0	1.2	1.3	1.4	1.6
	4.49	1100	.7	.8	.8	.9	1.0	1.2	1.2	1.4	1.4	1.6	1.8
	4.90	1200	.8	.9	1.0	1.2	1.2	1.3	1.4	1.6	1.7	1.8	2.2
	5.31	1300	.9	1.0	1.2	1.3	1.4	1.5	1.6	1.8	2.0	2.2	2.4
	5.71	1400	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2.1	2.2	2.4	2.8
	6.12	1500	1.3	1.4	1.5	1.6	1.7	2.0	2.1	2.3	2.4	2.8	3.1
	6.53	1600	1.4	1.6	1.7	1.8	2.0	2.2	2.3	2.5	2.8	3.0	3.6
	7.35	1800	1.7	2.0	2.1	2.3	2.4	2.6	2.8	3.1	3.3	3.7	4.3
	8.16	2000	2.2	2.4	2.5	2.8	3.0	3.2	3.5	3.8	4.0	4.5	5.2
	8.98	2200	2.5	2.9	3.0	3.3	3.5	3.8	4.0	4.5	4.7	5.3	6.0
	9.80	2400	3.0	3.3	3.6	3.9	4.1	4.5	4.7	5.2	5.5	6.2	7.0
	10.61	2600	3.6	3.9	4.1	4.5	4.7	5.2	5.4	6.0	6.4	7.1	8.1
	11.41	2800	4.0	4.5	4.7	5.2	5.4	5.9	6.2	6.8	7.4	8.1	9.2
	12.24	3000	4.6	5.1	5.4	5.9	6.1	6.7	7.0	7.7	8.3	9.1	10.4
12"	2.27	800	.1	.2	.2	.2	.2	.2	.3	.3	.3	.5	.3
	2.56	900	.2	.2	.2	.3	.3	.3	.3	.5	.5	.5	.6
	2.84	1000	.2	.2	.3	.3	.3	.5	.5	.5	.6	.6	.7
	3.41	1200	.3	.3	.5	.5	.5	.6	.6	.7	.7	.8	.9
	3.98	1400	.5	.5	.6	.6	.7	.7	.8	.8	.9	1.0	1.2
	4.55	1600	.6	.7	.7	.8	.8	.9	.9	1.0	1.2	1.3	1.5
	5.11	1800	.7	.8	.9	.9	1.0	1.2	1.3	1.4	1.5	1.6	1.8
	5.68	2000	.9	1.0	1.0	1.2	1.3	1.4	1.5	1.6	1.7	2.0	2.2
	7.00	2500	1.4	1.5	1.6	1.7	1.8	2.1	2.2	2.4	2.5	2.8	3.2
	8.52	3000	2.0	2.1	2.2	2.3	2.5	2.9	3.0	3.3	3.5	3.9	4.4

FRICTION LOSS IN FEET HEAD
PER 100 FEET OF SMOOTH BORE RUBBER HOSE

U. S. Gal. Per Min.	ACTUAL INSIDE DIAMETER IN INCHES ¾	1	1¼	½	2	2½	3	4
15	70	23	5.8	2.5	.9	.2		
20	122	32	10	4.2	1.6	.5		
25	182	51	15	6.7	2.3	.7		
30	259	72	21.2	9.3	3.2	.9	.2	
40		122	35	15.5	5.5	1.4	.7	
50		185	55	23	8.3	2.3	1.2	
60		233	81	32	11.8	3.2	1.4	
70			104	44	15.2	4.2	1.8	
80			134	55	19.8	5.3	2.5	
90			164	70	25	7	3.5	.7
100			203	85	29	8.1	4	.9
125			305	127	46	12.2	5.8	1.4
150			422	180	62	17.3	8.1	1.6
175				230	85	23.1	10.6	2.5
200				308	106	30	13.6	3.2
250					162	44	21	4.9
300					219	62	28	6.7
350					292	83	39	9.3
400						106	49	11.8
500						163	74	17.1
600						242	106	23
700						344	143	30
800						440	182	40
900							224	51
1000							270	63
1250							394	100
1500	Chart losses based on 31.5 SSU Liquid Viscosity. For other						525	141
1750	liquids, multiply these losses by friction factor for other							185
2000	viscosities shown in chart on page 26 of this manual.							230

LOSS OF HEAD IN FEET PER 100 FEET OF ALUMINUM PIPE

Table based on Scobey's Formula

(KS = .34 for 2" pipe,
K– = .33 for 3" pipe,
KS = .32) for other sizes

1 cubic ft. per sec. (sec. ft.) = 7.48 gal. per second
= 448.8 gal. per minute (commonly used as 450 gpm)
= 646,272 gal. per day (24 hours)

G.P.M.	C.F.S.	2" O.D. .05" Wall	3" O.D. .05" Wall	4" O.D. .063" Wall	5" O.D. .063" Wall	6" O.D. .063" Wall	7" O.D. .078" Wall	8" O.D. .094" Wall
5	.01	.07						
10	.02	.32	.04					
20	.04	1.20	.15	.04				
30	.07	2.58	.32	.08				
40	.09	4.49	.56	.13	.04			
50	.11	6.85	.85	.20	.07	.03		
60	.13	9.67	1.21	.28	.09	.04		
70	.16	12.95	1.61	.38	.12	.05		
80	.18	16.70	2.06	.49	.16	.06	.03	
90	.20	20.80	2.58	.60	.20	.08	.04	
100	.22	25.40	3.18	.74	.24	.10	.05	.03
120	.27		4.51	1.06	.34	.14	.07	.04
140	.31		6.00	1.41	.46	.19	.09	.05
160	.36		7.76	1.82	.59	.24	.11	.06
180	.40		9.67	2.27	.73	.30	.14	.07
200	.45		11.83	2.78	.89	.36	.17	.09
220	.49		14.12	3.31	1.07	.44	.20	.11
240	.54		16.72	3.91	1.27	.52	.24	.13
260	.58		19.42	4.56	1.47	.60	.28	.15
280	.62		22.40	5.26	1.71	.69	.33	.17
300	.67		25.45	5.98	1.93	.79	.37	.19
350	.78			8.03	2.59	1.05	.50	.26
400	.89			10.36	3.33	1.35	.64	.33
450	1.00			12.90	4.15	1.69	.80	.41
500	1.12			15.73	5.07	2.06	.97	.50
550	1.23			19.12	6.16	2.50	1.18	.62
600	1.34			22.46	7.24	2.94	1.38	.72
650	1.45			26.10	8.42	3.41	1.62	.84
700	1.56				9.68	3.92	1.86	.97
750	1.67				11.05	4.46	2.11	1.10
800	1.79				12.48	5.03	2.38	1.24
850	1.90				13.95	5.64	2.67	1.39
900	2.01				15.65	6.35	2.98	1.56
950	2.12				17.35	7.02	3.32	1.73
1000	2.23				19.10	7.72	3.64	1.90
1100	2.46				22.85	9.22	4.37	2.27
1200	2.68				26.95	10.88	5.16	2.68
1300	2.90					12.62	5.96	3.10
1400	3.12					14.65	6.90	3.60
1500	3.34					16.67	7.87	4.07
1600	3.57					18.80	8.89	4.62
1700	3.79					20.95	9.95	5.16
1800	4.01					23.60	11.15	5.79
1900	4.24						12.35	6.42
2000	4.46						13.65	7.10

(Above table computed for Aluminum Pipe with Coupler)

PLASTIC PIPE – FRICTION LOSS

HEAD LOSS IN FEET PER 100 FEET

GPM	SIZE PLASTIC PIPE									
	½"	¾"	1"	1¼"	1½"	2"	3"	4"	6"	GPM
5	24	5	15	0.5	—	—	—	—	—	5
10	—	19	5	1.5	1	—	—	—	—	10
15	—	30	10	3.5	1.5	—	—	—	—	15
20	—	—	17	5.5	2.5	1	—	—	—	20
25	—	—	26	8	4	1.5	—	—	—	25
30	—	—	—	11	5.5	2	—	—	—	30
35	—	—	—	14	7	2.5	—	—	—	35
40	—	—	—	18	8.5	3	—	—	—	40
45	—	—	—	21	10.5	3.5	—	—	—	45
50	—	—	—	25	13	4	1	—	—	50
75	—	—	—	—	27	8	1.5	—	—	75
100	—	—	—	—	—	15	2	—	—	100
125	—	—	—	—	—	22	3.5	—	—	125
150	—	—	—	—	—	30	5	—	—	150
200	—	—	—	—	—	—	8	2	—	200
250	—	—	—	—	—	—	12	3	—	250
300	—	—	—	—	—	—	16	4	1	300
350	—	—	—	—	—	—	21	6	1.5	350
400	—	—	—	—	—	—	26	8	1.5	400
500	—	—	—	—	—	—	—	12	2	500
600	—	—	—	—	—	—	—	17	2	600
700	—	—	—	—	—	—	—	—	3	700
900	—	—	—	—	—	—	—	—	5	900

FRICTION LOSS IN STEEL VALVES AND FITTINGS
EQUIVALENT LENGTH OF STRAIGHT PIPE

TURBULENT FLOW

Size in Inches		1"	1½"	2"	2½"	3"	4"	6"	8"	10"	12"
Elbow 45°	Screwed	1.3	2.1	2.7	3.2	4.0	5.5	—	—	—	—
	Flanged	0.81	1.3	1.7	2.0	2.6	3.5	5.6	77	9.0	11
Elbow 90°	Screwed	5.2	7.4	8.5	9.3	11	13	—	—	—	—
	Flanged	1.6	2.4	3.1	3.6	4.4	5.9	8.9	12	14	17
Elbow 90° Long Radius	Screwed	2.7	3.4	3.6	3.6	4.0	4.6	—	—	—	—
	Flanged	1.6	2.3	2.7	2.9	3.4	4.2	5.7	7	8	9
Tee — Run Thru	Screwed	3.2	5.6	7.7	9.3	12	17	—	—	—	—
	Flanged	1.0	1.5	1.8	1.9	2.2	2.8	3.8	4.7	5.2	6.0
Tee — Thru Side	Screwed	6.6	9.9	12	13	17	21	—	—	—	—
	Flanged	3.3	5.2	6.6	7.5	9.4	12	18	24	30	34
180° Return Bend	Screwed	5.2	7.4	8.5	9.3	11	13	—	—	—	—
	Flanged	1.6	2.4	3.1	3.6	4.4	5.9	8.9	12	14	17
Gate Valve	Screwed	.84	1.2	1.5	1.7	1.9	2.5	—	—	—	—
	Flanged	—	—	2.6	2.7	2.8	2.9	3.2	3.2	3.2	3.2
Globe Valve	Screwed	29	42	54	62	79	110	—	—	—	—
	Flanged	45	59	70	77	94	120	190	260	310	390
Swing Check Valve	Screwed	11	15	19	22	27	38	—	—	—	—
	Flanged	7.2	12	17	21	27	38	63	90	120	140
Angle Valve	Screwed	17	18	18	18	18	18	—	—	—	—
	Flanged	17	18	21	22	28	38	63	90	120	140
Plug Valve		—	—	6	7	8	17	65	110	150	—
Foot Valve		—	38	46	55	64	71	77	79	81	83
Enlargement	½	—	2.6	3.2	3.8	4.7	6.2	9.5	13	16	19
	¾	—	1.0	1.2	1.3	1.7	2.3	3.4	4.5	5.6	6.8
Contraction	½	—	1.5	1.8	2.2	2.8	3.6	5.6	24	9.5	11
	¾	—	1.0	1.2	1.3	1.7	2.3	3.4	4.5	5.6	6.8

VISCOSITY CORRECTION

FOR EQUIPMENT ON PAGES 27, 28, 29

MULTIPLY FRICTION LOSS BY:

31.5	SSU	1.0	150	SSU	1.7
40	SSU	1.15	200	SSU	1.8
60	SSU	1.3	300	SSU	2.1
80	SSU	1.4	400	SSU	2.5
100	SSU	1.5	500	SSU	2.8

NOZZLE LOSS (HEAD FEET)

	FUEL OIL TYPE		AVIATION TYPE		
GPM	1¼"	1½"	1½"	2"	2½"
50	19'	9'	—	—	—
75	33'	16'	—	—	—
100	—	28'	8'	5'	—
150	—	—	16'	7'	—
200	—	—	30'	12'	7'
300	—	—	—	25'	12'
400	—	—	—	—	18'
500	—	—	—	—	29'

PRESSURE DROPS (HEAD FEET)

AIR ELIMINATORS

GPM	1½"	2"	2½"	3"	4"	6"
50	3'	—	—	—	—	—
100	5'	3'	—	—	—	—
150	—	5'	3'	—	—	—
200	—	7'	5'	3'	—	—
250	—	—	10'	5'	—	—
300	—	—	—	6'	3'	—
350	—	—	—	7'	4'	—
400	—	—	—	10'	5'	3'
450	—	—	—	—	6'	3'
500	—	—	—	—	7'	4'
550	—	—	—	—	8'	4'
600	—	—	—	—	—	5'

LINE STRAINERS

	2"	2½"	3"	4"	6"
50	1'	—	—	—	—
100	4'	—	—	—	—
150	6'	3'	3'	—	—
200	—	5'	4'	—	—
250	—	7'	5'	—	—
300	—	—	6'	3'	—
350	—	—	7'	4'	—
400	—	—	10'	5'	1'
450	—	—	—	6'	1'
500	—	—	—	7'	3'
550	—	—	—	—	3'
600	—	—	—	—	4'

PRESSURE DROP IN FEET LOADING RACK EQUIPMENT

CAPACITY GPM	COMPLETE LOADING ASSEMBLY				SWING JOINT				LOADING VALVE			
	2"	2½"	3"	4"	2"	2½"	3"	4"	2"	2½"	3"	4"
100	13.8	6.9	—	—	1.1	—	—	—	6.9	3.4	1.1	—
150	27.7	12.7	4.6	—	2.3	1.1	—	—	13.8	5.7	3.4	1.1
200	41.5	20.7	9.2	—	3.4	2.3	1.1	—	23.1	9.2	4.6	2.3
250	64.6	30.0	13.8	4.6	4.6	3.4	2.3	1.1	—	16.1	6.9	3.4
300	87.7	43.8	18.4	5.7	6.9	4.6	3.4	2.3	—	—	9.2	3.4
350	—	57.7	25.4	8.0	11.5	6.9	5.7	2.3	—	—	11.5	4.6
400	—	—	33.4	10.3	13.8	9.2	6.9	3.4	—	—	13.8	4.6
450	—	—	46.2	13.8	16.1	11.5	9.2	3.4	—	—	20.7	6.9
500	—	—	57.7	16.1	20.7	16.1	11.5	4.6	—	—	25.4	9.2
550	—	—	—	18.4	—	—	16.1	4.6	—	—	—	11.5
600	—	—	—	21.9	—	—	—	6.9	—	—	—	13.8
650	—	—	—	27.7	—	—	—	8.0	—	—	—	16.1
700	—	—	—	32.3	—	—	—	8.0	—	—	—	18.4

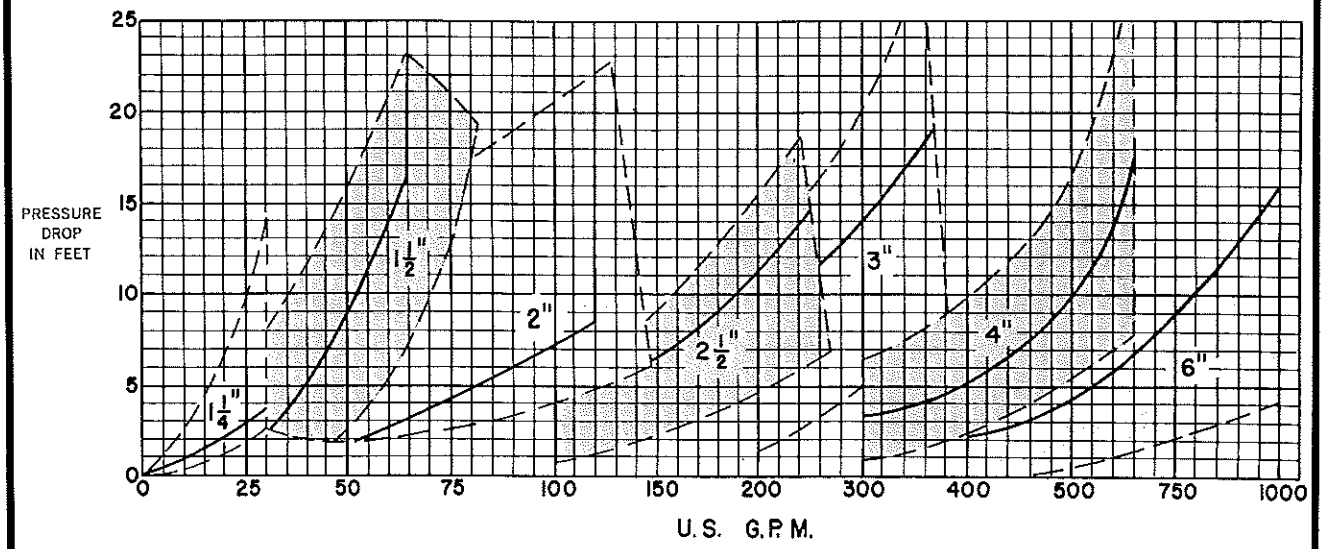
PRESSURE LOSS — METERS

THESE LOSSES REPRESENT AVERAGE FIGURES TO COVER THE MANY METER VARIATIONS AVAILABLE ON THE MARKET TODAY.

FOR METERS WITH AN AUTOMATIC STOP VALVE THE AVERAGE SHOULD BE TAKEN ABOVE THE SOLID LINE WITHIN EACH SIZE.

FOR METERS WITHOUT AN AUTOMATIC STOP THE AVERAGE CAN BE TAKEN BELOW THE SOLID LINE.

OBTAIN ACCURATE LOSS DATA FROM THE METER MANUFACTURER WHENEVER POSSIBLE.



TRANSPORT UNLOADING

SUCTION HEAD LOSS IN FEET (31.5 SSU)

FLOW G.P.M.	MANIFOLD LOSSES				HOSE LOSSES (15" LENGTH)		
	2"	2½"	3"	4"	2"	2½"	3"
50	2.2′	1.1′	.5′	—	1.3′	.4′	—
100	8.0′	4.2′	1.4′	.4′	4.4′	1.2′	—
150	17.5′	8.9′	3.0′	1.1′	9.3′	2.7′	1.2′
200	30.0′	15.5′	.5.1′	1.8′	16.0′	4.5′	2.0′
250	—	24.0′	7.9′	2.8′	—	6.6′	3.2′
300	—	—	11.1′	3.9′	—	9.3′	4.3′
400	—	—	19.5′	6.8′	—	16.0′	7.4′
500	—	—	30.2′	10.5′	—	—	11.3′
600	—	—	—	15.0′	—	—	16.0′

(CHART 1)