

Irrigation Association Friction Loss Chart 2008

**Type "K" Copper Tubing**

ASTM B88 C=140

psi loss per 100 feet of pipe

Nominal Size	1/2"	5/8"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	
Pipe ID	0.527	0.652	0.745	0.995	1.245	1.481	1.959	2.435	2.907	
Pipe OD	0.625	0.750	0.875	1.125	1.375	1.625	2.125	2.625	3.125	
Avg. Wall	0.049	0.049	0.065	0.065	0.065	0.072	0.083	0.095	0.109	
Flow gpm	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss
1	1.47	1.09	0.96	0.39	0.74	0.20	0.41	0.05	0.26	0.02
2	2.94	3.94	1.92	1.40	1.47	0.73	0.82	0.18	0.53	0.06
3	4.41	8.35	2.88	2.97	2.21	1.55	1.24	0.38	0.79	0.13
4	5.88	14.23	3.84	5.05	2.94	2.64	1.65	0.65	1.05	0.22
5	7.35	21.51	4.80	7.64	3.68	3.99	2.06	0.98	1.32	0.33
6	8.81	30.15	5.76	10.70	4.41	5.59	2.47	1.37	1.58	0.46
7	10.28	40.12	6.72	14.24	5.15	7.44	2.88	1.82	1.84	0.61
8	11.75	51.37	7.68	18.24	5.88	9.53	3.30	2.33	2.11	0.78
9	13.22	63.90	8.64	22.68	6.62	11.85	3.71	2.90	2.37	0.97
10	14.69	77.66	9.60	27.57	7.35	14.41	4.12	3.52	2.63	1.18
12			11.52	38.64	8.82	20.20	4.95	4.94	3.16	1.66
14			13.44	51.41	10.29	26.87	5.77	6.57	3.69	2.21
16			15.36	65.83	11.76	34.41	6.59	8.42	4.21	2.83
18			17.28	81.88	13.23	42.80	7.42	10.47	4.74	3.52
20					14.70	52.02	8.24	12.72	5.26	4.28
22					16.17	62.06	9.07	15.18	5.79	5.10
24					17.64	72.91	9.89	17.84	6.32	5.99
26							10.71	20.69	6.84	6.95
28							11.54	23.73	7.37	7.97
30							12.36	26.96	7.90	9.06
32							13.19	30.39	8.42	10.21
34							14.01	34.00	8.95	11.42
36							14.84	37.79	9.48	12.70
38							15.66	41.77	10.00	14.04
40							16.48	45.94	10.53	15.43
42							17.31	50.28	11.06	16.89
44									11.58	18.41
46									12.11	19.99
48									12.63	21.63
50									13.16	23.33
55									14.48	27.84
60									15.79	32.70
65									17.11	37.93
70									18.43	43.51
75									13.02	18.70
80									13.95	21.24
85									14.88	23.94
90									15.81	26.79
95									16.74	29.78
100									17.67	32.91
110									18.60	36.19
120									14.88	23.94
130									15.81	26.79
140									16.74	29.78
150									17.67	32.91
160									18.60	36.19
170									11.69	11.07
180									12.76	13.01
190									13.82	15.08
200									14.88	17.30
220									15.95	19.66
240									17.01	22.16
260									18.07	24.79
280									11.01	7.69
300									11.70	8.60
320									12.39	9.56
340									13.07	10.57
360									13.76	11.62
380									15.14	13.87
400									16.51	16.29
420									17.89	18.90
440									19.27	21.68
460									10.62	5.86
480									11.59	6.88
500									12.55	7.98

Shaded area represents velocities over 7 fps.  
Use with caution where water hammer is a concern.

Irrigation Association Friction Loss Chart 2008

**Type "L" Copper Tubing**

ASTM B88 C=140

psi loss per 100 feet of pipe

Nominal Size	1/2"	5/8"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	3"	
Pipe ID	0.545	0.666	0.785	1.025	1.265	1.505	1.985	2.465	2.945	
Pipe OD	0.625	0.750	0.875	1.125	1.375	1.625	2.125	2.625	3.125	
Avg. Wall	0.040	0.042	0.045	0.050	0.055	0.060	0.070	0.080	0.090	
Flow gpm	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss
1	1.37	0.93	0.92	0.35	0.66	0.16	0.39	0.04	0.25	0.02
2	2.75	3.35	1.84	1.26	1.32	0.57	0.78	0.15	0.51	0.06
3	4.12	7.09	2.76	2.67	1.99	1.20	1.17	0.33	0.76	0.12
4	5.49	12.09	3.68	4.56	2.65	2.05	1.55	0.56	1.02	0.20
5	6.87	18.27	4.60	6.89	3.31	3.09	1.94	0.85	1.27	0.30
6	8.24	25.61	5.52	9.65	3.97	4.34	2.33	1.18	1.53	0.43
7	9.62	34.07	6.44	12.84	4.63	5.77	2.72	1.58	1.78	0.57
8	10.99	43.63	7.36	16.45	5.30	7.39	3.11	2.02	2.04	0.72
9	12.36	54.26	8.28	20.45	5.96	9.19	3.50	2.51	2.29	0.90
10	13.74	65.95	9.20	24.86	6.62	11.17	3.88	3.05	2.55	1.10
12			11.04	34.85	7.95	15.66	4.66	4.28	3.06	1.54
14			12.88	46.36	9.27	20.83	5.44	5.69	3.57	2.04
16			14.72	59.37	10.59	26.68	6.21	7.28	4.08	2.62
18			16.56	73.84	11.92	33.18	6.99	9.06	4.59	3.25
20					13.24	40.33	7.77	11.01	5.10	3.96
22					14.57	48.11	8.54	13.14	5.61	4.72
24					15.89	56.53	9.32	15.44	6.12	5.55
26							10.10	17.90	6.63	6.43
28							10.87	20.54	7.14	7.38
30							11.65	23.33	7.65	8.38
32							12.43	26.30	8.16	9.45
34							13.20	29.42	8.67	10.57
36							13.98	32.71	9.18	11.75
38							14.76	36.15	9.69	12.99
40							15.53	39.75	10.20	14.28
42							16.31	43.51	10.71	15.63
44									11.22	17.04
46									11.73	18.50
48									12.24	20.02
50									12.75	21.59
55									14.02	25.76
60									15.30	30.26
65									16.57	35.10
70									17.85	40.26
75									13.51	19.65
80									14.41	22.14
85									15.31	24.77
90									16.21	27.54
95									17.11	30.44
100									18.01	33.47
110									11.39	10.38
120									12.43	12.20
130									13.46	14.15
140									14.50	16.23
150									15.53	18.44
160									16.57	20.78
170									17.60	23.25
180										
190									12.09	9.01
200									12.76	9.96
220									13.43	10.95
240									14.77	13.07
260									16.12	15.35
280									17.46	17.80
300									18.80	20.42
320										
340									15.05	11.00
360									15.99	12.31
380									16.94	13.69
400									17.88	15.13
420										
440										
460										
480										
500										

Shaded area represents velocities over 7 fps.  
Use with caution where water hammer is a concern.

Irrigation Association Friction Loss Chart 2008

Type "M" Copper Tubing

ASTM B88 C=140  
psi loss per 100 feet of pipe

Nominal Size	1/2"		5/8"		3/4"		1"		1-1/4"		1-1/2"		2"		2-1/2"		3"	
Pipe ID	0.569		0.690		0.811		1.055		1.291		1.527		2.009		2.495		2.981	
Pipe OD	0.625		0.750		0.875		1.125		1.375		1.625		2.125		2.625		3.125	
Avg. Wall	0.028		0.030		0.032		0.035		0.042		0.049		0.058		0.065		0.072	
Flow gpm	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss	Velocity fps	psi Loss
1	1.26	0.75	0.86	0.29	0.62	0.13	0.37	0.04	0.24	0.01								
2	2.52	2.71	1.71	1.06	1.24	0.48	0.73	0.13	0.49	0.05								
3	3.78	5.75	2.57	2.25	1.86	1.03	1.10	0.29	0.73	0.11								
4	5.04	9.80	3.43	3.83	2.48	1.75	1.47	0.49	0.98	0.18								
5	6.30	14.81	4.28	5.80	3.10	2.64	1.83	0.73	1.22	0.27								
6	7.56	20.76	5.14	8.13	3.72	3.70	2.20	1.03	1.47	0.39	1.05	0.17						
7	8.82	27.62	6.00	10.81	4.34	4.92	2.57	1.37	1.71	0.51	1.22	0.23						
8	10.08	35.37	6.86	13.84	4.96	6.31	2.93	1.75	1.96	0.66	1.40	0.29						
9	11.34	44.00	7.71	17.22	5.58	7.84	3.30	2.18	2.20	0.82	1.57	0.36						
10	12.60	53.48	8.57	20.93	6.20	9.53	3.67	2.65	2.45	0.99	1.75	0.44						
12			10.28	29.33	7.44	13.36	4.40	3.72	2.94	1.39	2.10	0.61	1.21	0.16				
14			12.00	39.02	8.68	17.78	5.13	4.94	3.43	1.85	2.45	0.82	1.42	0.22				
16			13.71	49.97	9.93	22.77	5.87	6.33	3.92	2.37	2.80	1.05	1.62	0.28				
18			15.43	62.15	11.17	28.32	6.60	7.87	4.41	2.95	3.15	1.30	1.82	0.34				
20			17.14	75.55	12.41	34.42	7.33	9.57	4.90	3.58	3.50	1.58	2.02	0.42				
22					13.65	41.06	8.06	11.42	5.39	4.28	3.85	1.89	2.22	0.50	1.44	0.17	1.01	0.07
24					14.89	48.24	8.80	13.41	5.88	5.02	4.20	2.22	2.43	0.58	1.57	0.20	1.10	0.09
26							9.53	15.56	6.36	5.83	4.55	2.57	2.63	0.68	1.70	0.24	1.19	0.10
28							10.26	17.85	6.85	6.68	4.90	2.95	2.83	0.78	1.84	0.27	1.29	0.11
30							11.00	20.28	7.34	7.59	5.25	3.35	3.03	0.88	1.97	0.31	1.38	0.13
32							11.73	22.85	7.83	8.56	5.60	3.78	3.23	0.99	2.10	0.35	1.47	0.15
34							12.46	25.57	8.32	9.57	5.95	4.23	3.44	1.11	2.23	0.39	1.56	0.16
36							13.20	28.42	8.81	10.64	6.30	4.70	3.64	1.24	2.36	0.43	1.65	0.18
38							13.93	31.42	9.30	11.76	6.65	5.20	3.84	1.37	2.49	0.48	1.74	0.20
40							14.66	34.55	9.79	12.94	7.00	5.71	4.04	1.50	2.62	0.52	1.84	0.22
42							15.40	37.81	10.28	14.16	7.35	6.26	4.25	1.65	2.75	0.57	1.93	0.24
44									10.77	15.43	7.70	6.82	4.45	1.79	2.88	0.63	2.02	0.26
46									11.26	16.76	8.05	7.40	4.65	1.95	3.01	0.68	2.11	0.29
48									11.75	18.13	8.40	8.01	4.85	2.11	3.15	0.73	2.20	0.31
50									12.24	19.56	8.75	8.64	5.05	2.27	3.28	0.79	2.30	0.33
55									13.46	23.33	9.62	10.31	5.56	2.71	3.60	0.95	2.53	0.40
60									14.69	27.41	10.50	12.11	6.07	3.19	3.93	1.11	2.75	0.47
65									15.91	31.79	11.37	14.04	6.57	3.70	4.26	1.29	2.98	0.54
70									17.14	36.47	12.25	16.11	7.08	4.24	4.59	1.48	3.21	0.62
75									13.12	18.31	7.58	8.82	4.92	1.68	4.92	1.68	3.44	0.71
80									14.00	20.63	8.09	5.43	5.24	1.89	5.24	1.89	3.67	0.80
85									14.87	23.08	8.59	6.07	5.57	2.12	5.57	2.12	3.90	0.89
90									15.75	25.66	9.10	6.75	5.90	2.35	5.90	2.35	4.13	0.99
95									16.62	28.36	9.60	7.46	6.23	2.60	6.23	2.60	4.36	1.09
100									17.50	31.19	10.11	8.21	6.55	2.86	6.55	2.86	4.59	1.20
110													11.12	9.79	7.21	3.41	5.05	1.44
120													12.13	11.51	7.87	4.01	5.51	1.69
130													13.14	13.34	8.52	4.65	5.97	1.96
140													14.15	15.31	9.18	5.33	6.43	2.24
150													15.16	17.39	9.83	6.06	6.89	2.55
160													16.17	19.60	10.49	6.83	7.35	2.87
170													17.18	21.93	11.14	7.64	7.81	3.21
180															11.80	8.50	8.26	3.57
190															12.45	9.39	8.72	3.95
200															13.11	10.33	9.18	4.34
220															14.42	12.32	10.10	5.18
240															15.73	14.47	11.02	6.09
260															17.04	16.79	11.94	7.06
280															18.35	19.25	12.86	8.10
300																	13.77	9.20
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