



# Section TECH-C

## Water Data

### TECH-C-1 Friction Loss for Water – Sched 40 Steel Pipe

U.S. Gallons per Minute	1/8 In. (0.269" I.D.)			1/4 In. (0.364" I.D.)			3/8 In. (0.493" I.D.)			1/2 In. (0.622" I.D.)			U.S. Gallons per Minute
	V (Ft./Sec.)	V <sup>2</sup> /2g	h <sub>f</sub> (Ft./100 ft.)	V	V <sup>2</sup> /2g	h <sub>f</sub>	V	V <sup>2</sup> /2g	h <sub>f</sub>	V	V <sup>2</sup> /2g	h <sub>f</sub>	
0.2	1.13	0.020	2.72										0.2
0.4	2.26	0.079	16.2	1.23	0.024	3.7							0.4
0.6	3.39	0.178	33.8	1.85	0.053	7.6	1.01	0.016	1.74				0.6
0.8	4.52	0.317	57.4	2.47	0.095	12.7	1.34	0.028	2.89				0.8
1.0	5.65	0.495	87.0	3.08	0.148	19.1	1.68	0.044	4.30	1.06	0.017	1.86	1.0
1.5	8.48	1.12	188	4.62	0.332	40.1	2.52	0.099	8.93	1.58	0.039	2.85	1.5
2.0	11.3	1.98	324	6.17	0.591	69.0	3.36	0.176	15.0	2.11	0.069	4.78	2.0
2.5				7.17	0.923	105	4.20	0.274	22.6	2.64	0.108	7.16	2.5
3.0				9.25	1.33	148	5.04	0.395	31.8	3.17	0.156	10.0	3.0
3.5				10.79	1.81	200	5.88	0.538	42.6	3.70	0.212	13.3	3.5
4.0				12.33	2.36	259	6.72	0.702	54.9	4.22	0.277	17.1	4.0
4.5				13.87	2.99	326	7.56	0.889	68.4	4.75	0.351	21.3	4.5
5				15.42	3.69	398	8.40	1.10	83.5	5.28	0.433	25.8	5
6							10.1	1.58	118	6.34	0.624	36.5	6
7							11.8	2.15	158	7.39	0.849	48.7	7
8							13.4	2.81	205	8.45	1.11	62.7	8
9							15.1	3.56	258	9.50	1.40	78.3	9
10							16.8	4.39	316	10.6	1.73	95.9	10
12										12.7	2.49	136	12
14										14.8	3.40	183	14

U.S. Gallons per Minute	3/4 In. (0.824" I.D.)			1 In. (1.049" I.D.)			1 1/4 In. (1.3880" I.D.)			1 1/2 In. (1.610" I.D.)			U.S. Gallons per Minute
	V	V <sup>2</sup> /2g	h <sub>f</sub>	V	V <sup>2</sup> /2g	h <sub>f</sub>	V	V <sup>2</sup> /2g	h <sub>f</sub>	V	V <sup>2</sup> /2g	h <sub>f</sub>	
4	2.41	0.090	4.21	1.48	0.034	1.29							4
5	3.01	0.141	6.32	1.86	0.053	1.93							5
6	3.61	0.203	8.87	2.23	0.077	2.68	1.29	0.026	0.70				6
7	4.21	0.276	11.8	2.60	0.105	3.56	1.50	0.035	0.93				7
8	4.81	0.360	15.0	2.97	0.137	4.54	1.72	0.046	1.18	1.26	0.025	0.56	8
9	5.42	0.456	18.8	3.34	0.173	5.65	1.93	0.058	1.46	1.42	0.031	0.69	9
10	6.02	0.563	23.0	3.71	0.214	6.86	2.15	0.071	1.77	1.58	0.039	0.83	10
12	7.22	0.810	32.6	4.45	0.308	9.62	2.57	0.103	2.48	1.89	0.056	1.16	12
14	8.42	1.10	43.5	5.20	0.420	12.8	3.00	0.140	3.28	2.21	0.076	1.53	14
16	9.63	1.44	56.3	5.94	0.548	16.5	3.43	0.183	4.20	2.52	0.099	1.96	16
18	10.8	1.82	70.3	6.68	0.694	20.6	3.86	0.232	5.22	2.84	0.125	2.42	18
20	12.0	2.25	86.1	7.42	0.857	25.1	4.29	0.286	6.34	3.15	0.154	2.94	20
25	15.1	3.54	134	9.29	1.34	37.4	5.37	0.448	9.66	3.94	0.241	4.50	25
30	18.1	5.06	187	11.1	1.93	54.6	6.44	0.644	13.6	4.73	0.347	6.26	30
35				13.0	2.62	73.3	7.52	0.879	18.5	5.52	0.473	8.38	35
40				14.8	3.43	95.0	8.58	1.14	23.5	6.30	0.618	10.8	40
45				16.7	4.33	119	9.66	1.45	29.5	7.10	0.783	13.5	45
50				18.6	5.35	146	10.7	1.79	36.0	7.88	0.965	16.4	50
60				22.3	7.71	209	12.9	2.57	51.0	9.46	1.39	23.2	60
70				26.0	10.5	283	15.0	3.50	68.8	11.0	1.89	31.3	70
80							17.2	4.58	89.2	12.6	2.47	40.5	80
90							19.3	5.79	112	14.2	3.13	51.0	90
100							21.5	7.15	138	15.8	3.86	62.2	100
120							25.7	10.3	197	18.9	5.56	88.3	120
140										22.1	7.56	119	140

U.S. Gallons per Minute	2 In. (2.067" I.D.)			2½ In. (2.469" I.D.)			3 In. (3.068" I.D.)			3½ In. (3.548" I.D.)			U.S. Gallons per Minute
	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	
30	2.87	0.128	1.82	2.01	0.063	0.75							30
35	3.35	0.174	2.42	2.35	0.085	1.00							35
40	3.82	0.227	3.10	2.68	0.112	1.28							40
50	4.78	0.355	4.67	3.35	0.174	1.94	2.17	0.073	0.66				50
60	5.74	0.511	6.59	4.02	0.251	2.72	2.60	0.105	0.92	1.95	0.059	0.45	60
80	7.65	0.909	11.4	5.36	0.447	4.66	3.47	0.187	1.57	2.60	0.105	0.77	80
100	9.56	1.42	17.4	6.70	0.698	7.11	4.34	0.293	2.39	3.25	0.164	1.17	100
120	11.5	2.05	24.7	8.04	1.00	10.0	5.21	0.421	3.37	3.89	0.236	1.64	120
140	13.4	2.78	33.2	9.38	1.37	13.5	6.08	0.574	4.51	4.54	0.321	2.18	140
160	15.3	3.64	43.0	10.7	1.79	17.4	6.94	0.749	5.81	5.19	0.419	2.80	160
180	17.2	4.60	54.1	12.1	2.26	21.9	7.81	0.948	7.28	5.84	0.530	3.50	180
200	19.1	5.68	66.3	13.4	2.79	26.7	8.68	1.17	8.90	6.49	0.655	4.27	200
220	21.0	6.88	80.0	14.7	3.38	32.2	9.55	1.42	10.7	7.14	0.792	5.12	220
240	22.9	8.18	95.0	16.1	4.02	38.1	10.4	1.69	12.6	7.79	0.943	6.04	240
260	24.9	9.60	111	17.4	4.72	44.5	11.3	1.98	14.7	8.44	1.11	7.04	260
280	26.8	11.1	128	18.8	5.47	51.3	12.2	2.29	16.9	9.09	1.28	8.11	280
300	28.7	12.8	146	20.1	6.28	58.5	13.0	2.63	19.2	9.74	1.47	9.26	300
350				23.5	8.55	79.2	15.2	3.57	26.3	11.3	2.00	12.4	350
400				26.8	11.2	103	17.4	4.68	33.9	13.0	2.62	16.2	400
500				33.5	17.4	160	21.7	7.32	52.5	16.2	4.09	25.0	500
600							26.0	10.5	74.8	19.5	5.89	35.6	600
700							30.4	14.3	101	22.7	8.02	48.0	700
800							34.7	18.7	131	26.0	10.5	62.3	800
1000										32.5	16.44	96.4	1000

U.S. Gallons per Minute	4 In. (4.026" I.D.)			5 In. (5.047" I.D.)			6 In. (6.065" I.D.)			8 In. (7.981" I.D.)			U.S. Gallons per Minute
	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	
140	3.53	0.193	1.16	2.25	0.078	0.38							140
160	4.03	0.253	1.49	2.57	0.102	0.49							160
180	4.54	0.320	1.86	2.89	0.129	0.61							180
200	5.04	0.395	2.27	3.21	0.160	0.74	2.22	0.077	0.30				200
240	6.05	0.569	3.21	3.85	0.230	1.03	2.66	0.110	0.42				240
280	7.06	0.774	4.30	4.49	0.313	1.38	3.11	0.150	0.56				280
320	8.06	1.01	5.51	5.13	0.409	1.78	3.55	0.196	0.72				320
360	9.07	1.28	6.92	5.77	0.518	2.22	4.00	0.240	0.90				360
400	10.1	1.58	8.47	6.41	0.639	2.72	4.44	0.307	1.09	2.57	0.102	0.28	400
450	11.3	2.00	10.5	7.23	0.811	3.42	5.00	0.388	1.37	2.89	0.129	0.35	450
500	12.6	2.47	13.0	8.02	0.999	4.16	5.55	0.479	1.66	3.21	0.160	0.42	500
600	15.1	3.55	18.6	9.62	1.44	5.88	6.66	0.690	2.34	3.85	0.230	0.60	600
700	17.6	4.84	25.0	11.2	1.96	7.93	7.77	0.939	3.13	4.49	0.313	0.80	700
800	20.2	6.32	32.4	12.8	2.56	10.2	8.88	1.23	4.03	5.13	0.409	1.02	800
900	22.7	8.00	40.8	14.4	3.24	12.9	9.99	1.55	5.05	5.77	0.518	1.27	900
1000	25.2	9.87	50.2	16.0	4.00	15.8	11.1	1.92	6.17	6.41	0.639	1.56	1000
1200	30.2	14.2	72.0	19.2	5.76	22.5	13.3	2.76	8.76	7.70	0.920	2.20	1200
1400	35.3	19.3	97.6	22.5	7.83	30.4	15.5	3.76	11.8	8.98	1.25	2.95	1400
1600				25.7	10.2	39.5	17.8	4.91	15.4	10.3	1.64	3.82	1600
1800				28.8	12.9	49.7	20.0	6.21	19.4	11.5	2.07	4.79	1800
2000				32.1	16.0	61.0	22.2	7.67	23.8	12.8	2.56	5.86	2000
2400							26.6	11.0	34.2	15.4	3.68	8.31	2400
2800							31.1	15.0	46.1	18.0	5.01	11.2	2800
3200							35.5	19.6	59.9	20.5	6.55	14.5	3200
3600										23.1	8.28	18.4	3600
4000										25.7	10.2	22.6	4000

U.S. Gallons per Minute	10 In. (10.020" I.D.)			12 In. (11.938" I.D.)			14 In. (13.124" I.D.)			16 In. (15.000" I.D.)			U.S. Gallons per Minute
	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	
800	3.25	0.165	0.328										800
900	3.66	0.208	0.410	2.58	0.103	0.173							900
1000	4.07	0.257	0.500	2.87	0.128	0.210	2.37	0.087	0.131				1000
1200	4.88	0.370	0.703	3.44	0.184	0.296	2.85	0.126	0.185				1200
1400	5.70	0.504	0.940	4.01	0.250	0.395	3.32	0.171	0.247				1400
1600	6.51	0.659	1.21	4.59	0.327	0.609	3.79	0.224	0.317	2.90	0.131	0.163	1600
1800	7.32	0.834	1.52	5.16	0.414	0.636	4.27	0.283	0.395	3.27	0.166	0.203	1800
2000	8.14	1.03	1.86	5.73	0.511	0.776	4.74	0.349	0.483	3.63	0.205	0.248	2000
2500	10.2	1.62	2.86	7.17	0.799	1.19	5.93	0.546	0.738	4.54	0.320	0.377	2500
3000	12.2	2.32	4.06	8.60	1.15	1.68	7.11	0.786	1.04	5.45	0.461	0.535	3000
3500	14.2	3.13	5.46	10.0	1.55	2.25	8.30	1.07	1.40	6.35	0.627	0.718	3500
4000	16.3	4.12	7.07	11.5	2.04	2.92	9.48	1.40	1.81	7.26	0.820	0.921	4000
4500	18.3	5.21	8.88	12.9	2.59	3.65	10.7	1.77	2.27	8.17	1.04	1.15	4500
5000	20.3	6.43	10.9	14.3	3.19	4.47	11.9	2.18	2.78	9.08	1.28	1.41	5000
6000	24.4	9.26	15.6	17.2	4.60	6.39	14.2	3.14	3.95	10.9	1.84	2.01	6000
7000	28.5	12.6	21.1	20.1	6.26	8.63	16.6	4.28	5.32	12.7	2.51	2.69	7000
8000	32.5	16.5	27.5	22.9	8.17	11.2	19.0	5.59	6.90	14.5	3.28	3.498	8000
9000	36.6	20.8	34.6	25.8	10.3	14.1	21.3	7.08	8.7	16.3	4.15	4.38	9000
10,000				28.7	12.8	17.4	23.7	8.74	10.7	18.2	5.12	5.38	10,000
12,000				34.4	18.3	24.8	28.5	12.6	15.2	21.8	7.38	7.69	12,000
14,000				40.1	25.0	33.5	33.2	17.1	20.7	25.4	10.0	10.4	14,000
16,000								37.9	22.4	26.8	13.1	13.5	16,000
18,000								42.7	28.3	33.9	16.6	17.2	18,000
20,000										36.3	20.5	21.2	20,000

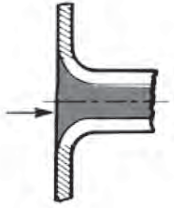
U.S. Gallons per Minute	18 In. (16.876" I.D.)			20 In. (18.812" I.D.)			24 In. (22.624" I.D.)			U.S. Gallons per Minute
	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	
2000	2.87	0.128	0.139							2000
3000	4.30	0.288	0.297	3.46	0.186	0.174				3000
4000	5.74	0.512	0.511	4.62	0.331	0.298	3.19	0.158	0.120	4000
5000	7.17	0.799	0.781	5.77	0.517	0.455	3.99	0.247	0.181	5000
6000	8.61	1.15	1.11	6.92	0.745	0.645	4.79	0.356	0.257	6000
8000	11.5	2.05	1.93	9.23	1.32	1.11	6.38	0.633	0.441	8000
10,000	14.3	3.20	2.97	11.5	2.07	.70	7.98	0.989	0.671	10,000
12,000	17.2	4.60	4.21	13.8	2.98	2.44	9.58	1.42	0.959	12,000
14,000	20.1	6.27	5.69	16.2	4.06	3.29	11.2	1.94	1.29	14,000
16,000	22.9	8.19	7.41	18.5	5.30	4.26	12.8	2.53	1.67	16,000
18,000	25.8	10.4	9.33	20.8	6.71	5.35	14.4	3.21	2.10	18,000
20,000	28.7	12.8	11.5	23.1	8.28	6.56	16.0	3.96	2.58	20,000
22,000	31.6	15.5	13.9	25.4	10.0	7.91	17.6	4.79	3.10	22,000
24,000	34.4	18.4	16.5	27.7	11.9	9.39	19.2	5.70	3.67	24,000
26,000	37.3	21.6	19.2	30.0	14.0	11.0	20.7	6.69	4.29	26,000
28,000	40.2	25.1	22.2	32.3	16.2	12.7	22.3	7.76	4.96	28,000
30,000	43.0	28.8	25.5	34.6	18.6	14.6	23.9	8.91	5.68	30,000
34,000				39.2	23.9	18.7	27.1	11.4	7.22	34,000
38,000				43.9	29.9	23.2	30.3	14.3	9.00	38,000
42,000							33.5	17.5	11.0	42,000
46,000							36.7	20.9	13.2	46,000
50,000							39.9	24.7	15.5	50,000

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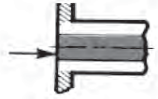
U.S. Gallons per Minute	30 In.			36 In.			42 In.			U.S. Gallons per Minute
	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	
5,000	2.43	0.0917	0.0535							5,000
6,000	2.91	0.132	0.0750							6,000
7,000	3.40	0.180	0.100							7,000
8,000	3.89	0.235	0.129	2.52	0.0988	0.0442				8,000
9,000	4.37	0.297	0.161	2.84	0.125	0.0551				9,000
10,000	4.86	0.367	0.196	3.15	0.154	0.0670				10,000
12,000	5.83	0.528	0.277	3.78	0.222	0.0942	2.78	0.120	0.0441	12,000
14,000	6.80	0.719	0.371	4.41	0.303	0.126	3.24	0.163	0.0591	14,000
16,000	7.77	0.939	0.478	5.04	0.395	0.162	3.71	0.213	0.0758	16,000
18,000	8.74	1.19	0.598	5.67	0.500	0.203	4.17	0.270	0.0944	18,000
20,000	9.71	1.47	0.732	6.30	0.618	0.248	4.63	0.333	0.115	20,000
25,000	12.1	2.29	1.13	7.88	0.965	0.378	5.79	0.521	0.176	25,000
30,000	14.6	3.30	1.61	9.46	1.39	0.540	6.95	0.750	0.250	30,000
35,000	17.0	4.49	2.17	11.03	1.89	0.724	8.11	1.02	0.334	35,000
40,000	19.4	5.87	2.83	12.6	2.47	0.941	9.26	1.33	0.433	40,000
45,000	21.9	7.42	3.56	14.1	3.13	1.18	10.42	1.69	0.545	45,000
50,000	24.3	9.17	4.38	15.8	3.86	1.45	11.6	2.08	0.668	50,000
60,000	29.1	13.2	6.23	18.9	5.56	2.07	13.9	3.00	0.946	60,000
70,000	34.0	18.0	8.43	22.1	7.56	2.81	16.2	4.08	1.27	70,000
80,000	38.9	23.5	11.0	25.2	9.88	3.66	18.5	5.33	1.66	80,000
90,000				28.4	12.5	4.59	20.8	6.75	2.08	90,000
100,000				31.5	15.4	5.64	23.2	8.33	2.57	100,000
120,000				37.8	22.2	8.05	27.8	12.0	3.67	120,000
140,000							32.4	16.3	4.98	140,000
160,000							37.1	21.3	6.46	160,000
180,000							41.7	27.0	8.12	180,000

U.S. Gallons per Minute	48 In.			54 In.			60 In.			U.S. Gallons per Minute
	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	V	$\frac{V^2}{2g}$	$h_f$	
16,000	2.84	0.125	0.0391							16,000
18,000	3.19	0.158	0.0488							18,000
20,000	3.55	0.195	0.0598	2.80	0.122	0.0333				20,000
25,000	4.43	0.305	0.0910	3.50	0.191	0.0504	2.84	0.125	0.0301	25,000
30,000	5.32	0.440	0.128	4.20	0.274	0.0713	3.40	0.180	0.0424	30,000
35,000	6.21	0.598	0.172	4.90	0.374	0.0958	3.97	0.245	0.0567	35,000
40,000	7.09	0.782	0.222	5.60	0.488	0.124	4.54	0.320	0.0730	40,000
45,000	7.98	0.989	0.278	6.30	0.618	0.155	5.11	0.405	0.0916	45,000
50,000	8.87	1.221	0.341	7.00	0.762	0.189	5.67	0.500	0.112	50,000
60,000	10.64	1.76	0.484	8.40	1.098	0.267	6.81	0.720	0.158	60,000
70,000	12.4	2.39	0.652	9.81	1.49	0.358	7.94	0.980	0.213	70,000
80,000	14.2	3.13	0.849	11.21	1.95	0.465	9.08	1.28	0.275	80,000
90,000	16.0	3.96	1.06	12.6	2.47	0.586	10.21	1.62	0.344	90,000
100,000	17.7	4.89	1.30	14.0	3.05	0.715	11.3	2.00	0.420	100,000
120,000	21.3	7.03	1.87	16.8	4.39	1.02	13.6	2.88	0.600	120,000
140,000	24.8	9.57	2.51	19.6	5.98	1.38	15.9	3.92	0.806	140,000
160,000	28.4	12.5	3.26	22.4	7.81	1.80	18.2	5.12	1.04	160,000
180,000	31.9	15.8	4.11	25.2	9.88	2.26	20.4	6.48	1.32	180,000
200,000	35.5	19.5	5.05	28.0	12.2	2.77	22.7	8.00	1.62	200,000
250,000				35.0	19.1	4.32	28.4	12.5	2.52	250,000
300,000				42.0	27.4	6.19	34.0	18.0	3.60	300,000
350,000							39.7	24.5	4.88	350,000

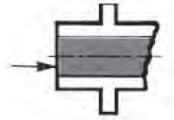
# TECH-C-2 Resistance Coefficients for Valves and Fittings



BELL-MOUTH  
INLET OR REDUCER  
K = 0.05



SQUARE EDGED INLET  
K = 0.5

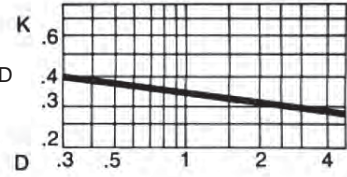


INWARD PROJECTING PIPE  
K = 1.0

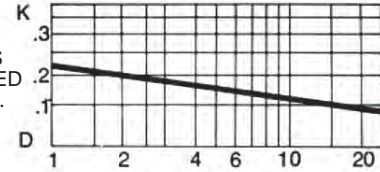
**NOTE:** K DECREASES WITH INCREASING WALL THICKNESS OF PIPE AND ROUNDING OF EDGES



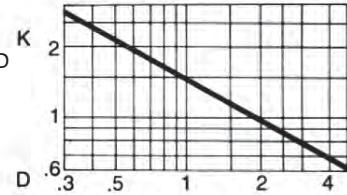
REGULAR  
THREADED  
45° ELL.



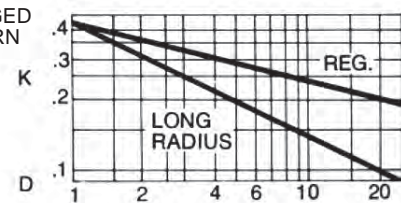
LONG  
RADIUS  
FLANGED  
45° ELL.



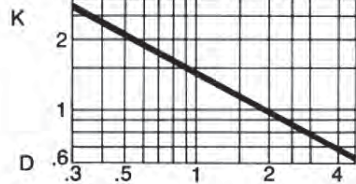
THREADED  
RETURN  
BEND



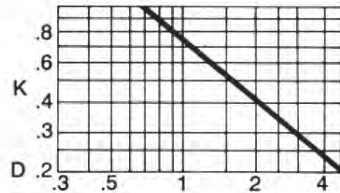
FLANGED  
RETURN  
BEND



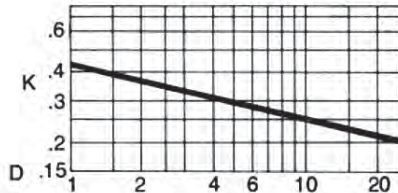
REGULAR  
THREADED  
90° ELL.



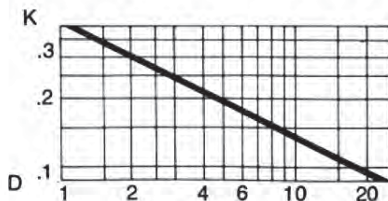
LONG  
RADIUS  
THREADED  
90° ELL.



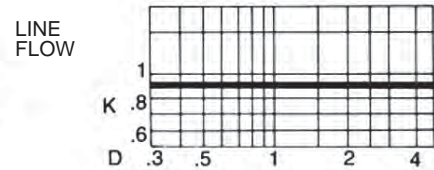
REGULAR  
FLANGED  
90° ELL.



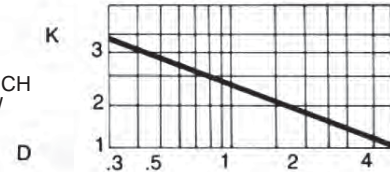
LONG  
RADIUS  
FLANGED  
90° ELL.



THREADED  
TEE

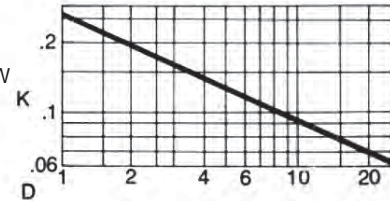


BRANCH  
FLOW

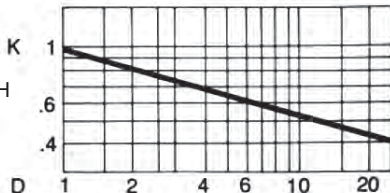


FLANGED  
TEE

LINE  
FLOW



BRANCH  
FLOW



$$h = K \frac{V^2}{2g}$$

Chart 1  
Where:

h = Frictional Resistance in Feet of Liquid  
V = Average Velocity in Feet/Second in a Pipe of Corresponding Diameter

g = 32.17 Feet/Second/Second  
K = Resistance Coefficient For Valve or Fitting

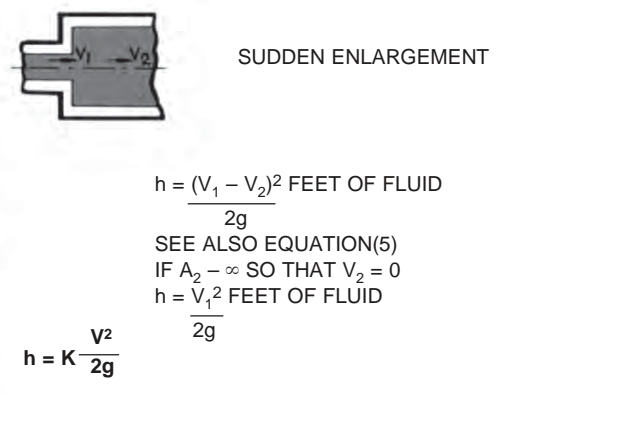
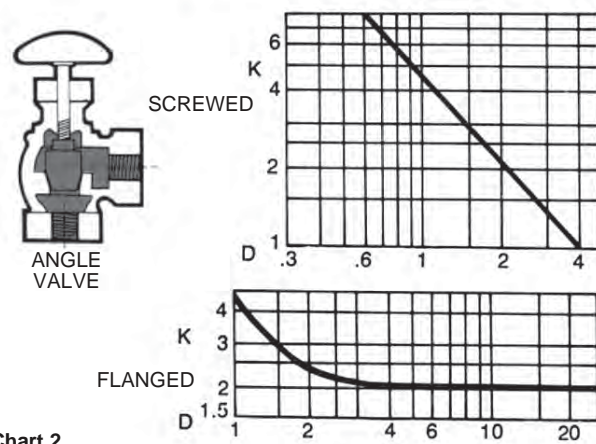
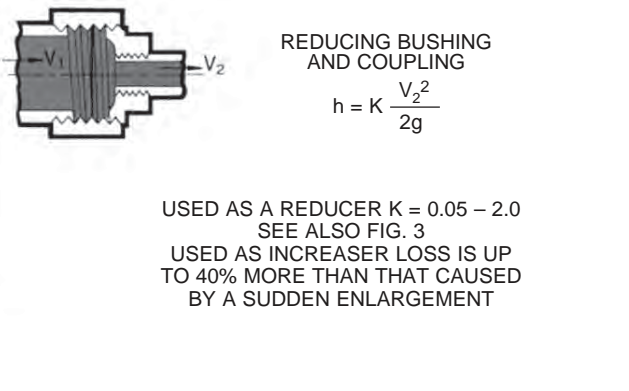
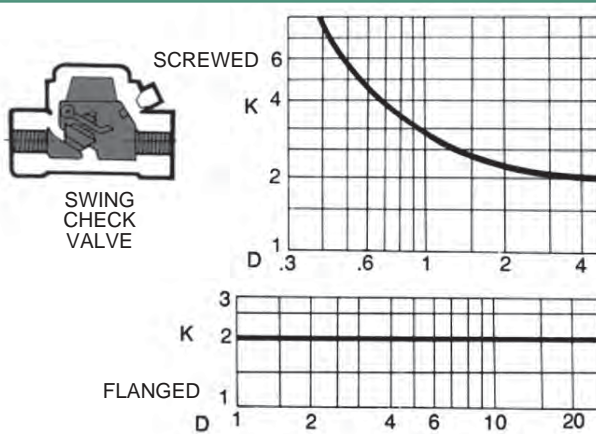
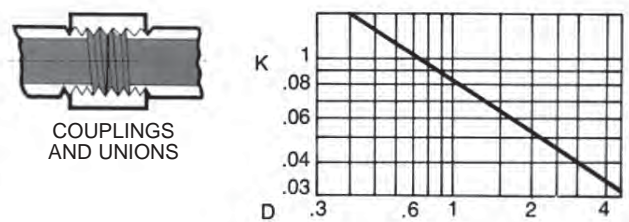
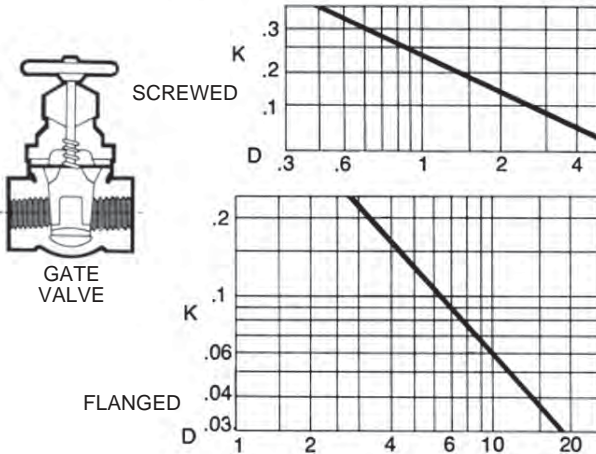
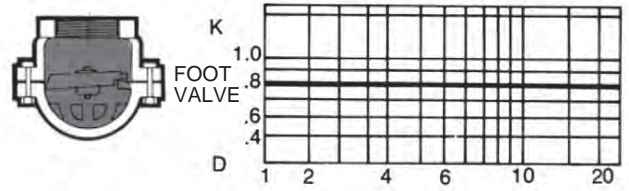
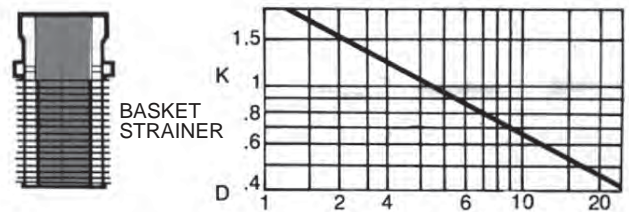
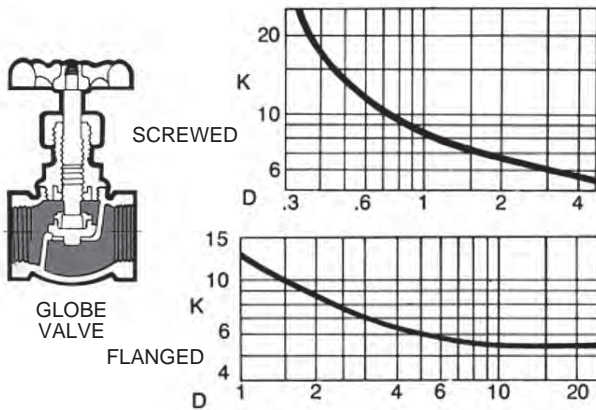
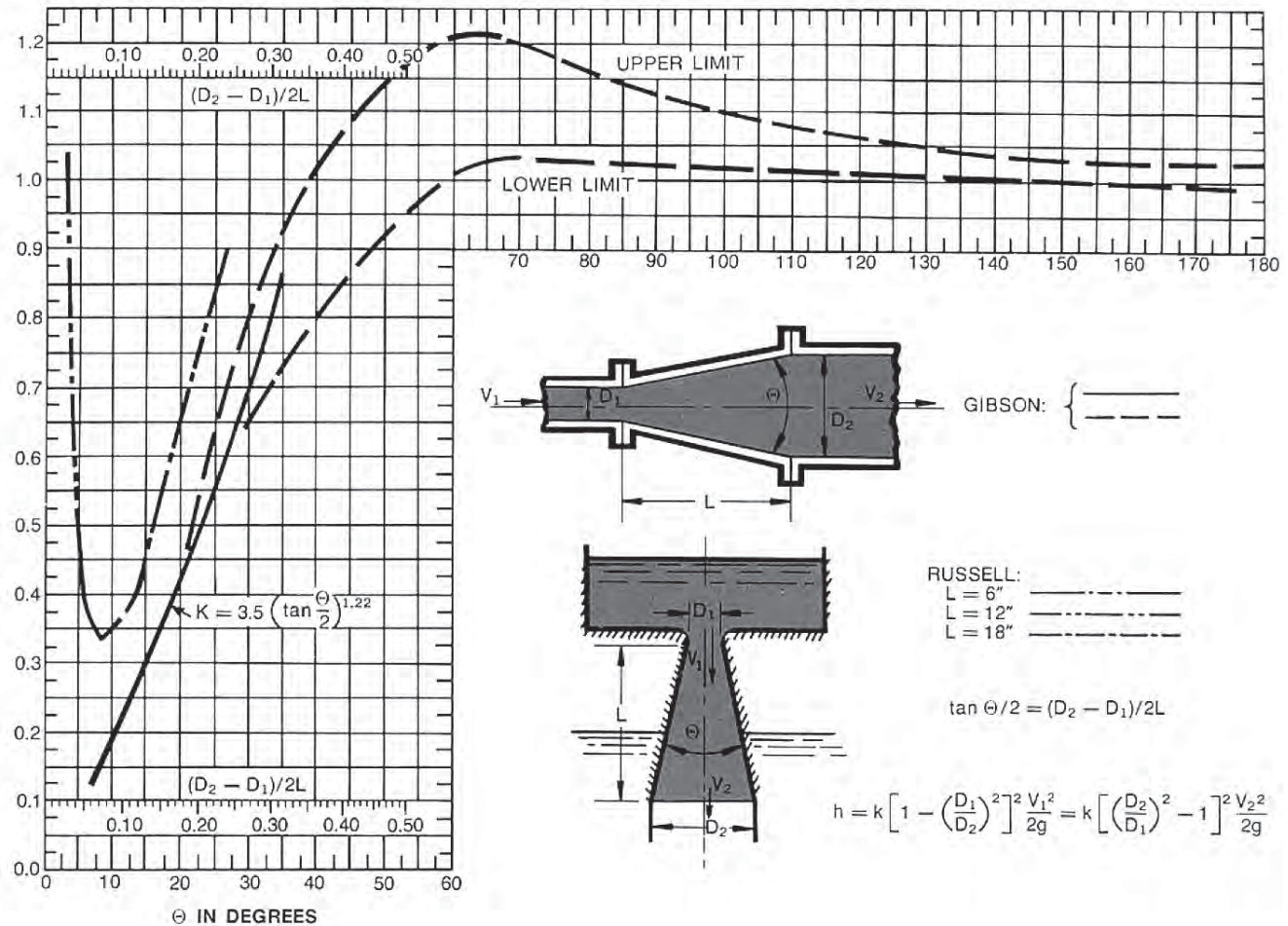


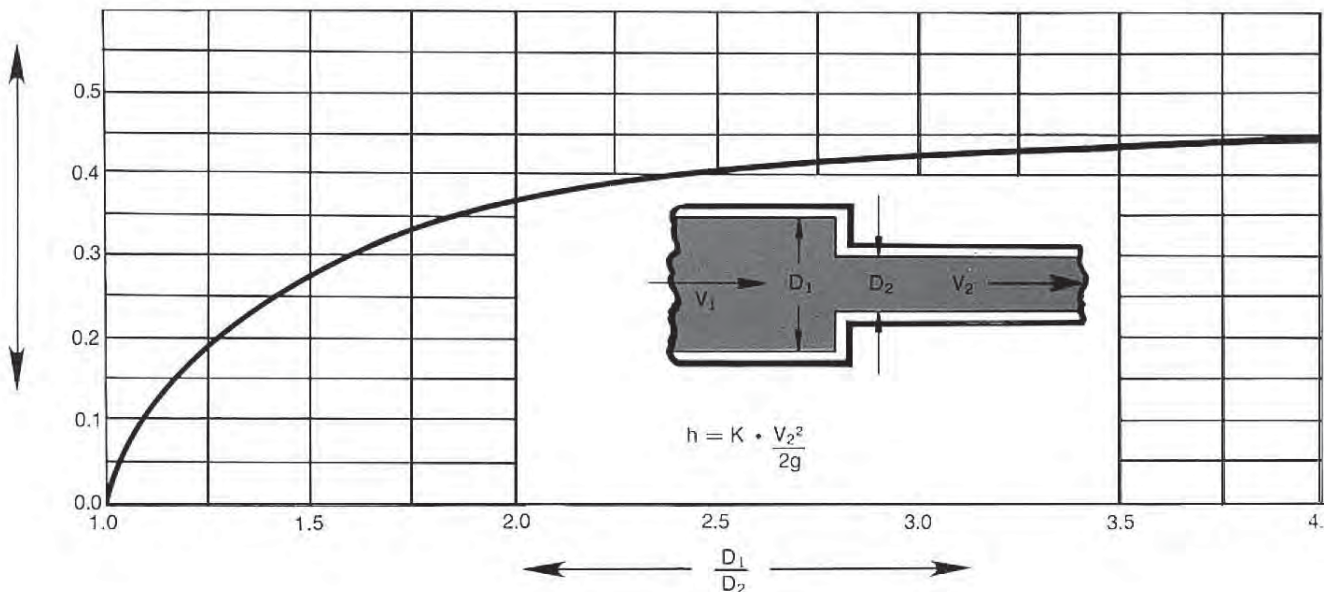
Chart 2  
Reprinted from PIPE FRICTION MANUAL, Third Edition, Copyright 1961 by Hydraulic Institute.

## TECH-C-3 Resistance Coefficients for Increases and Diffusers



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## TECH-C-4 Resistance Coefficients for Reducers



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# TECH-C-5 Properties of Water at Various Temperatures from 32° to 705.4°F

Temp. F	Temp. C	SPECIFIC GRAVITY 60 F Reference	Wt. in Lb/Cu Ft	Vapor Pressure Psi Abs	Vapor Pressure* Feet Abs. (At Temp.)
32	0	1.002	62.42	0.0885	0.204
40	4.4	1.001	62.42	0.1217	0.281
45	7.2	1.001	62.40	0.1471	0.340
50	10.0	1.001	62.38	0.1781	0.411
55	12.8	1.000	62.36	0.2141	0.494
60	15.6	1.000	62.34	0.2653	0.591
65	18.3	.999	62.31	0.3056	0.706
70	21.1	.999	62.27	0.3631	0.839
75	23.9	.998	62.24	0.4298	0.994
80	26.7	.998	62.19	0.5069	1.172
85	29.4	.997	62.16	0.5959	1.379
90	32.2	.996	62.11	0.6982	1.167
95	35.0	.995	62.06	0.8153	1.890
100	37.8	.994	62.00	0.9492	2.203
110	43.3	.992	61.84	1.275	2.965
120	48.9	.990	61.73	1.692	3.943
130	54.4	.987	61.54	2.223	5.196
140	60.0	.985	61.39	2.889	6.766
150	65.5	.982	61.20	3.718	8.735
160	71.1	.979	61.01	4.741	11.172
170	76.7	.975	60.79	5.992	14.178
180	82.2	.972	60.57	7.510	17.825
190	87.7	.968	60.35	9.339	22.257
200	93.3	.966	60.13	11.526	27.584
212	100.0	.959	59.81	14.696	35.353
220	104.4	.956	59.63	17.186	41.343
240	115.6	.948	59.10	24.97	60.77
260	126.7	.939	58.51	35.43	87.05
280	137.8	.929	58.00	49.20	122.18
300	148.9	.919	57.31	67.01	168.22
320	160.0	.909	56.66	89.66	227.55
340	171.1	.898	55.96	118.01	303.17
360	182.2	.886	55.22	153.04	398.49
380	193.3	.874	54.47	195.77	516.75
400	204.4	.860	53.65	247.31	663.42
420	215.6	.847	52.80	308.83	841.17
440	226.7	.833	51.92	381.59	1056.8
460	237.8	.818	51.02	466.9	1317.8
480	248.9	.802	50.00	566.1	1628.4
500	260.0	.786	49.02	680.8	1998.2
520	271.1	.766	47.85	812.4	2446.7
540	282.2	.747	46.51	962.5	2972.5
560	293.3	.727	45.3	1133.1	3595.7
580	304.4	.704	43.9	1325.8	4345.
600	315.6	.679	42.3	1524.9	5242.
620	326.7	.650	40.5	1786.6	6341.
640	337.8	.618	38.5	2059.7	7689.
660	348.9	.577	36.0	2365.4	9458.
680	360.0	.526	32.8	2708.1	11878.
700	371.1	.435	27.1	3039.7	16407.

\* Vapor pressure in feet of water (Abs.) Converted from PSIA using sp. gr. at temperature.



# TECH-C-6 Atmospheric Pressure, Barometric Reading and Boiling Point of Water at Various Altitudes

Altitude		Barometric Reading		Atmospheric Pressure		Boiling Pt. Of Water °F
Feet	Meters	In. Hg.	Mm. Hg.	psia	Ft. Water	
— 1000	— 304.8	31.0	788	15.2	35.2	213.8
— 500	— 152.4	30.5	775	15.0	34.6	212.9
0	0.0	29.9	760	14.7	33.9	212.0
+ 500	+ 152.4	29.4	747	14.4	33.3	211.1
+ 1000	304.8	28.9	734	14.2	32.8	210.2
1500	457.2	28.3	719	13.9	32.1	209.3
2000	609.6	27.8	706	13.7	31.5	208.4
2500	762.0	27.3	694	13.4	31.0	207.4
3000	914.4	26.8	681	13.2	30.4	206.5
3500	1066.8	26.3	668	12.9	29.8	205.6
4000	1219.2	25.8	655	12.7	29.2	204.7
4500	1371.6	25.4	645	12.4	28.8	203.8
5000	1524.0	24.9	633	12.2	28.2	202.9
5500	1676.4	24.4	620	12.0	27.6	201.9
6000	1828.8	24.0	610	11.8	27.2	201.0
6500	1981.2	23.5	597	11.5	26.7	200.1
7000	2133.6	23.1	587	11.3	26.2	199.2
7500	2286.0	22.7	577	11.1	25.7	198.3
8000	2438.4	22.2	564	10.9	25.2	197.4
8500	2590.8	21.8	554	10.7	24.7	196.5
9000	2743.2	21.4	544	10.5	24.3	195.5
9500	2895.6	21.0	533	10.3	23.8	194.6
10000	3048.0	20.6	523	10.1	23.4	193.7
15000	4572.0	16.9	429	8.3	19.2	184.0

# TECH-C-7 Saturation: Temperatures

## Steam Data

Temp. Ft	Abs. press. Lb Sq. In. P	Specific Volume			Enthalpy			Entropy			Temp Ft
		Sat. Liquid $v_f$	Evap $v_{fg}$	Sat. Vapor $v_g$	Sat. Liquid $h_f$	Evap $h_{fg}$	Sat. Vapor $h_g$	Sat. Liquid $s_f$	Sfg $s_{fg}$	Sat Vapor $s_g$	
32	0.08854	0.01602	3306	3306	0.00	1075.8	1075.8	0.0000	2.1877	2.1877	32
35	0.09995	0.01602	2947	2947	3.02	1074.1	1077.1	0.0061	2.1709	2.1770	35
40	0.12170	0.01602	2444	2444	8.05	1071.3	1079.3	0.0162	2.1435	2.1597	40
45	0.14752	0.01602	2036.4	2036.4	13.06	1068.4	1081.5	0.0262	2.1167	2.1429	45
50	0.17811	0.01603	1703.2	1703.2	18.07	1065.6	1083.7	0.0361	2.0903	2.1264	50
60	0.2563	0.01604	1206.6	1206.7	28.06	1059.9	1088.0	0.0555	2.0393	2.0948	60
70	0.3631	0.01606	867.8	867.9	38.04	1054.3	1092.3	0.0745	1.9902	2.0647	70
80	0.5069	0.01608	633.1	633.1	48.02	1048.6	1096.6	0.0932	1.9428	2.0360	80
90	0.6982	0.01610	468.0	468.0	57.99	1042.9	1100.9	0.1115	1.8972	2.0087	90
100	0.9492	0.01613	350.3	350.4	67.97	1037.2	1105.2	0.1295	1.8531	1.9826	100
110	1.2748	0.01617	265.3	265.4	77.94	1031.6	1109.5	0.1471	1.8106	1.9577	110
120	1.6924	0.01620	203.25	203.27	87.92	1025.8	1113.7	0.1645	1.7694	1.9339	120
130	2.2225	0.01625	157.32	157.34	97.90	1020.0	1117.9	0.1816	1.7296	1.9112	130
140	2.8886	0.01629	122.99	123.01	107.89	1014.1	1122.0	0.1984	1.6910	1.8894	140
150	3.718	0.01634	97.06	97.07	117.89	1008.2	1126.1	0.2149	1.6537	1.8685	150
160	4.741	0.01639	77.27	77.29	127.89	1002.3	1130.2	0.2311	1.6174	1.8485	160
170	5.992	0.01645	62.04	62.06	137.90	996.3	1134.2	0.2472	1.5822	1.8293	170
180	7.510	0.01651	50.21	50.23	147.92	990.2	1138.1	0.2630	1.5480	1.8109	180
190	9.339	0.01657	40.94	40.96	157.95	984.1	1142.0	0.2785	1.5147	1.7932	190
200	11.526	0.01663	33.62	33.64	167.99	977.9	1145.9	0.2938	1.4824	1.7762	200
210	14.123	0.01670	27.80	27.82	178.05	971.6	1149.7	0.3090	1.4508	1.7598	210
212	14.696	0.01672	26.78	26.80	180.07	970.3	1150.4	0.3120	1.4446	1.7566	212
220	17.186	0.01677	23.13	23.15	188.13	965.2	1153.4	0.3239	1.4201	1.7440	220
230	20.780	0.01684	19.365	19.382	198.23	958.8	1157.0	0.3387	1.3901	1.7288	230
240	24.969	0.01692	16.306	16.323	208.34	952.2	1160.5	0.3531	1.3609	1.7140	240
250	29.825	0.01700	13.804	13.821	218.48	945.5	1164.0	0.3675	1.3323	1.6998	250
260	35.429	0.01709	11.746	11.763	228.64	938.7	1167.3	0.3817	1.3043	1.6860	260
270	41.858	0.01717	10.044	10.061	238.84	931.8	1170.6	0.3958	1.2769	1.6727	270
280	49.203	0.01726	8.628	8.645	249.06	924.7	1173.8	0.4096	1.2501	1.6597	280
290	57.556	0.01735	7.444	7.461	259.31	917.5	1176.8	0.4234	1.2238	1.6472	290
300	67.013	0.01745	6.449	6.446	269.59	910.1	1179.7	0.4369	1.1980	1.6350	300
320	89.66	0.01765	4.896	4.914	290.28	894.9	1185.2	0.4637	1.1478	1.6115	320
340	118.01	0.01787	3.770	3.788	311.13	879.0	1190.1	0.4900	1.0992	1.5891	340
360	153.04	0.01811	2.939	2.957	332.18	862.2	1194.4	0.5158	1.0519	1.5677	360
380	195.77	0.01836	2.317	2.335	353.45	844.6	1198.1	0.5413	1.0059	1.5471	380
400	247.31	0.01864	1.8447	1.8633	374.97	826.0	1201.0	0.5664	0.9608	1.5272	400
420	308.83	0.01894	1.4811	1.5000	396.77	806.3	1203.1	0.5912	0.9166	1.5078	420
440	381.59	0.01926	1.1979	1.2171	418.90	785.4	1204.3	0.6158	0.8730	1.4887	440
460	466.9	0.0196	0.9748	0.9944	441.4	763.2	1204.6	0.6402	0.8298	1.4700	460
480	566.1	0.0200	0.7972	0.8172	464.4	739.4	1203.7	0.6645	0.7868	1.4513	480
500	680.8	0.0204	0.6545	0.6749	487.8	713.9	1201.7	0.6887	0.7438	1.4325	500
520	812.4	0.0209	0.5385	0.5594	511.9	686.4	1198.2	0.7130	0.7006	1.4136	520
540	962.5	0.0215	0.4434	0.4649	536.6	656.6	1193.2	0.7374	0.6568	1.3942	540
560	1133.1	0.0221	0.3647	0.3868	562.2	624.2	1186.4	0.7621	0.6121	1.3742	560
580	1325.8	0.0228	0.2989	0.3217	588.9	588.4	1177.3	0.7872	0.5659	1.3532	580
600	1542.9	0.0236	0.2432	0.2668	617.0	548.5	1165.5	0.8131	0.5176	1.3307	600
620	1786.6	0.0247	0.1955	0.2201	646.7	503.6	1150.3	0.8398	0.4664	1.3062	620
640	2059.7	0.0260	0.1538	0.1798	678.6	452.0	1130.5	0.8679	0.4110	1.2789	640
660	2365.4	0.0278	0.1165	0.1442	714.2	390.2	1104.4	0.8987	0.3485	1.2472	660
680	2708.1	0.0305	0.0810	0.1115	757.3	309.9	1067.2	0.9351	0.2719	1.2071	680
700	3093.7	0.0369	0.0392	0.0761	823.3	172.1	995.4	0.9905	0.1484	1.1389	700
705.4	3206.2	0.0503	0	0.0503	902.7	0	902.7	1.0680	0	1.0580	705.4

# TECH-C-8 Saturation: Pressures

## Steam Data

Abs. press. Lb Sq. In. p	Temp. Liquid t	Specific Volume		Enthalpy			Entropy			Internal Energy			Abs. press. Lb Sq. In. P
		Sat. Vapor $v_f$	Sat. Liquid $v_g$	Sat. Liquid $h_r$	Evap $h_{fg}$	Sat. Vapor $h_g$	Sat. Liquid $s_f$	Evap $s_{fg}$	Sat Vapor $s_g$	Sat. Liquid $u_f$	Evap $u_{fg}$	Sat Vapor $u_g$	
1.0	101.74	0.01614	333.6	69.70	1036.3	1106.0	0.1326	1.8456	1.9782	69.70	974.6	1044.2	1.0
2.0	126.08	0.01623	173.73	93.99	1022.2	1116.2	0.1749	1.7451	1.9200	93.98	957.9	1051.9	2.0
3.0	141.48	0.01630	118.71	109.37	1031.2	1122.6	0.2008	1.6855	1.8863	109.36	947.3	1056.7	3.0
4.0	152.97	0.01636	90.63	120.86	1006.4	1127.3	0.2198	1.6427	1.8625	120.85	939.3	1060.2	4.0
5.0	162.24	0.01640	73.52	130.13	1001.0	1131.1	0.2347	1.6094	1.8441	130.12	933.0	1063.1	5.0
6.0	170.06	0.01645	61.98	137.96	996.2	1134.2	0.2472	1.5820	1.8292	137.94	927.5	1065.4	6.0
7.0	176.85	0.01649	53.64	144.76	992.1	1136.9	0.2581	1.5586	1.8167	144.74	922.7	1067.4	7.0
8.0	182.86	0.01653	47.34	150.79	988.5	1139.3	0.2674	1.5383	1.8057	150.77	918.4	1069.2	8.0
9.0	188.28	0.01656	42.40	156.22	985.2	1141.4	0.2759	1.5203	1.7962	156.19	914.6	1070.8	9.0
10	193.21	0.01659	38.42	161.17	982.1	1143.3	0.2835	1.5041	1.7876	161.14	911.1	1072.2	10
14.696	212.00	0.01672	26.80	180.07	970.3	1150.4	0.3120	1.4446	1.7566	180.02	897.5	1077.5	14.696
15	213.03	0.01672	26.29	181.11	969.7	1150.8	0.3135	1.4115	1.7549	181.06	896.7	1077.8	15
20	227.96	0.01683	20.089	196.16	960.1	1156.3	0.3356	1.3962	1.7319	196.10	885.8	1081.9	20
30	250.33	0.01701	13.746	218.82	945.3	1164.1	0.3680	1.3313	1.6993	218.73	869.1	1087.8	30
40	267.25	0.01715	10.498	236.03	933.7	1169.7	0.3919	1.2844	1.6763	235.90	856.1	1092.0	40
50	281.01	0.01727	8.515	250.09	924.0	1174.1	0.4110	1.2474	1.6585	249.93	845.4	1095.3	50
60	292.71	0.01738	7.175	262.09	915.5	1177.6	0.4270	1.2168	1.6438	261.90	836.0	1097.9	60
70	302.92	0.01748	6.206	272.61	907.9	1180.6	0.4409	1.1906	1.6315	272.38	827.8	1100.2	70
80	312.03	0.01757	5.472	282.02	901.1	1183.1	0.4531	1.1676	1.6207	281.76	820.3	1102.1	80
90	320.27	0.01766	4.896	290.56	894.7	1185.3	0.4641	1.1471	1.6112	290.27	813.4	1103.7	90
100	327.81	0.01774	4.432	298.40	888.8	1187.2	0.4740	1.1286	1.6026	298.08	807.1	1105.2	100
120	341.25	0.01789	3.728	312.44	877.9	1190.4	0.4916	1.0962	1.5878	312./05	795.6	1107.6	120
140	353.02	0.01802	3.220	324.82	868.2	1193.0	0.5069	1.0682	1.5751	324.35	785.2	1109.6	140
160	363.53	0.01815	2.834	335.93	859.2	1195.1	0.5204	1.0436	1.5640	335.39	775.8	1111.2	160
180	373.06	0.01827	2.532	346.03	850.8	1196.9	0.5325	1.0217	1.5542	345.42	767.1	1112.5	180
200	381.79	0.01839	2.288	355.36	843.0	1198.4	0.5435	1.0018	1.5453	354.68	759.0	1113.7	200
250	400.95	0.01865	1.8438	376.00	825.1	1201.1	0.5676	0.9588	1.5263	375.14	740.7	1115.8	250
300	417.33	0.01890	1.5433	393.84	809.1	1202.8	0.5879	0.9225	1.5104	392.79	724.3	1117.1	300
350	431.72	0.01913	1.3260	409.69	794.2	1203.9	0.6056	0.8910	1.4966	408.55	709.6	1118.0	350
400	444.59	0.0193	1.1613	424.0	780.5	1204.5	0.6214	0.8630	1.4844	422.6	695.9	1118.5	400
450	456.28	0.0195	1.0320	437.2	767.4	1204.6	0.6356	0.8378	1.4734	435.5	683.2	1118.7	450
500	467.01	0.0197	0.9278	449.4	755.0	1204.4	0.6487	0.8147	1.4634	447.6	671.0	1118.6	500
550	476.93	0.0199	0.8422	460.8	743.1	1203.9	0.6608	0.7934	1.4542	458.8	659.4	1118.2	550
600	486.21	0.0201	0.7698	471.6	731.6	1203.2	0.6720	0.7734	1.4454	469.4	648.3	1117.7	600
700	503.10	0.0205	0.6554	491.5	709.7	1201.2	0.6925	0.7371	1.4296	488.8	627.5	1116.3	700
800	518.23	0.0209	0.5687	509.7	688.9	1198.6	0.7108	0.7054	1.4235	506.6	607.8	1114.4	800
900	531.98	0.0212	0.5006	526.6	668.8	1195.4	0.7275	0.6744	1.4020	523.1	589.0	1112.1	900
1000	544.61	0.0216	0.4456	542.4	649.4	1191.8	0.7430	0.6467	1.3897	538.4	571.0	1109.4	1000
1100	556.31	0.0220	0.4001	557.4	630.4	1187.8	0.7575	0.6205	1.3780	552.9	553.5	1106.4	1100
1200	567.22	0.0223	0.3619	571.7	611.7	1183.4	0.7711	0.5956	1.3667	566.7	536.3	1103.0	1200
1300	577.46	0.0227	0.3293	585.4	593.2	1178.6	0.7840	0.5719	1.3559	580.0	519.4	1099.4	1300
1400	587.10	0.0231	0.3012	598.7	574.7	1173.4	0.7963	0.5491	1.3454	592.7	502.7	1095.4	1400
1500	596.23	0.0235	0.2765	611.6	556.3	1167.9	0.8082	0.5269	1.3351	605.1	486.1	1091.2	1500
2000	635.82	0.0257	0.1878	671.7	463.4	1135.1	0.8619	0.4230	1.2849	662.2	403.4	1065.6	2000
2500	668.13	0.0287	0.1307	730.6	360.5	1091.1	0.9126	0.3197	1.2322	717.3	313.3	1030.6	2500
3000	695.36	0.0346	0.0858	802.5	217.8	1020.3	0.9731	0.1885	1.1615	783.4	189.3	972.7	3000
3206.2	705.40	0.0503	0.0503	902.7	0	902.7	1.0580	0	1.0580	872.9	0	872.9	3206.2