



# E20-4G SED/J66

File: EQUIPMENT MANUAL - Section 20  
Replaces: E20-4G/D63  
Dist: 1, 1a, 1b, 1c, 4, 4b, 4c

# ENGINEERING DATA AND TABLES



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SECTION I - AMMONIA

THERMODYNAMIC PROPERTIES

TEMP F	PRESSURE		VOLUME		DENSITY		ENTHALPY			ENTROPY		TEMP F
	lb per sq in		cu ft per lb		lb per cu ft		Btu per lb			Btu per (lb) (°R)		
t	Absolute P	Gage p	Liquid v <sub>f</sub>	Vapor v <sub>g</sub>	Liquid l/v <sub>f</sub>	Vapor l/v <sub>g</sub>	Liquid h <sub>f</sub>	Latent h <sub>fg</sub>	Vapor h <sub>g</sub>	Liquid s <sub>f</sub>	Vapor s <sub>g</sub>	t
(Critical)												(Critical)
-107.86	0.878	28.1*	0.02182	251.3	45.83	0.00398	-71.6	640.6	569.0	-0.1859	1.6354	-107.86
-107	0.912	28.1*		242.4		.00413	-70.6	640.0	569.4	-.1833	1.6320	-107
-106	0.954	28.0*		232.6		.00430	-69.6	639.4	569.8	-.1803	1.6281	-106
-105	0.996	27.9*		223.2		0.00448	-68.5	638.8	570.3	-0.1774	1.6243	-105
-104	1.041	27.8*		214.2		.00467	-67.5	638.2	570.7	-.1744	1.6205	-104
-103	1.087	27.7*		205.7		.00486	-66.4	637.6	571.2	-.1714	1.6167	-103
-102	1.135	27.6*		197.6		.00506	-65.4	637.0	571.6	-.1685	1.6129	-102
-101	1.184	27.5*		189.8		.00527	-64.3	636.4	572.1	-.1655	1.6092	-101
-100	1.24	27.4*	0.02197	182.4	45.52	0.00548	-63.3	635.8	572.5	-0.1626	1.6055	-100
-99	1.29	27.3*		175.3		.00571	-62.2	635.2	572.9	-.1597	1.6018	-99
-98	1.34	27.2*		168.5		.00593	-61.2	634.6	573.4	-.1568	1.5982	-98
-97	1.40	27.1*		162.1		.00617	-60.1	633.9	573.8	-.1539	1.5945	-97
-96	1.46	26.9*		155.9		.00641	-59.1	633.3	574.3	-.1510	1.5910	-96
-95	1.52	26.8*	0.02207	150.0	45.32	0.00667	-58.0	632.7	574.7	-0.1481	1.5874	-95
-94	1.59	26.7*		144.3		.00693	-57.0	632.1	575.1	-.1452	1.5838	-94
-93	1.65	26.6*		138.9		.00720	-55.9	631.5	575.6	-.1423	1.5803	-93
-92	1.72	26.4*		133.8		.00747	-54.9	630.9	576.0	-.1395	1.5768	-92
-91	1.79	26.3*		128.9		.00776	-53.8	630.3	576.5	-.1366	1.5734	-91
-90	1.86	26.1*	0.02216	124.1	45.12	0.00806	-52.8	629.7	576.9	-0.1338	1.5699	-90
-89	1.94	26.0*		119.6		.00836	-51.7	629.0	577.3	-.1309	1.5665	-89
-88	2.02	25.8*		115.3		.00868	-50.7	628.4	577.8	-.1281	1.5631	-88
-87	2.10	25.6*		111.1		.00900	-49.6	627.8	578.2	-.1253	1.5597	-87
-86	2.18	25.5*		107.1		.00933	-48.6	627.2	578.6	-.1225	1.5564	-86
-85	2.27	25.3*	0.02226	103.3	44.92	0.00968	-47.5	626.6	579.1	-0.1197	1.5531	-85
-84	2.35	25.1*		99.68		.01003	-46.5	625.9	579.5	-.1169	1.5498	-84
-83	2.45	24.9*		96.17		.01040	-45.4	625.3	579.9	-.1141	1.5465	-83
-82	2.54	24.7*		92.81		.01077	-44.4	624.7	580.4	-.1113	1.5432	-82
-81	2.64	24.5*		89.59		.01116	-43.3	624.1	580.8	-.1085	1.5400	-81
-80	2.74	24.3*	0.02236	86.50	44.72	0.01156	-42.2	623.5	581.2	-0.1057	1.5368	-80
-79	2.84	24.1*		83.54		.01197	-41.2	622.8	581.6	-.1030	1.5336	-79
-78	2.95	23.9*		80.69		.01239	-40.1	622.2	582.1	-.1002	1.5304	-78
-77	3.06	23.7*		77.96		.01283	-39.1	621.6	582.5	-.0975	1.5273	-77
-76	3.18	23.5*		75.33		.01327	-38.0	621.0	582.9	-.0947	1.5242	-76
-75	3.29	23.2*	0.02246	72.81	44.52	0.01373	-37.0	620.3	583.3	-0.0920	1.5211	-75
-74	3.42	23.0*		70.39		.01421	-35.9	619.7	583.8	-.0892	1.5180	-74
-73	3.54	22.7*		68.06		.01469	-34.9	619.1	584.2	-.0865	1.5149	-73
-72	3.67	22.4*		65.82		.01519	-33.8	618.4	584.6	-.0838	1.5119	-72
-71	3.80	22.2*		63.67		.01571	-32.8	617.8	585.0	-.0811	1.5089	-71
-70	3.94	21.9*	0.02256	61.60	44.32	0.01623	-31.7	617.2	585.5	-0.0784	1.5059	-70
-69	4.08	21.6*		59.61		.01678	-30.7	616.6	585.9	-.0757	1.5029	-69
-68	4.23	21.3*		57.69		.01733	-29.6	615.9	586.3	-.0730	1.4999	-68
-67	4.38	21.0*		55.85		.01791	-28.6	615.3	586.7	-.0703	1.4970	-67
-66	4.53	20.7*		54.08		.01849	-27.5	614.6	587.1	-.0676	1.4940	-66
-65	4.69	20.4*	0.02267	52.37	44.11	0.01910	-26.5	614.0	587.5	-0.0650	1.4911	-65
-64	4.85	20.0*		50.73		.01971	-25.4	613.4	588.0	-.0623	1.4883	-64
-63	5.02	19.7*		49.14		.02035	-24.4	612.7	588.4	-.0596	1.4854	-63
-62	5.19	19.4*		47.62		.02100	-23.3	612.1	588.8	-.0570	1.4826	-62
-61	5.37	19.0*		46.15		.02167	-22.2	611.4	589.2	-.0543	1.4797	-61
-60	5.55	18.6*	0.02278	44.73	43.91	0.02235	-21.2	610.8	589.6	-0.0517	1.4769	-60
-59	5.74	18.2*		43.37		.02306	-20.1	610.1	590.0	-.0490	1.4741	-59
-58	5.93	17.8*		42.05		.02378	-19.1	609.5	590.4	-.0464	1.4713	-58
-57	6.13	17.4*		40.79		.02452	-18.0	608.8	590.8	-.0438	1.4686	-57
-56	6.33	17.0*		39.56		.02528	-17.0	608.2	591.2	-.0412	1.4658	-56
-55	6.54	16.6*	0.02288	38.38	43.70	0.02605	-15.9	607.5	591.6	-0.0386	1.4631	-55
-54	6.75	16.2*		37.24		.02685	-14.8	606.9	592.1	-.0360	1.4604	-54
-53	6.97	15.7*		36.15		.02766	-13.8	606.2	592.4	-.0334	1.4577	-53
-52	7.20	15.3*		35.09		.02850	-12.7	605.6	592.9	-.0307	1.4551	-52
-51	7.43	14.8*		34.06		.02936	-11.7	604.9	593.2	-.0281	1.4524	-51
-50	7.67	14.3*	0.02299	33.08	43.49	0.03023	-10.6	604.3	593.7	-0.0256	1.4497	-50
-49	7.91	13.8*		32.12		.03113	-9.6	603.6	594.0	-.0230	1.4471	-49
-48	8.16	13.3*		31.20		.03205	-8.5	602.9	594.4	-.0204	1.4445	-48
-47	8.42	12.8*		30.31		.03299	-7.4	602.3	594.9	-.0179	1.4419	-47
-46	8.68	12.2*		29.45		.03395	-6.4	601.6	595.2	-0.0153	1.4393	-46

\* Inches of mercury below one atmosphere

SECTION I - AMMONIA

THERMODYNAMIC PROPERTIES - Con't.

TEMP F	PRESSURE lb per sq in		VOLUME cu ft per lb		DENSITY lb per cu ft		ENTHALPY Btu per lb			ENTROPY Btu per (lb) (°R)		TEMP F
	t	Absolute P	Gage p	Liquid v <sub>f</sub>	Vapor v <sub>g</sub>	Liquid l/v <sub>f</sub>	Vapor l/v <sub>g</sub>	Liquid h <sub>f</sub>	Latent h <sub>fg</sub>	Vapor h <sub>g</sub>	Liquid s <sub>f</sub>	
-45	8.95	11.7*	0.02310	28.62	43.28	0.03494	-5.3	600.9	595.6	-0.0127	1.4368	-45
-44	9.23	11.1*		27.82		.03595	-4.3	600.3	596.0	-.0102	1.4342	-44
-43	9.51	10.6*		27.04		.03698	-3.2	599.6	596.4	-.0076	1.4317	-43
-42	9.81	10.0*		26.29		.03804	-2.1	598.9	596.8	-.0051	1.4292	-42
-41	10.10	9.3*		25.56		.03912	-1.1	598.3	597.2	-.0025	1.4267	-41
-40	10.41	8.7*	0.02322	24.86	43.08	0.04022	0.0	597.6	597.6	0.0000	1.4242	-40
-39	10.72	8.1*		24.18		.04135	1.1	596.9	598.0	.0025	1.4217	-39
-38	11.04	7.4*		23.53		.04251	2.1	596.2	598.3	.0051	1.4193	-38
-37	11.37	6.8*		22.89		.04369	3.2	595.5	598.7	.0076	1.4169	-37
-36	11.71	6.1*		22.27		.04489	4.3	594.8	599.1	.0101	1.4144	-36
-35	12.05	5.4*	0.02333	21.68	42.86	0.04613	5.3	594.2	599.5	0.0126	1.4120	-35
-34	12.41	4.7*		21.10		.04739	6.4	593.5	599.9	.0151	1.4096	-34
-33	12.77	3.9*		20.54		.04868	7.4	592.8	600.2	.0176	1.4072	-33
-32	13.14	3.2*		20.00		.04999	8.5	592.1	600.6	.0201	1.4048	-32
-31	13.52	2.4*		19.48		.05134	9.6	591.4	601.0	.0226	1.4025	-31
-30	13.90	1.6*	0.02345	18.97	42.65	0.05271	10.7	590.7	601.4	0.0250	1.4001	-30
-29	14.30	0.8*		18.48		.05411	11.7	590.0	601.7	.0275	1.3978	-29
-28	14.71	0.0		18.00		.05555	12.8	589.3	602.1	.0300	1.3955	-28
-27	15.12	0.4		17.54		.05701	13.9	588.6	602.5	.0325	1.3932	-27
-26	15.55	0.8		17.09		.05850	14.9	587.9	602.8	.0350	1.3909	-26
-25	15.98	1.3	0.02357	16.66	42.44	0.06003	16.0	587.2	603.2	0.0374	1.3886	-25
-24	16.42	1.7		16.24		.06158	17.1	586.5	603.6	.0399	1.3863	-24
-23	16.88	2.2		15.83		.06317	18.1	585.8	603.9	.0423	1.3840	-23
-22	17.34	2.6		15.43		.06479	19.2	585.1	604.3	.0448	1.3818	-22
-21	17.81	3.1		15.05		.06644	20.3	584.3	604.6	.0472	1.3796	-21
-20	18.30	3.6	0.02369	14.68	42.22	0.06813	21.4	583.6	605.0	0.0497	1.3774	-20
-19	18.79	4.1		14.32		.06985	22.4	582.9	605.3	.0521	1.3752	-19
-18	19.30	4.6		13.97		.07161	23.5	582.2	605.7	.0545	1.3729	-18
-17	19.81	5.1		13.62		.07340	24.6	581.5	606.1	.0570	1.3708	-17
-16	20.34	5.6		13.29		.07522	25.6	580.8	606.4	.0594	1.3686	-16
-15	20.88	6.2	0.02381	12.97	42.00	0.07709	26.7	580.0	606.7	0.0618	1.3664	-15
-14	21.43	6.7		12.66		.07898	27.8	579.3	607.1	.0642	1.3643	-14
-13	21.99	7.3		12.36		.08092	28.9	578.6	607.5	.0666	1.3621	-13
-12	22.56	7.9		12.06		.08289	30.0	577.8	607.8	.0690	1.3600	-12
-11	23.15	8.5		11.78		.08490	31.0	577.1	608.1	.0714	1.3579	-11
-10	23.74	9.0	0.02393	11.50	41.78	0.08695	32.1	576.4	608.5	0.0738	1.3558	-10
-9	24.35	9.7		11.23		.08904	33.2	575.6	608.8	.0762	1.3537	-9
-8	24.97	10.3		10.97		.09117	34.3	574.9	609.2	.0786	1.3516	-8
-7	25.61	10.9		10.71		.09334	35.4	574.1	609.5	.0809	1.3495	-7
-6	26.26	11.6		10.47		.09555	36.4	573.4	609.8	.0833	1.3474	-6
-5	26.92	12.2	0.02406	10.23	41.56	0.09780	37.5	572.6	610.1	0.0857	1.3454	-5
-4	27.59	12.9		9.991		.1001	38.6	571.9	610.5	.0880	1.3433	-4
-3	28.28	13.6		9.763		.1024	39.7	571.1	610.8	.0904	1.3413	-3
-2	28.98	14.3		9.541		.1048	40.7	570.4	611.1	.0928	1.3393	-2
-1	29.69	15.0		9.326		.1072	41.8	569.6	611.4	.0951	1.3372	-1
0	30.42	15.7	0.02419	9.116	41.34	0.1097	42.9	568.9	611.8	0.0975	1.3352	0
1	31.16	16.5		8.912		.1122	44.0	568.1	612.1	.0998	1.3332	1
2	31.92	17.2		8.714		.1148	45.1	567.3	612.4	.1022	1.3312	2
3	32.69	18.0		8.521		.1174	46.2	566.5	612.7	.1045	1.3292	3
4	33.47	18.8		8.333		.1200	47.2	565.8	613.0	.1069	1.3273	4
5	34.27	19.6	0.02432	8.150	41.11	0.1227	48.3	565.0	613.3	0.1092	1.3253	5
6	35.09	20.4		7.971		.1254	49.4	564.2	613.6	.1115	1.3234	6
7	35.92	21.2		7.798		.1282	50.5	563.4	613.9	.1138	1.3214	7
8	36.77	22.1		7.629		.1311	51.6	562.7	614.3	.1162	1.3195	8
9	37.63	22.9		7.464		.1340	52.7	561.9	614.6	.1185	1.3176	9
10	38.51	23.8	0.02446	7.304	40.89	0.1369	53.8	561.1	614.9	0.1208	1.3157	10
11	39.40	24.7		7.148		.1399	54.9	560.3	615.2	.1231	1.3137	11
12	40.31	25.6		6.996		.1429	56.0	559.5	615.5	.1254	1.3118	12
13	41.24	26.5		6.847		.1460	57.1	558.7	615.8	.1277	1.3099	13
14	42.18	27.5		6.703		.1492	58.2	557.9	616.1	.1300	1.3081	14
15	43.14	28.4	0.02460	6.562	40.66	0.1524	59.2	557.1	616.3	0.1323	1.3062	15
16	44.12	29.4		6.425		.1556	60.3	556.3	616.6	.1346	1.3043	16
17	45.12	30.4		6.291		.1590	61.4	555.5	616.9	.1369	1.3025	17
18	46.13	31.4		6.163		.1623	62.5	554.7	617.2	.1392	1.3006	18
19	47.16	32.5		6.034		0.1657	63.6	553.9	617.5	0.1415	1.2988	19

\* Inches of mercury below one atmosphere

SECTION I - AMMONIA

THERMODYNAMIC PROPERTIES - Con't.

TEMP F	PRESSURE lb per sq in		VOLUME cu ft per lb		DENSITY lb per cu ft		ENTHALPY Btu per lb			ENTROPY Btu per (lb) (°R)		TEMP F
	t	Absolute P	Gage p	Liquid v <sub>f</sub>	Vapor v <sub>g</sub>	Liquid l/v <sub>f</sub>	Vapor l/v <sub>g</sub>	Liquid h <sub>f</sub>	Latent h <sub>fg</sub>	Vapor h <sub>g</sub>	Liquid s <sub>f</sub>	
20	48.21	33.5	0.02474	5.910	40.43	0.1692	64.7	553.1	617.8	0.1437	1.2969	20
21	49.28	34.6		5.789		.1728	65.8	552.2	618.0	.1460	1.2951	21
22	50.36	35.7		5.671		.1763	66.9	551.4	618.3	.1483	1.2933	22
23	51.47	36.8		5.556		.1800	68.0	550.6	618.6	.1505	1.2915	23
24	52.59	37.9		5.443		.1837	69.1	549.8	618.9	.1528	1.2897	24
25	53.73	39.0	0.02488	5.334	40.20	0.1875	70.2	548.9	619.1	0.1551	1.2879	25
26	54.90	40.2		5.227		.1913	71.3	548.1	619.4	.1573	1.2861	26
27	56.08	41.4		5.123		.1952	72.4	547.3	619.7	.1596	1.2843	27
28	57.28	42.6		5.021		.1992	73.5	546.4	619.9	.1618	1.2825	28
29	58.50	43.8		4.922		.2032	74.6	545.6	620.2	.1641	1.2808	29
30	59.74	45.0	0.02503	4.825	39.96	0.2073	75.7	544.8	620.5	0.1663	1.2790	30
31	61.00	46.3		4.730		.2114	76.8	543.9	620.7	.1686	1.2773	31
32	62.29	47.6		4.637		.2156	77.9	543.1	621.0	.1708	1.2755	32
33	63.59	48.9		4.547		.2199	79.0	542.2	621.2	.1730	1.2738	33
34	64.91	50.2		4.459		.2243	80.1	541.4	621.5	.1753	1.2721	34
35	66.26	51.6	0.02518	4.373	39.72	0.2287	81.2	540.5	621.7	0.1775	1.2704	35
36	67.63	52.9		4.289		.2332	82.3	539.7	622.0	.1797	1.2686	36
37	69.02	54.3		4.207		.2377	83.4	538.8	622.2	.1819	1.2669	37
38	70.43	55.7		4.126		.2423	84.6	537.9	622.5	.1841	1.2652	38
39	71.87	57.2		4.048		.2470	85.7	537.0	622.7	.1863	1.2635	39
40	73.32	58.6	0.02533	3.971	39.49	0.2518	86.8	536.2	623.0	0.1885	1.2618	40
41	74.80	60.1		3.897		.2566	87.9	535.3	623.2	.1908	1.2602	41
42	76.31	61.6		3.823		.2616	89.0	534.4	623.4	.1930	1.2585	42
43	77.83	63.1		3.752		.2665	90.1	533.6	623.7	.1952	1.2568	43
44	79.38	64.7		3.682		.2716	91.2	532.7	623.9	.1974	1.2552	44
45	80.96	66.3	0.02548	3.614	39.24	0.2767	92.3	531.8	624.1	0.1996	1.2535	45
46	82.55	67.9		3.547		.2819	93.5	530.9	624.4	.2018	1.2519	46
47	84.18	69.5		3.481		.2872	94.6	530.0	624.6	.2040	1.2502	47
48	85.82	71.1		3.418		.2926	95.7	529.1	624.8	.2062	1.2486	48
49	87.49	72.8		3.355		.2981	96.8	528.2	625.0	.2083	1.2469	49
50	89.19	74.5	0.02564	3.294	39.00	0.3036	97.9	527.3	625.2	0.2105	1.2453	50
51	90.91	76.2		3.234		.3092	99.1	526.4	625.5	.2127	1.2437	51
52	92.66	78.0		3.176		.3149	100.2	525.5	625.7	.2149	1.2421	52
53	94.43	79.7		3.119		.3207	101.3	524.6	625.9	.2171	1.2405	53
54	96.23	81.5		3.063		.3265	102.4	523.7	626.1	.2192	1.2389	54
55	98.06	83.4	0.02581	3.008	38.75	0.3325	103.5	522.8	626.3	0.2214	1.2373	55
56	99.91	85.2		2.954		.3385	104.7	521.8	626.5	.2236	1.2357	56
57	101.8	87.1		2.902		.3446	105.8	520.9	626.7	.2257	1.2341	57
58	103.7	89.0		2.851		.3508	106.9	520.0	626.9	.2279	1.2325	58
59	105.6	90.9		2.800		.3571	108.1	519.0	627.1	.2301	1.2310	59
60	107.6	92.9	0.02597	2.751	38.50	0.3635	109.2	518.1	627.3	0.2322	1.2294	60
61	109.6	94.9		2.703		.3700	110.3	517.2	627.5	.2344	1.2278	61
62	111.6	96.9		2.656		.3765	111.5	516.2	627.7	.2365	1.2262	62
63	113.6	98.9		2.610		.3832	112.6	515.3	627.9	.2387	1.2247	63
64	115.7	101.0		2.565		.3899	113.7	514.3	628.0	.2408	1.2231	64
65	117.8	103.1	0.02614	2.520	38.25	0.3968	114.8	513.4	628.2	0.2430	1.2216	65
66	120.0	105.3		2.477		.4037	116.0	512.4	628.4	.2451	1.2201	66
67	122.1	107.4		2.435		.4108	117.1	511.5	628.6	.2473	1.2186	67
68	124.3	109.6		2.393		.4179	118.3	510.5	628.8	.2494	1.2170	68
69	126.5	111.8		2.352		.4251	119.4	509.5	628.9	.2515	1.2155	69
70	128.8	114.1	0.02632	2.312	38.00	0.4325	120.5	508.6	629.1	0.2537	1.2140	70
71	131.1	116.4		2.273		.4399	121.7	507.6	629.3	.2558	1.2125	71
72	133.4	118.7		2.235		.4474	122.8	506.6	629.4	.2579	1.2110	72
73	135.7	121.0		2.197		.4551	124.0	505.6	629.6	.2601	1.2095	73
74	138.1	123.4		2.161		.4628	125.1	504.7	629.8	.2622	1.2080	74
75	140.5	125.8	0.02650	2.125	37.74	0.4707	126.2	503.7	629.9	0.2643	1.2065	75
76	143.0	128.3		2.089		.4786	127.4	502.7	630.1	.2664	1.2050	76
77	145.4	130.7		2.055		.4867	128.5	501.7	630.2	.2685	1.2035	77
78	147.9	133.2		2.021		.4949	129.7	500.7	630.4	.2706	1.2020	78
79	150.5	135.8		1.988		.5031	130.8	499.7	630.5	.2728	1.2006	79
80	153.0	138.3	0.02668	1.955	37.48	0.5115	132.0	498.7	630.7	0.2749	1.1991	80
81	155.6	140.9		1.923		.5200	133.1	497.7	630.8	.2769	1.1976	81
82	158.3	143.6		1.892		.5287	134.3	496.7	631.0	.2791	1.1962	82
83	161.0	146.3		1.861		.5374	135.4	495.7	631.1	.2812	1.1947	83
84	163.7	149.0		1.831		.5462	136.6	494.7	631.3	.2833	1.1933	84

AIR CONDITIONING • REFRIGERATION

SECTION I – AMMONIA

THERMODYNAMIC PROPERTIES – Con'd.

TEMP F	PRESSURE per sq in.		VOLUME cu ft per lb		DENSITY lb per cu ft		ENTHALPY Btu per lb			ENTROPY Btu per (lb) (°R)		TEMP F
	t Absolute P	Gauge p	Liquid v <sub>f</sub>	Vapor v <sub>g</sub>	Liquid l/v <sub>f</sub>	Vapor l/v <sub>g</sub>	Liquid h <sub>f</sub>	Latent h <sub>fg</sub>	Vapor h <sub>g</sub>	Liquid s <sub>f</sub>	Vapor s <sub>g</sub>	
85	166.4	151.7	0.02687	1.801	37.21	0.5552	137.8	493.6	631.4	0.2854	1.1918	85
86	169.2	154.5		1.772		0.5643	138.9	492.6	631.5	0.2875	1.1904	86
87	172.0	157.3		1.744		0.5735	140.1	491.6	631.7	0.2895	1.1889	87
88	174.8	160.1		1.716		0.5828	141.2	490.6	631.8	0.2917	1.1875	88
89	177.7	163.0		1.688		0.5923	142.4	489.5	631.9	0.2937	1.1860	89
90	180.6	165.9	0.02707	1.661	36.95	0.6019	143.5	488.5	632.0	0.2958	1.1846	90
91	183.6	168.9		1.635		0.6116	144.7	487.4	632.1	0.2979	1.1832	91
92	186.6	171.9		1.609		0.6214	145.8	486.4	632.2	0.3000	1.1818	92
93	189.6	174.9		1.584		0.6314	147.0	485.3	632.3	0.3021	1.1804	93
94	192.7	178.0		1.559		0.6415	148.2	484.3	632.5	0.3041	1.1789	94
95	195.8	181.1	0.02727	1.534	36.67	0.6517	149.4	483.2	632.6	0.3062	1.1775	95
96	198.9	184.2		1.510		0.6620	150.5	482.1	632.6	0.3083	1.1761	96
97	202.1	187.4		1.487		0.6725	151.7	481.1	632.8	0.3104	1.1747	97
98	205.3	190.6		1.464		0.6832	152.9	480.0	632.9	0.3125	1.1733	98
99	208.6	193.9		1.441		0.6939	154.0	478.9	632.9	0.3145	1.1719	99
100	211.9	197.2	0.02747	1.419	36.40	0.7048	155.2	477.8	633.0	0.3166	1.1705	100
101	215.2	200.5		1.397		0.7159	156.4	476.7	633.1	0.3187	1.1691	101
102	218.6	203.9		1.375		0.7270	157.6	475.6	633.2	0.3207	1.1677	102
103	222.0	207.3		1.354		0.7384	158.7	474.6	633.3	0.3228	1.1663	103
104	225.4	210.7		1.334		0.7498	159.9	473.5	633.4	0.3248	1.1649	104
105	228.9	214.2	0.02769	1.313	36.12	0.7615	161.1	472.3	633.4	0.3269	1.1635	105
106	232.5	217.8		1.293		0.7732	162.3	471.2	633.5	0.3289	1.1621	106
107	236.0	221.3		1.274		0.7852	163.5	470.1	633.6	0.3310	1.1607	107
108	239.7	225.0		1.254		0.7972	164.6	469.0	633.6	0.3330	1.1593	108
109	243.3	228.6		1.235		0.8095	165.8	467.9	633.7	0.3351	1.1580	109
110	247.0	232.3	0.02790	1.217	35.84	0.8219	167.0	466.7	633.7	0.3372	1.1566	110
111	250.8	236.1		1.198		0.8344	168.2	465.6	633.8	0.3392	1.1552	111
112	254.5	239.8		1.180		0.8471	169.4	464.4	633.8	0.3413	1.1538	112
113	258.4	243.7		1.163		0.8600	170.6	463.3	633.9	0.3433	1.1524	113
114	262.2	247.5		1.145		0.8730	171.8	462.1	633.9	0.3453	1.1510	114
115	266.2	251.5	0.02813	1.128	35.55	0.8862	173.0	460.9	633.9	0.3474	1.1497	115
116	270.1	255.4		1.112		0.8996	174.2	459.8	634.0	0.3495	1.1483	116
117	274.1	259.4		1.095		0.9132	175.4	458.6	634.0	0.3515	1.1469	117
118	278.2	263.5		1.079		0.9269	176.6	457.4	634.0	0.3535	1.1455	118
119	282.3	267.6		1.063		0.9408	177.8	456.2	634.0	0.3556	1.1441	119
120	286.4	271.7	0.02836	1.047	35.26	0.9549	179.0	455.0	634.0	0.3576	1.1427	120
121	290.6	275.9		1.032		0.9692	180.2	453.8	634.0	0.3597	1.1414	121
122	294.8	280.1		1.017		0.9837	181.4	452.6	634.0	0.3618	1.1400	122
123	299.1	284.4		1.002		0.9983	182.6	451.4	634.0	0.3638	1.1386	123
124	303.4	288.7		0.987		1.0132	183.9	450.1	634.0	0.3659	1.1372	124
125	307.8	293.1	0.02860	0.973	34.96	1.0280	185.1	448.9	634.0	0.3679	1.1358	125

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SECTION I - AMMONIA

SUCTION LINE CAPACITIES - TONS

LINE SIZE <sup>2</sup> (Inches)	Saturated Suction Temperature—F																			
	— 30				— 20				0				20				40			
	Pressure Drop, Psi/100 ft																			
IPS	½	1	2	½	1	2	½	1	2	½	1	2	3	½	1	2	3			
½	0.44	0.62	0.88	0.50	0.72	1.02	0.65	0.92	1.31	0.82	1.18	1.70	2.40	1.02	1.45	2.06	2.92			
¾	0.96	1.37	1.96	1.11	1.58	2.24	1.45	2.06	2.93	1.81	2.60	3.70	5.23	2.25	3.22	4.61	6.52			
1	1.92	2.72	3.85	2.13	3.01	4.26	2.74	3.9	5.61	3.5	4.98	7.06	8.70	4.33	6.14	8.84	10.8			
1¼	4.8	6.95	9.85	5.43	7.80	11.1	7.07	10.1	14.6	8.99	12.95	18.5	22.8	11.18	16.15	23.1	28.3			
1½	7.3	10.5	14.9	8.25	11.9	16.8	10.7	15.5	22.0	14.6	19.7	27.8	34.2	17.1	24.2	34.5	42.6			
2	14.1	20.5	29.0	15.9	23.9	32.5	20.9	29.6	42.7	26.4	38.0	53.7	67.1	32.8	46.8	66.7	82.0			
2½	22.8	32.6	46.1	25.3	36.1	52.0	33.3	47.7	68.2	42.3	60.2	85.6	105.0	52.5	75.0	106.5	131.0			
3	40.1	57.5	81.4	45.1	64.6	91.5	59.1	84.2	121.	74.5	106.5	151.	187.5	92.5	132.	190.	233.			
4	83.5	119.	169.	93.0	132.	186.	121.	172.	244.	153.	218.	305.	378.	190.	269.	382.	469.			
5	150.	214.	303.	168.	238.	341.	218.	312.	443.	276.	394.	555.	683.	342.	485.	690.	849.			
6	244.	344.	487.	274.	388.	550.	354.	505.	715.	447.	637.	900.	1110.	558.	789.	1125.	1380.			
8	500.	710.	1000.	560.	796.	1128.	726.	1039.	1468.	920.	1308.	1850.	2270.	1135.	1615.	2295.	2810.			
10	900.	1280.	1810.	1010.	1435.	2020.	1305.	1860.	2645.	1645.	2350.	3310.	4100.	2040.	2900.	4140.	5035.			
12	1450.	2050.	2900.	1625.	2310.	3280.	2100.	2780.	4280.	2675.	3820.	5410.	6600.	3325.	4685.	6670.	8200.			

<sup>1</sup> Based on fluid flow at 90F saturated condensing temperature.

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<sup>2</sup> Data based on schedule 40 steel pipe, except that 1" and smaller are based on Schedule 80.

DISCHARGE AND LIQUID LINE CAPACITIES - TONS

LINE SIZE <sup>2, 3, 4</sup> (Inches)	DISCHARGE LINES				LIQUID LINES	
	Temperature 250 F				To Receiver	To System
	Pressure Drop Psi/100 ft				Velocity fpm	Pressure Drop Psi/100 ft
IPS	½	1	2	3	100	2
¾	—	—	—	—	8.5	11.6
½	1.28	1.85	2.65	3.25	13.6	23.5
¾	2.84	4.03	5.83	7.15	25.2	53.2
1	5.68	8.06	11.6	14.2	42.1	105.
1¼	14.7	21.1	30.4	37.2	75.3	225.
1½	22.2	31.5	45.0	55.0	103.	351.
2	43.0	61.4	87.6	107.	197.	805.
2½	68.6	98.5	140.	171.	280.	1280.
3	122.	174.	246.	300.	432.	2270.
4	244.	351.	497.	608.	745.	4630.
5	450.	638.	900.	1100.	—	—
6	734.	1030.	1470.	1800.	—	—
8	1480.	2110.	3010.	3650.	—	—

<sup>1</sup> Based on fluid flow at 90F saturated condensing temperature and 20F saturated evaporating temperature.

Data for discharge line sizes 1¼" and 1½" based on Schedule 40 steel pipe — for liquid line sizes 1¼" and 1½" based on Schedule 80 steel pipe.

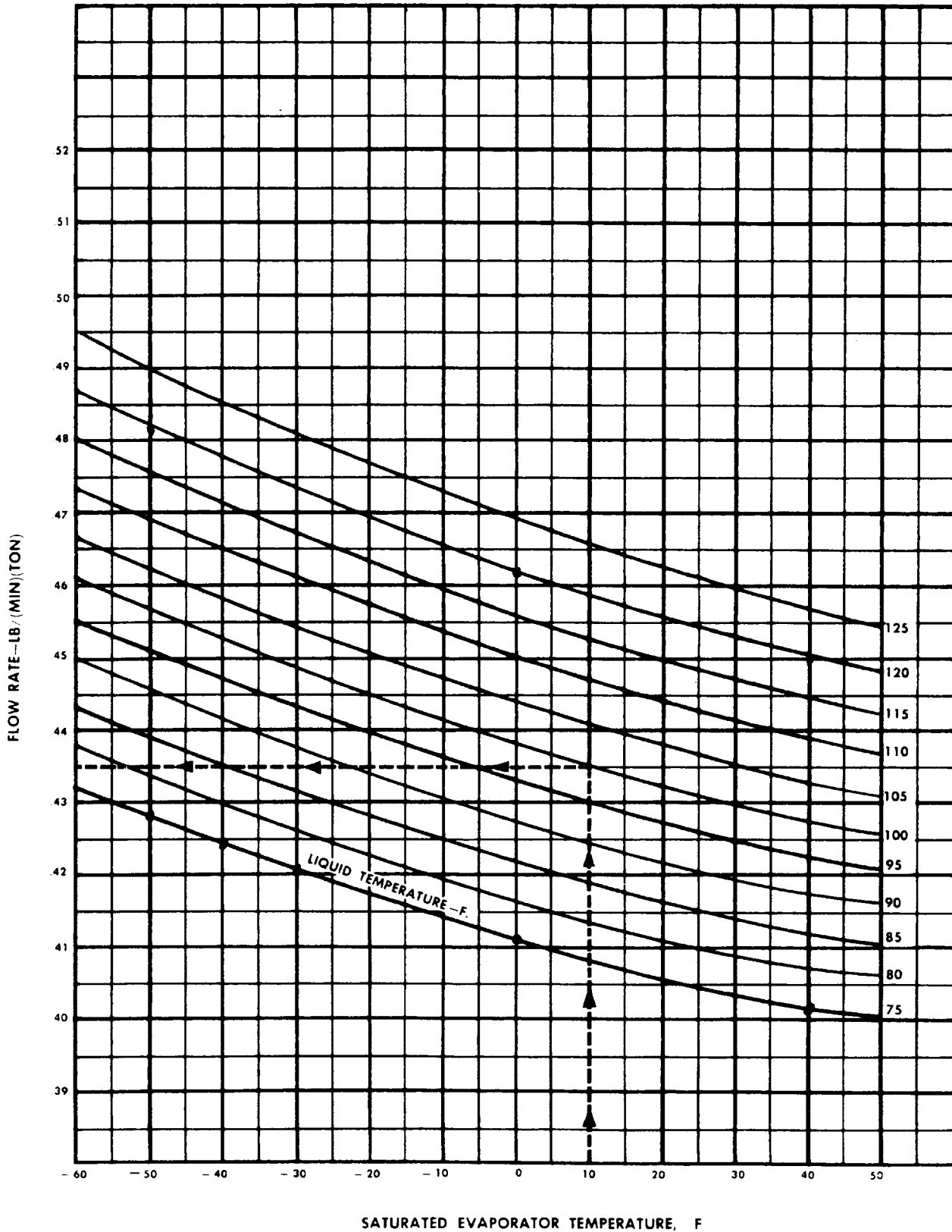
<sup>2</sup> Data on sizes 2" and over based on Schedule 40 steel pipe.

<sup>3</sup> Data on sizes 1" and smaller based on Schedule 80 steel pipe.

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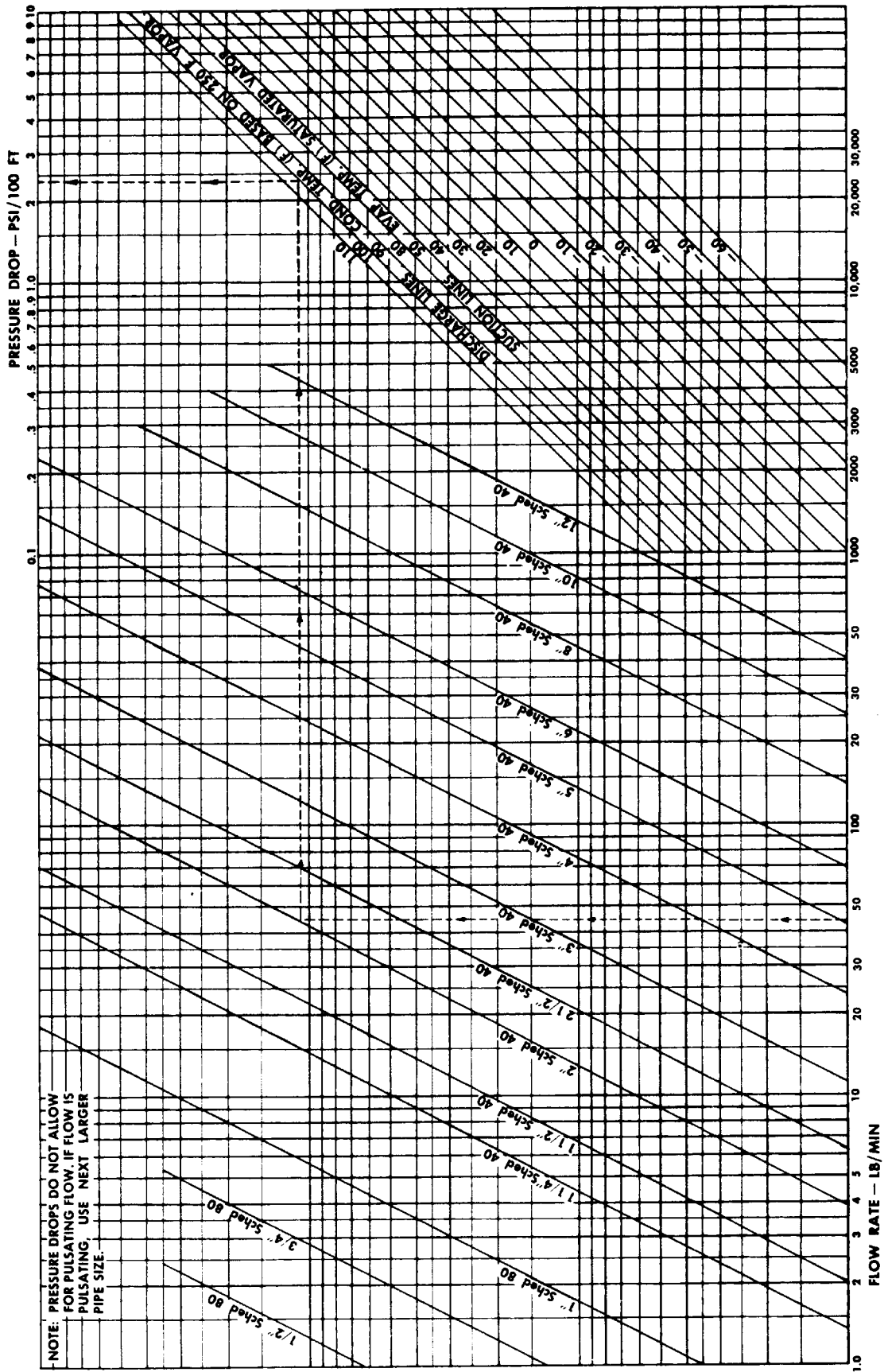
# SECTION I - AMMONIA

## FLOW RATE PER TON OF REFRIGERATION



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SECTION I - AMMONIA



NOTE: PRESSURE DROPS DO NOT ALLOW FOR PULSATING FLOW. IF FLOW IS PULSATING, USE NEXT LARGER PIPE SIZE.

PRESSURE DROP - STEEL PIPE

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SECTION III - REFRIGERANT 22

THERMODYNAMIC PROPERTIES

TEMP. °F	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb)(°R)		TEMP. °F
	PSIA	PSIG	LIQUID $v_f$	VAPOR $v_g$	LIQUID $l/v_f$	VAPOR $l/v_g$	LIQUID $h_f$	LATENT $h_{fg}$	VAPOR $h_g$	LIQUID $s_f$	VAPOR $s_g$	
-155	0.20882	29.49604*	0.010135	180.81	98.669	0.0055308	-27.095	114.040	86.945	-0.07512	0.29917	-155
-154	0.22027	29.47273*	0.010144	171.96	98.582	0.0058153	-26.870	113.931	87.060	-0.07438	0.29832	-154
-153	0.23225	29.44833*	0.010153	163.61	98.496	0.0061121	-26.646	113.822	87.175	-0.07365	0.29748	-153
-152	0.24479	29.42280*	0.010162	155.72	98.409	0.0064216	-26.422	113.713	87.291	-0.07292	0.29665	-152
-151	0.25791	29.39609*	0.010171	148.27	98.323	0.0067443	-26.198	113.604	87.406	-0.07219	0.29583	-151
-150	0.27163	29.36816*	0.010180	141.23	98.236	0.0070805	-25.974	113.495	87.521	-0.07147	0.29501	-150
-149	0.28597	29.33897*	0.010189	134.57	98.149	0.0074308	-25.749	113.386	87.637	-0.07074	0.29421	-149
-148	0.30095	29.30847*	0.010198	128.28	98.062	0.0077956	-25.525	113.277	87.753	-0.07002	0.29341	-148
-147	0.31660	29.27661*	0.010207	122.32	97.975	0.0081754	-25.300	113.168	87.868	-0.06930	0.29262	-147
-146	0.33294	29.24334*	0.010216	116.68	97.888	0.0085707	-25.075	113.059	87.984	-0.06859	0.29183	-146
-145	0.34999	29.20861*	0.010225	111.34	97.800	0.0089819	-24.851	112.951	88.100	-0.06787	0.29106	-145
-144	0.36779	29.17238*	0.010234	106.27	97.713	0.0094096	-24.626	112.842	88.216	-0.06716	0.29029	-144
-143	0.38636	29.13458*	0.010243	101.48	97.625	0.0098542	-24.401	112.733	88.332	-0.06645	0.28953	-143
-142	0.40571	29.09516*	0.010252	96.933	97.538	0.010316	-24.175	112.624	88.448	-0.06574	0.28877	-142
-141	0.42589	29.05407*	0.010262	92.622	97.450	0.010797	-23.950	112.515	88.564	-0.06503	0.28803	-141
-140	0.44692	29.01126*	0.010271	88.532	97.363	0.011295	-23.725	112.405	88.681	-0.06432	0.28729	-140
-139	0.46883	28.96665*	0.010280	84.650	97.275	0.011813	-23.499	112.296	88.797	-0.06362	0.28655	-139
-138	0.49165	28.92020*	0.010289	80.965	97.187	0.012351	-23.274	112.187	88.914	-0.06291	0.28583	-138
-137	0.51540	28.87184*	0.010299	77.466	97.099	0.012909	-23.048	112.078	89.030	-0.06221	0.28511	-137
-136	0.54012	28.82151*	0.010308	74.141	97.011	0.013488	-22.822	111.969	89.147	-0.06152	0.28440	-136
-135	0.56584	28.76914*	0.010318	70.981	96.922	0.014088	-22.596	111.859	89.263	-0.06082	0.28369	-135
-134	0.59260	28.71467*	0.010327	67.978	96.834	0.014711	-22.369	111.750	89.380	-0.06012	0.28299	-134
-133	0.62041	28.65803*	0.010336	65.121	96.746	0.015356	-22.143	111.640	89.497	-0.05943	0.28230	-133
-132	0.64933	28.59915*	0.010346	62.404	96.657	0.016025	-21.917	111.530	89.614	-0.05874	0.28162	-132
-131	0.67938	28.53797*	0.010355	59.818	96.569	0.016717	-21.690	111.421	89.731	-0.05805	0.28094	-131
-130	0.71060	28.47441*	0.010365	57.356	96.480	0.017435	-21.463	111.311	89.848	-0.05736	0.28027	-130
-129	0.74302	28.40840*	0.010374	55.013	96.391	0.018178	-21.236	111.201	89.965	-0.05667	0.27960	-129
-128	0.77669	28.33985*	0.010384	52.780	96.302	0.018947	-21.009	111.091	90.082	-0.05598	0.27894	-128
-127	0.81163	28.26871*	0.010394	50.653	96.213	0.019742	-20.781	110.980	90.199	-0.05530	0.27829	-127
-126	0.84789	28.19488*	0.010403	48.625	96.124	0.020565	-20.554	110.870	90.316	-0.05462	0.27764	-126
-125	0.88551	28.11829*	0.010413	46.692	96.035	0.021417	-20.326	110.760	90.433	-0.05394	0.27700	-125
-124	0.92452	28.03886*	0.010423	44.849	95.945	0.022297	-20.098	110.649	90.551	-0.05326	0.27636	-124
-123	0.96497	27.95650*	0.010432	43.090	95.856	0.023207	-19.870	110.538	90.668	-0.05258	0.27573	-123
-122	1.0069	27.8711*	0.010442	41.411	95.767	0.024148	-19.642	110.427	90.785	-0.05190	0.27511	-122
-121	1.0504	27.7827*	0.010452	39.809	95.677	0.025120	-19.413	110.316	90.903	-0.05123	0.27449	-121
-120	1.0954	27.6910*	0.010462	38.280	95.587	0.026124	-19.185	110.205	91.020	-0.05055	0.27388	-120
-119	1.1420	27.5961*	0.010471	36.818	95.497	0.027160	-18.956	110.093	91.138	-0.04988	0.27327	-119
-118	1.1903	27.4978*	0.010481	35.423	95.407	0.028231	-18.727	109.982	91.255	-0.04921	0.27267	-118
-117	1.2402	27.3961*	0.010491	34.088	95.317	0.029335	-18.497	109.870	91.373	-0.04854	0.27207	-117
-116	1.2920	27.2907*	0.010501	32.813	95.227	0.030476	-18.268	109.758	91.490	-0.04787	0.27148	-116
-115	1.3455	27.1818*	0.010511	31.594	95.137	0.031652	-18.038	109.646	91.608	-0.04720	0.27090	-115
-114	1.4008	27.0691*	0.010521	30.427	95.047	0.032865	-17.808	109.533	91.725	-0.04654	0.27032	-114
-113	1.4581	26.9525*	0.010531	29.311	94.956	0.034116	-17.578	109.421	91.843	-0.04587	0.26974	-113
-112	1.5173	26.8320*	0.010541	28.244	94.866	0.035406	-17.348	109.308	91.960	-0.04521	0.26918	-112
-111	1.5784	26.7075*	0.010551	27.221	94.775	0.036736	-17.117	109.195	92.078	-0.04455	0.26861	-111
-110	1.6417	26.5788*	0.010561	26.242	94.684	0.038106	-16.886	109.082	92.196	-0.04389	0.26805	-110
-109	1.7070	26.4458*	0.010572	25.305	94.593	0.039518	-16.655	108.968	92.313	-0.04323	0.26750	-109
-108	1.7744	26.3084*	0.010582	24.407	94.502	0.040972	-16.424	108.854	92.431	-0.04257	0.26695	-108
-107	1.8441	26.1666*	0.010592	23.546	94.411	0.042470	-16.192	108.740	92.548	-0.04191	0.26641	-107
-106	1.9161	26.0201*	0.010602	22.721	94.320	0.044012	-15.960	108.626	92.666	-0.04125	0.26587	-106
-105	1.9903	25.8689*	0.010613	21.930	94.228	0.045599	-15.728	108.512	92.783	-0.04060	0.26533	-105
-104	2.0669	25.7129*	0.010623	21.172	94.137	0.047233	-15.496	108.397	92.901	-0.03995	0.26481	-104
-103	2.1460	25.5520*	0.010633	20.444	94.045	0.048914	-15.263	108.282	93.018	-0.03929	0.26428	-103
-102	2.2275	25.3860*	0.010644	19.746	93.953	0.050644	-15.031	108.167	93.136	-0.03864	0.26376	-102
-101	2.3116	25.2148*	0.010654	19.076	93.862	0.052423	-14.798	108.051	93.253	-0.03799	0.26325	-101

\*Inches of mercury below one atmosphere

SECTION III – REFRIGERANT 22

THERMODYNAMIC PROPERTIES – Con't.

TEMP. °F	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb)(°R)		TEMP. °F
	PSIA	PSIG	LIQUID $v_f$	VAPOR $v_g$	LIQUID $l/v_f$	VAPOR $l/v_g$	LIQUID $h_f$	LATENT $h_{fg}$	VAPOR $h_g$	LIQUID $s_f$	VAPOR $s_g$	
-100	2.3983	25.0383*	0.010664	18.433	93.770	0.054252	-14.564	107.935	93.371	-0.03734	0.26274	-100
-99	2.4877	24.8563*	0.010675	17.815	93.678	0.056133	-14.331	107.819	93.488	-0.03670	0.26223	-99
-98	2.5798	24.6688*	0.010685	17.222	93.585	0.058066	-14.097	107.702	93.606	-0.03605	0.26173	-98
-97	2.6747	24.4755*	0.010696	16.652	93.493	0.060053	-13.863	107.586	93.723	-0.03540	0.26123	-97
-96	2.7724	24.2765*	0.010707	16.104	93.401	0.062095	-13.628	107.469	93.840	-0.03476	0.26074	-96
-95	2.8731	24.0715*	0.010717	15.578	93.308	0.064192	-13.393	107.351	93.958	-0.03411	0.26025	-95
-94	2.9768	23.8604*	0.010728	15.072	93.215	0.066347	-13.158	107.233	94.075	-0.03347	0.25977	-94
-93	3.0836	23.6430*	0.010739	14.586	93.123	0.068559	-12.923	107.115	94.192	-0.03283	0.25929	-93
-92	3.1934*	23.4193*	0.010749	14.118	93.030	0.070831	-12.688	106.997	94.309	-0.03219	0.25881	-92
-91	3.3065	23.1891*	0.010760	13.668	92.937	0.073163	-12.452	106.878	94.426	-0.03155	0.25834	-91
-90	3.4229	22.9522*	0.010771	13.235	92.843	0.075557	-12.216	106.759	94.544	-0.03091	0.25787	-90
-89	3.5426	22.7085*	0.010782	12.818	92.750	0.078014	-11.979	106.640	94.661	-0.03027	0.25741	-89
-88	3.6657	22.4579*	0.010793	12.417	92.657	0.080534	-11.743	106.520	94.777	-0.02963	0.25695	-88
-87	3.7922	22.2002*	0.010803	12.031	92.563	0.083120	-11.506	106.400	94.894	-0.02900	0.25649	-87
-86	3.9224	21.9352*	0.010814	11.659	92.469	0.085772	-11.268	106.279	95.011	-0.02836	0.25604	-86
-85	4.0562	21.6628*	0.010825	11.301	92.376	0.088491	-11.031	106.159	95.128	-0.02773	0.25560	-85
-84	4.1936	21.3829*	0.010836	10.955	92.282	0.091280	-10.793	106.037	95.244	-0.02709	0.25515	-84
-83	4.3349	21.0953*	0.010847	10.623	92.188	0.094138	-10.555	105.916	95.361	-0.02646	0.25471	-83
-82	4.4800	20.7998*	0.010859	10.302	92.093	0.097068	-10.316	105.794	95.478	-0.02583	0.25428	-82
-81	4.6291	20.4963*	0.010870	9.9929	91.999	0.10007	-10.077	105.671	95.594	-0.02520	0.25384	-81
-80	4.7822	20.1846*	0.010881	9.6949	91.905	0.10315	-9.838	105.548	95.710	-0.02457	0.25342	-80
-79	4.9394	19.8646*	0.010892	9.4074	91.810	0.10630	-9.599	105.425	95.827	-0.02394	0.25299	-79
-78	5.1007	19.5361*	0.010903	9.1301	91.715	0.10953	-9.359	105.302	95.943	-0.02331	0.25257	-78
-77	5.2664	19.1989*	0.010915	8.8625	91.620	0.11283	-9.119	105.178	96.059	-0.02269	0.25215	-77
-76	5.4363	18.8528*	0.010926	8.6043	91.525	0.11622	-8.878	105.053	96.175	-0.02206	0.25174	-76
-75	5.6107	18.4977*	0.010937	8.3551	91.430	0.11969	-8.638	104.928	96.290	-0.02143	0.25133	-75
-74	5.7896	18.1334*	0.010949	8.1145	91.335	0.12324	-8.397	104.803	96.406	-0.02081	0.25092	-74
-73	5.9732	17.7598*	0.010960	7.8822	91.240	0.12687	-8.155	104.677	96.522	-0.02019	0.25052	-73
-72	6.1614	17.3766*	0.010972	7.6579	91.144	0.13058	-7.914	104.551	96.637	-0.01956	0.25012	-72
-71	6.3543	16.9837*	0.010983	7.4412	91.048	0.13439	-7.672	104.424	96.753	-0.01894	0.24972	-71
-70	6.5522	16.5809*	0.010995	7.2318	90.952	0.13828	-7.429	104.297	96.868	-0.01832	0.24932	-70
-69	6.7550	16.1680*	0.011006	7.0295	90.856	0.14226	-7.187	104.170	96.983	-0.01770	0.24893	-69
-68	6.9628	15.7449*	0.011018	6.8339	90.760	0.14633	-6.944	104.042	97.098	-0.01708	0.24855	-68
-67	7.1757	15.3113*	0.011030	6.6449	90.664	0.15049	-6.700	103.913	97.213	-0.01646	0.24816	-67
-66	7.3939	14.8671*	0.011041	6.4621	90.568	0.15475	-6.457	103.785	97.328	-0.01584	0.24778	-66
-65	7.6174	14.4120*	0.011053	6.2854	90.471	0.15910	-6.213	103.655	97.443	-0.01522	0.24740	-65
-64	7.8463	13.9460*	0.011065	6.1144	90.374	0.16355	-5.968	103.525	97.557	-0.01460	0.24703	-64
-63	8.0808	13.4687*	0.011077	5.9491	90.277	0.16809	-5.724	103.395	97.672	-0.01399	0.24666	-63
-62	8.3208	12.9800*	0.011089	5.7891	90.180	0.17274	-5.479	103.264	97.786	-0.01337	0.24629	-62
-61	8.5665	12.4798*	0.011101	5.6343	90.083	0.17749	-5.233	103.133	97.900	-0.01276	0.24592	-61
-60	8.8180	11.9677*	0.011113	5.4844	89.986	0.18233	-4.987	103.001	98.014	-0.01214	0.24556	-60
-59	9.0754	11.4436*	0.011125	5.3394	89.888	0.18729	-4.741	102.869	98.128	-0.01153	0.24520	-59
-58	9.3388	10.9074*	0.011137	5.1989	89.791	0.19235	-4.495	102.736	98.241	-0.01092	0.24484	-58
-57	9.6082	10.3587*	0.011149	5.0629	89.693	0.19752	-4.248	102.603	98.355	-0.01030	0.24449	-57
-56	9.8839	9.7975*	0.011161	4.9312	89.595	0.20279	-4.001	102.469	98.468	-0.00969	0.24414	-56
-55	10.166	9.223*	0.011174	4.8036	89.497	0.20818	-3.754	102.335	98.581	-0.00908	0.24379	-55
-54	10.454	8.636*	0.011186	4.6799	89.399	0.21368	-3.506	102.200	98.694	-0.00847	0.24345	-54
-53	10.749	8.036*	0.011198	4.5601	89.300	0.21929	-3.258	102.065	98.807	-0.00786	0.24310	-53
-52	11.051	7.422*	0.011211	4.4440	89.202	0.22502	-3.009	101.929	98.920	-0.00725	0.24276	-52
-51	11.359	6.795*	0.011223	4.3315	89.103	0.23087	-2.761	101.793	99.032	-0.00665	0.24243	-51
-50	11.674	6.154*	0.011235	4.2224	89.004	0.23683	-2.511	101.656	99.144	-0.00604	0.24209	-50
-49	11.996	5.498*	0.011248	4.1166	88.905	0.24292	-2.262	101.519	99.257	-0.00543	0.24176	-49
-48	12.324	4.829*	0.011261	4.0140	88.806	0.24913	-2.012	101.381	99.369	-0.00483	0.24143	-48
-47	12.660	4.144*	0.011273	3.9145	88.707	0.25546	-1.762	101.242	99.480	-0.00422	0.24110	-47
-46	13.004	3.445*	0.011286	3.8179	88.607	0.26192	-1.511	101.103	99.592	-0.00361	0.24078	-46

\* Inches of mercury below one atmosphere

SECTION III - REFRIGERANT 22

THERMODYNAMIC PROPERTIES - Con't.

TEMP. °F	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb°R)		TEMP. °F
	PSIA	PSIG	LIQUID $v_f$	VAPOR $v_g$	LIQUID $1/v_f$	VAPOR $1/v_g$	LIQUID $h_f$	LATENT $h_{fg}$	VAPOR $h_g$	LIQUID $s_f$	VAPOR $s_g$	
-45	13.354	2.732*	0.011298	3.7243	88.507	0.26851	-1.260	100.963	99.703	-0.00301	0.24046	-45
-44	13.712	2.002*	0.011311	3.6334	88.407	0.27523	-1.009	100.823	99.814	-0.00241	0.24014	-44
-43	14.078	1.258*	0.011324	3.5452	88.307	0.28207	-0.757	100.683	99.925	-0.00181	0.23982	-43
-42	14.451	0.498*	0.011337	3.4596	88.207	0.28905	-0.505	100.541	100.036	-0.00120	0.23951	-42
-41	14.833	0.137	0.011350	3.3764	88.107	0.29617	-0.253	100.399	100.147	-0.00060	0.23919	-41
-40	15.222	0.526	0.011363	3.2957	88.006	0.30342	0.000	100.257	100.257	0.00000	0.23888	-40
-39	15.619	0.923	0.011376	3.2173	87.905	0.31082	0.253	100.114	100.367	0.00060	0.23858	-39
-38	16.024	1.328	0.011389	3.1412	87.805	0.31835	0.506	99.971	100.477	0.00120	0.23827	-38
-37	16.437	1.741	0.011402	3.0673	87.703	0.32602	0.760	99.826	100.587	0.00180	0.23797	-37
-36	16.859	2.163	0.011415	2.9954	87.602	0.33384	1.014	99.682	100.696	0.00240	0.23767	-36
-35	17.290	2.594	0.011428	2.9256	87.501	0.34181	1.269	99.536	100.805	0.00300	0.23737	-35
-34	17.728	3.032	0.011442	2.8578	87.399	0.34992	1.524	99.391	100.914	0.00359	0.23707	-34
-33	18.176	3.480	0.011455	2.7919	87.297	0.35818	1.779	99.244	101.023	0.00419	0.23678	-33
-32	18.633	3.937	0.011469	2.7278	87.195	0.36660	2.035	99.097	101.132	0.00479	0.23649	-32
-31	19.098	4.402	0.011482	2.6655	87.093	0.37517	2.291	98.949	101.240	0.00538	0.23620	-31
-30	19.573	4.877	0.011495	2.6049	86.991	0.38389	2.547	98.801	101.348	0.00598	0.23591	-30
-29	20.056	5.360	0.011509	2.5460	86.888	0.39278	2.804	98.652	101.456	0.00657	0.23563	-29
-28	20.549	5.853	0.011523	2.4887	86.785	0.40182	3.061	98.503	101.564	0.00716	0.23534	-28
-27	21.052	6.356	0.011536	2.4329	86.682	0.41103	3.318	98.353	101.671	0.00776	0.23506	-27
-26	21.564	6.868	0.011550	2.3787	86.579	0.42040	3.576	98.202	101.778	0.00835	0.23478	-26
-25	22.086	7.390	0.011564	2.3260	86.476	0.42993	3.834	98.051	101.885	0.00894	0.23451	-25
-24	22.617	7.921	0.011578	2.2746	86.372	0.43964	4.093	97.899	101.992	0.00953	0.23423	-24
-23	23.159	8.463	0.011592	2.2246	86.269	0.44951	4.352	97.746	102.098	0.01013	0.23396	-23
-22	23.711	9.015	0.011606	2.1760	86.165	0.45956	4.611	97.593	102.204	0.01072	0.23369	-22
-21	24.272	9.576	0.011620	2.1287	86.061	0.46978	4.871	97.439	102.310	0.01131	0.23342	-21
-20	24.845	10.149	0.011634	2.0826	85.956	0.48018	5.131	97.285	102.415	0.01189	0.23315	-20
-19	25.427	10.731	0.011648	2.0377	85.852	0.49075	5.391	97.129	102.521	0.01248	0.23289	-19
-18	26.020	11.324	0.011662	1.9940	85.747	0.50151	5.652	96.974	102.626	0.01307	0.23262	-18
-17	26.624	11.928	0.011677	1.9514	85.642	0.51245	5.913	96.817	102.730	0.01366	0.23236	-17
-16	27.239	12.543	0.011691	1.9099	85.537	0.52358	6.175	96.660	102.835	0.01425	0.23210	-16
-15	27.865	13.169	0.011705	1.8695	85.431	0.53489	6.436	96.502	102.939	0.01483	0.23184	-15
-14	28.501	13.805	0.011720	1.8302	85.326	0.54640	6.699	96.344	103.043	0.01542	0.23159	-14
-13	29.149	14.453	0.011734	1.7918	85.220	0.55810	6.961	96.185	103.146	0.01600	0.23133	-13
-12	29.809	15.113	0.011749	1.7544	85.114	0.56999	7.224	96.025	103.250	0.01659	0.23108	-12
-11	30.480	15.784	0.011764	1.7180	85.008	0.58207	7.488	95.865	103.353	0.01717	0.23083	-11
-10	31.162	16.466	0.011778	1.6825	84.901	0.59436	7.751	95.704	103.455	0.01776	0.23058	-10
-9	31.856	17.160	0.011793	1.6479	84.795	0.60685	8.015	95.542	103.558	0.01834	0.23033	-9
-8	32.563	17.867	0.011808	1.6141	84.688	0.61954	8.280	95.380	103.660	0.01892	0.23008	-8
-7	33.281	18.585	0.011823	1.5812	84.581	0.63244	8.545	95.217	103.762	0.01950	0.22984	-7
-6	34.011	19.315	0.011838	1.5491	84.473	0.64555	8.810	95.053	103.863	0.02009	0.22960	-6
-5	34.754	20.058	0.011853	1.5177	84.366	0.65887	9.075	94.889	103.964	0.02067	0.22936	-5
-4	35.509	20.813	0.011868	1.4872	84.258	0.67240	9.341	94.724	104.065	0.02125	0.22912	-4
-3	36.277	21.581	0.011884	1.4574	84.150	0.68615	9.608	94.558	104.166	0.02183	0.22888	-3
-2	37.057	22.361	0.011899	1.4283	84.042	0.70012	9.874	94.391	104.266	0.02241	0.22864	-2
-1	37.850	23.154	0.011914	1.4000	83.933	0.71431	10.142	94.224	104.366	0.02299	0.22841	-1
0	38.657	23.961	0.011930	1.3723	83.825	0.72872	10.409	94.056	104.465	0.02357	0.22817	0
1	39.476	24.780	0.011945	1.3453	83.716	0.74336	10.677	93.888	104.565	0.02414	0.22794	1
2	40.309	25.613	0.011961	1.3189	83.606	0.75822	10.945	93.718	104.663	0.02472	0.22771	2
3	41.155	26.459	0.011976	1.2931	83.497	0.77332	11.214	93.548	104.762	0.02530	0.22748	3
4	42.014	27.318	0.011992	1.2680	83.387	0.78865	11.483	93.378	104.860	0.02587	0.22725	4
5	42.888	28.192	0.012008	1.2434	83.277	0.80422	11.752	93.206	104.958	0.02645	0.22703	5
6	43.775	29.079	0.012024	1.2195	83.167	0.82003	12.022	93.034	105.056	0.02703	0.22680	6
7	44.676	29.980	0.012040	1.1961	83.057	0.83608	12.292	92.861	105.153	0.02760	0.22658	7
8	45.591	30.895	0.012056	1.1732	82.946	0.85237	12.562	92.688	105.250	0.02818	0.22636	8
9	46.521	31.825	0.012072	1.1509	82.835	0.86892	12.833	92.513	105.346	0.02875	0.22614	9

\*Inches of mercury below one atmosphere

SECTION III – REFRIGERANT 22

THERMODYNAMIC PROPERTIES – Con't.

TEMP. °F	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb×°R)		TEMP. °F
	PSIA	PSIG	LIQUID $v_f$	VAPOR $v_g$	LIQUID $l/v_f$	VAPOR $l/v_g$	LIQUID $h_f$	LATENT $h_{fg}$	VAPOR $h_g$	LIQUID $s_f$	VAPOR $s_g$	
10	47.464	32.768	0.012088	1.1290	82.724	0.88571	13.104	92.338	105.442	0.02932	0.22592	10
11	48.423	33.727	0.012105	1.1077	82.612	0.90275	13.376	92.162	105.538	0.02990	0.22570	11
12	49.396	34.700	0.012121	1.0869	82.501	0.92005	13.648	91.986	105.633	0.03047	0.22548	12
13	50.384	35.688	0.012138	1.0665	82.389	0.93761	13.920	91.808	105.728	0.03104	0.22527	13
14	51.387	36.691	0.012154	1.0466	82.276	0.95544	14.193	91.630	105.823	0.03161	0.22505	14
15	52.405	37.709	0.012171	1.0272	82.164	0.97352	14.466	91.451	105.917	0.03218	0.22484	15
16	53.438	38.742	0.012188	1.0082	82.051	0.99188	14.739	91.272	106.011	0.03275	0.22463	16
17	54.487	39.791	0.012204	0.98961	81.938	1.0105	15.013	91.091	106.105	0.03332	0.22442	17
18	55.551	40.855	0.012221	0.97144	81.825	1.0294	15.288	90.910	106.198	0.03389	0.22421	18
19	56.631	41.935	0.012238	0.95368	81.711	1.0486	15.562	90.728	106.290	0.03446	0.22400	19
20	57.727	43.031	0.012255	0.93631	81.597	1.0680	15.837	90.545	106.383	0.03503	0.22379	20
21	58.839	44.143	0.012273	0.91932	81.483	1.0878	16.113	90.362	106.475	0.03560	0.22358	21
22	59.967	45.271	0.012290	0.90270	81.368	1.1078	16.389	90.178	106.566	0.03617	0.22338	22
23	61.111	46.415	0.012307	0.88645	81.253	1.1281	16.665	89.993	106.657	0.03674	0.22318	23
24	62.272	47.576	0.012325	0.87055	81.138	1.1487	16.942	89.807	106.748	0.03730	0.22297	24
25	63.450	48.754	0.012342	0.85500	81.023	1.1696	17.219	89.620	106.839	0.03787	0.22277	25
26	64.644	49.948	0.012360	0.83978	80.907	1.1908	17.496	89.433	106.928	0.03844	0.22257	26
27	65.855	51.159	0.012378	0.82488	80.791	1.2123	17.774	89.244	107.018	0.03900	0.22237	27
28	67.083	52.387	0.012395	0.81031	80.675	1.2341	18.052	89.055	107.107	0.03958	0.22217	28
29	68.328	53.632	0.012413	0.79604	80.558	1.2562	18.330	88.865	107.196	0.04013	0.22198	29
30	69.591	54.895	0.012431	0.78208	80.441	1.2786	18.609	88.674	107.284	0.04070	0.22178	30
31	70.871	56.175	0.012450	0.76842	80.324	1.3014	18.889	88.483	107.372	0.04126	0.22158	31
32	72.169	57.473	0.012468	0.75503	80.207	1.3244	19.169	88.290	107.459	0.04182	0.22139	32
33	73.485	58.789	0.012486	0.74194	80.089	1.3478	19.449	88.097	107.546	0.04239	0.22119	33
34	74.818	60.122	0.012505	0.72911	79.971	1.3715	19.729	87.903	107.632	0.04295	0.22100	34
35	76.170	61.474	0.012523	0.71655	79.852	1.3956	20.010	87.708	107.719	0.04351	0.22081	35
36	77.540	62.844	0.012542	0.70425	79.733	1.4199	20.292	87.512	107.804	0.04407	0.22062	36
37	78.929	64.233	0.012561	0.69221	79.614	1.4447	20.574	87.316	107.889	0.04464	0.22043	37
38	80.336	65.640	0.012579	0.68041	79.495	1.4697	20.856	87.118	107.974	0.04520	0.22024	38
39	81.761	67.065	0.012598	0.66885	79.375	1.4951	21.138	86.920	108.058	0.04576	0.22005	39
40	83.206	68.510	0.012618	0.65753	79.255	1.5208	21.422	86.720	108.142	0.04632	0.21986	40
41	84.670	69.974	0.012637	0.64643	79.134	1.5469	21.705	86.520	108.225	0.04688	0.21968	41
42	86.153	71.457	0.012656	0.63557	79.013	1.5734	21.989	86.319	108.308	0.04744	0.21949	42
43	87.655	72.959	0.012676	0.62492	78.892	1.6002	22.273	86.117	108.390	0.04800	0.21931	43
44	89.177	74.481	0.012695	0.61448	78.770	1.6274	22.558	85.914	108.472	0.04855	0.21912	44
45	90.719	76.023	0.012715	0.60425	78.648	1.6549	22.843	85.710	108.553	0.04911	0.21894	45
46	92.280	77.584	0.012735	0.59422	78.526	1.6829	23.129	85.506	108.634	0.04967	0.21876	46
47	93.861	79.165	0.012755	0.58440	78.403	1.7112	23.415	85.300	108.715	0.05023	0.21858	47
48	95.463	80.767	0.012775	0.57476	78.280	1.7398	23.701	85.094	108.795	0.05079	0.21839	48
49	97.085	82.389	0.012795	0.56532	78.157	1.7689	23.988	84.886	108.874	0.05134	0.21821	49
50	98.727	84.031	0.012815	0.55606	78.033	1.7984	24.275	84.678	108.953	0.05190	0.21803	50
51	100.39	85.69	0.012836	0.54698	77.909	1.8282	24.563	84.468	109.031	0.05245	0.21785	51
52	102.07	87.38	0.012856	0.53808	77.784	1.8585	24.851	84.258	109.109	0.05301	0.21768	52
53	103.78	89.08	0.012877	0.52934	77.659	1.8891	25.139	84.047	109.186	0.05357	0.21750	53
54	105.50	90.81	0.012898	0.52078	77.534	1.9202	25.429	83.834	109.263	0.05412	0.21732	54
55	107.25	92.56	0.012919	0.51238	77.408	1.9517	25.718	83.621	109.339	0.05468	0.21714	55
56	109.02	94.32	0.012940	0.50414	77.282	1.9836	26.008	83.407	109.415	0.05523	0.21697	56
57	110.81	96.11	0.012961	0.49606	77.155	2.0159	26.298	83.191	109.490	0.05579	0.21679	57
58	112.62	97.93	0.012982	0.48813	77.028	2.0486	26.589	82.975	109.564	0.05634	0.21662	58
59	114.46	99.76	0.013004	0.48035	76.900	2.0818	26.880	82.758	109.638	0.05689	0.21644	59
60	116.31	101.62	0.013025	0.47272	76.773	2.1154	27.172	82.540	109.712	0.05745	0.21627	60
61	118.19	103.49	0.013047	0.46523	76.644	2.1495	27.464	82.320	109.785	0.05800	0.21610	61
62	120.09	105.39	0.013069	0.45788	76.515	2.1840	27.757	82.100	109.857	0.05855	0.21592	62
63	122.01	107.32	0.013091	0.45066	76.386	2.2190	28.050	81.878	109.929	0.05910	0.21575	63
64	123.96	109.26	0.013114	0.44358	76.257	2.2544	28.344	81.656	110.000	0.05966	0.21558	64

SECTION III – REFRIGERANT 22

THERMODYNAMIC PROPERTIES – Con't.

TEMP. °F	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb)(°R)		TEMP. °F
	PSIA	PSIG	LIQUID $v_f$	VAPOR $v_g$	LIQUID $l/v_f$	VAPOR $l/v_g$	LIQUID $h_f$	LATENT $h_{fg}$	VAPOR $h_g$	LIQUID $s_f$	VAPOR $s_g$	
65	125.93	111.23	0.013136	0.43663	76.126	2.2903	28.638	81.432	110.070	0.06021	0.21541	65
66	127.92	113.22	0.013159	0.42981	75.996	2.3266	28.932	81.208	110.140	0.06076	0.21524	66
67	129.94	115.24	0.013181	0.42311	75.865	2.3635	29.228	80.982	110.209	0.06131	0.21507	67
68	131.97	117.28	0.013204	0.41653	75.733	2.4008	29.523	80.755	110.278	0.06186	0.21490	68
69	134.04	119.34	0.013227	0.41007	75.601	2.4386	29.819	80.527	110.346	0.06241	0.21473	69
70	136.12	121.43	0.013251	0.40373	75.469	2.4769	30.116	80.298	110.414	0.06296	0.21456	70
71	138.23	123.54	0.013274	0.39751	75.336	2.5157	30.413	80.068	110.480	0.06351	0.21439	71
72	140.37	125.67	0.013297	0.39139	75.202	2.5550	30.710	79.836	110.547	0.06406	0.21422	72
73	142.52	127.83	0.013321	0.38539	75.068	2.5948	31.008	79.604	110.612	0.06461	0.21405	73
74	144.71	130.01	0.013345	0.37949	74.934	2.6351	31.307	79.370	110.677	0.06516	0.21388	74
75	146.91	132.22	0.013369	0.37369	74.799	2.6760	31.606	79.135	110.741	0.06571	0.21372	75
76	149.15	134.45	0.013393	0.36800	74.664	2.7174	31.906	78.899	110.805	0.06626	0.21355	76
77	151.40	136.71	0.013418	0.36241	74.528	2.7593	32.206	78.662	110.868	0.06681	0.21338	77
78	153.69	138.99	0.013442	0.35691	74.391	2.8018	32.506	78.423	110.930	0.06736	0.21321	78
79	155.99	141.30	0.013467	0.35151	74.254	2.8449	32.808	78.184	110.991	0.06791	0.21305	79
80	158.33	143.63	0.013492	0.34621	74.116	2.8885	33.109	77.943	111.052	0.06846	0.21288	80
81	160.68	145.99	0.013518	0.34099	73.978	2.9326	33.412	77.701	111.112	0.06901	0.21271	81
82	163.07	148.37	0.013543	0.33587	73.839	2.9774	33.714	77.457	111.171	0.06956	0.21255	82
83	165.48	150.78	0.013569	0.33083	73.700	3.0227	34.018	77.212	111.230	0.07011	0.21238	83
84	167.92	153.22	0.013594	0.32588	73.560	3.0686	34.322	76.966	111.288	0.07065	0.21222	84
85	170.38	155.68	0.013620	0.32101	73.420	3.1151	34.626	76.719	111.345	0.07120	0.21205	85
86	172.87	158.17	0.013647	0.31623	73.278	3.1622	34.931	76.470	111.401	0.07175	0.21188	86
87	175.38	160.69	0.013673	0.31153	73.137	3.2100	35.237	76.220	111.457	0.07230	0.21172	87
88	177.93	163.23	0.013700	0.30690	72.994	3.2583	35.543	75.968	111.512	0.07285	0.21155	88
89	180.50	165.80	0.013727	0.30236	72.851	3.3073	35.850	75.716	111.566	0.07339	0.21139	89
90	183.09	168.40	0.013754	0.29789	72.708	3.3570	36.158	75.461	111.619	0.07394	0.21122	90
91	185.72	171.02	0.013781	0.29349	72.564	3.4073	36.466	75.206	111.671	0.07449	0.21106	91
92	188.37	173.67	0.013809	0.28917	72.419	3.4582	36.774	74.949	111.723	0.07504	0.21089	92
93	191.05	176.35	0.013836	0.28491	72.273	3.5098	37.084	74.690	111.774	0.07559	0.21072	93
94	193.76	179.06	0.013864	0.28073	72.127	3.5621	37.394	74.430	111.824	0.07613	0.21056	94
95	196.50	181.80	0.013893	0.27662	71.980	3.6151	37.704	74.168	111.873	0.07668	0.21039	95
96	199.26	184.56	0.013921	0.27257	71.833	3.6688	38.016	73.905	111.921	0.07723	0.21023	96
97	202.05	187.36	0.013950	0.26859	71.685	3.7232	38.328	73.641	111.968	0.07778	0.21006	97
98	204.87	190.18	0.013979	0.26467	71.536	3.7783	38.640	73.375	112.015	0.07832	0.20989	98
99	207.72	193.03	0.014008	0.26081	71.386	3.8341	38.953	73.107	112.060	0.07887	0.20973	99
100	210.60	195.91	0.014038	0.25702	71.236	3.8907	39.267	72.838	112.105	0.07942	0.20956	100
101	213.51	198.82	0.014068	0.25329	71.084	3.9481	39.582	72.567	112.149	0.07997	0.20939	101
102	216.45	201.76	0.014098	0.24962	70.933	4.0062	39.897	72.294	112.192	0.08052	0.20923	102
103	219.42	204.72	0.014128	0.24600	70.780	4.0651	40.213	72.020	112.233	0.08107	0.20906	103
104	222.42	207.72	0.014159	0.24244	70.626	4.1247	40.530	71.744	112.274	0.08161	0.20889	104
105	225.45	210.75	0.014190	0.23894	70.472	4.1852	40.847	71.467	112.314	0.08216	0.20872	105
106	228.50	213.81	0.014221	0.23549	70.317	4.2465	41.166	71.187	112.353	0.08271	0.20855	106
107	231.59	216.90	0.014253	0.23209	70.161	4.3086	41.485	70.906	112.391	0.08326	0.20838	107
108	234.71	220.02	0.014285	0.22875	70.005	4.3715	41.804	70.623	112.427	0.08381	0.20821	108
109	237.86	223.17	0.014317	0.22546	69.847	4.4354	42.125	70.338	112.463	0.08436	0.20804	109
110	241.04	226.35	0.014350	0.22222	69.689	4.5000	42.446	70.052	112.498	0.08491	0.20787	110
111	244.25	229.56	0.014382	0.21903	69.529	4.5656	42.768	69.763	112.531	0.08546	0.20770	111
112	247.50	232.80	0.014416	0.21589	69.369	4.6321	43.091	69.473	112.564	0.08601	0.20753	112
113	250.77	236.08	0.014449	0.21279	69.208	4.6994	43.415	69.180	112.595	0.08656	0.20736	113
114	254.08	239.38	0.014483	0.20974	69.046	4.7677	43.739	68.886	112.626	0.08711	0.20718	114
115	257.42	242.72	0.014517	0.20674	68.883	4.8370	44.065	68.590	112.655	0.08766	0.20701	115
116	260.79	246.10	0.014552	0.20378	68.719	4.9072	44.391	68.291	112.682	0.08821	0.20684	116
117	264.20	249.50	0.014587	0.20087	68.554	4.9784	44.718	67.991	112.709	0.08876	0.20666	117
118	267.63	252.94	0.014622	0.19800	68.388	5.0506	45.046	67.688	112.735	0.08932	0.20649	118
119	271.10	256.41	0.014658	0.19517	68.221	5.1238	45.375	67.384	112.759	0.08987	0.20631	119

SECTION III – REFRIGERANT 22

THERMODYNAMIC PROPERTIES – Con't.

TEMP. °F	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb×°R)		TEMP. °F
	PSIA	PSIG	LIQUID $v_f$	VAPOR $v_g$	LIQUID $l/v_f$	VAPOR $l/v_g$	LIQUID $h_f$	LATENT $h_{fg}$	VAPOR $h_g$	LIQUID $s_f$	VAPOR $s_g$	
120	274.60	259.91	0.014694	0.19238	68.054	5.1981	45.705	67.077	112.782	0.09042	0.20613	120
121	278.14	263.44	0.014731	0.18963	67.885	5.2734	46.036	66.767	112.803	0.09098	0.20595	121
122	281.71	267.01	0.014768	0.18692	67.714	5.3498	46.368	66.456	112.824	0.09153	0.20578	122
123	285.31	270.62	0.014805	0.18426	67.543	5.4272	46.701	66.142	112.843	0.09208	0.20560	123
124	288.95	274.25	0.014843	0.18163	67.371	5.5058	47.034	65.826	112.860	0.09264	0.20542	124
125	292.62	277.92	0.014882	0.17903	67.197	5.5856	47.369	65.507	112.877	0.09320	0.20523	125
126	296.33	281.63	0.014920	0.17648	67.023	5.6665	47.705	65.186	112.891	0.09375	0.20505	126
127	300.07	285.37	0.014960	0.17396	66.847	5.7486	48.042	64.863	112.905	0.09431	0.20487	127
128	303.84	289.14	0.014999	0.17147	66.670	5.8319	48.380	64.537	112.917	0.09487	0.20468	128
129	307.65	292.95	0.015039	0.16902	66.492	5.9164	48.719	64.208	112.927	0.09543	0.20449	129
130	311.50	296.80	0.015080	0.16661	66.312	6.0022	49.059	63.877	112.936	0.09598	0.20431	130
131	315.38	300.68	0.015121	0.16422	66.131	6.0893	49.400	63.543	112.943	0.09654	0.20412	131
132	319.29	304.60	0.015163	0.16187	65.949	6.1777	49.743	63.206	112.949	0.09711	0.20393	132
133	323.25	308.55	0.015206	0.15956	65.766	6.2674	50.087	62.866	112.953	0.09767	0.20374	133
134	327.23	312.54	0.015248	0.15727	65.581	6.3585	50.432	62.523	112.955	0.09823	0.20354	134
135	331.26	316.56	0.015292	0.15501	65.394	6.4510	50.778	62.178	112.956	0.09879	0.20335	135
136	335.32	320.63	0.015336	0.15279	65.207	6.5450	51.125	61.829	112.954	0.09936	0.20315	136
137	339.42	324.73	0.015381	0.15059	65.017	6.6405	51.474	61.477	112.951	0.09992	0.20295	137
138	343.56	328.86	0.015426	0.14843	64.826	6.7374	51.824	61.123	112.947	0.10049	0.20275	138
139	347.73	333.04	0.015472	0.14629	64.634	6.8359	52.175	60.764	112.940	0.10106	0.20255	139
140	351.94	337.25	0.015518	0.14418	64.440	6.9360	52.528	60.403	112.931	0.10163	0.20235	140
141	356.19	341.50	0.015566	0.14209	64.244	7.0377	52.883	60.038	112.921	0.10220	0.20214	141
142	360.48	345.79	0.015613	0.14004	64.047	7.1410	53.238	59.670	112.908	0.10277	0.20194	142
143	364.81	350.11	0.015662	0.13801	63.848	7.2461	53.596	59.298	112.893	0.10334	0.20173	143
144	369.17	354.48	0.015712	0.13600	63.647	7.3529	53.955	58.922	112.877	0.10391	0.20152	144
145	373.58	358.88	0.015762	0.13402	63.445	7.4615	54.315	58.543	112.858	0.10449	0.20130	145
146	378.02	363.32	0.015813	0.13207	63.240	7.5719	54.677	58.159	112.836	0.10507	0.20109	146
147	382.50	367.81	0.015865	0.13014	63.034	7.6842	55.041	57.772	112.813	0.10564	0.20087	147
148	387.03	372.33	0.015917	0.12823	62.825	7.7985	55.406	57.380	112.787	0.10622	0.20065	148
149	391.59	376.89	0.015971	0.12635	62.615	7.9148	55.774	56.985	112.758	0.10681	0.20042	149
150	396.19	381.50	0.016025	0.12448	62.402	8.0331	56.143	56.585	112.728	0.10739	0.20020	150
151	400.84	386.14	0.016080	0.12265	62.187	8.1536	56.514	56.180	112.694	0.10797	0.19997	151
152	405.52	390.83	0.016137	0.12083	61.970	8.2763	56.887	55.771	112.658	0.10856	0.19974	152
153	410.25	395.56	0.016194	0.11903	61.751	8.4011	57.261	55.358	112.619	0.10915	0.19950	153
154	415.02	400.32	0.016252	0.11726	61.529	8.5284	57.638	54.939	112.577	0.10974	0.19926	154
155	419.83	405.13	0.016312	0.11550	61.305	8.6580	58.017	54.515	112.533	0.11034	0.19902	155
156	424.68	409.99	0.016372	0.11376	61.079	8.7901	58.399	54.087	112.485	0.11093	0.19878	156
157	429.58	414.88	0.016434	0.11205	60.849	8.9247	58.782	53.652	112.435	0.11153	0.19853	157
158	434.52	419.82	0.016497	0.11035	60.617	9.0620	59.168	53.213	112.381	0.11213	0.19828	158
159	439.50	424.80	0.016561	0.10867	60.383	9.2020	59.557	52.767	112.324	0.11273	0.19802	159
160	444.53	429.83	0.016627	0.10701	60.145	9.3449	59.948	52.316	112.263	0.11334	0.19776	160
161	449.59	434.90	0.016693	0.10537	59.904	9.4907	60.341	51.858	112.199	0.11395	0.19750	161
162	454.71	440.01	0.016762	0.10374	59.660	9.6395	60.737	51.394	112.131	0.11456	0.19723	162
163	459.87	445.17	0.016831	0.10213	59.413	9.7915	61.136	50.923	112.060	0.11518	0.19696	163
164	465.07	450.37	0.016902	0.10054	59.163	9.9467	61.538	50.446	111.984	0.11580	0.19668	164
165	470.32	455.62	0.016975	0.098956	58.909	10.106	61.943	49.961	111.904	0.11642	0.19640	165
166	475.61	460.92	0.017050	0.097393	58.651	10.268	62.351	49.469	111.820	0.11705	0.19611	166
167	480.95	466.26	0.017126	0.095844	58.390	10.434	62.763	48.969	111.732	0.11768	0.19581	167
168	486.34	471.65	0.017204	0.094309	58.125	10.603	63.178	48.461	111.639	0.11831	0.19552	168
169	491.78	477.08	0.017285	0.092787	57.855	10.777	63.596	47.945	111.541	0.11895	0.19521	169
170	497.26	482.56	0.017367	0.091279	57.581	10.955	64.019	47.419	111.438	0.11959	0.19490	170
171	502.79	488.09	0.017451	0.089783	57.303	11.138	64.445	46.885	111.330	0.12024	0.19458	171
172	508.37	493.67	0.017538	0.088299	57.019	11.325	64.875	46.340	111.216	0.12089	0.19425	172
173	513.99	499.30	0.017627	0.086827	56.731	11.517	65.310	45.786	111.096	0.12155	0.19392	173
174	519.67	504.97	0.017719	0.085365	56.438	11.714	65.750	45.221	110.970	0.12222	0.19358	174

SECTION III – REFRIGERANT 22

THERMODYNAMIC PROPERTIES – Con't.

TEMP. °F	PRESSURE		VOLUME cu ft/lb		DENSITY lb/cu ft		ENTHALPY Btu/lb			ENTROPY Btu/(lb)(°R)		TEMP. °F
	PSIA	PSIG	LIQUID $v_f$	VAPOR $v_g$	LIQUID $l/v_f$	VAPOR $l/v_g$	LIQUID $h_f$	LATENT $h_{fg}$	VAPOR $h_g$	LIQUID $s_f$	VAPOR $s_g$	
175	525.39	510.70	0.017813	0.083914	56.139	11.917	66.194	44.644	110.838	0.12289	0.19323	175
176	531.17	516.47	0.017910	0.082473	55.834	12.125	66.643	44.056	110.699	0.12356	0.19287	176
177	537.00	522.30	0.018011	0.081040	55.523	12.340	67.098	43.455	110.553	0.12425	0.19250	177
178	542.87	528.18	0.018114	0.079616	55.205	12.560	67.558	42.841	110.400	0.12494	0.19212	178
179	548.80	534.11	0.018221	0.078200	54.881	12.788	68.025	42.213	110.238	0.12564	0.19173	179
180	554.78	540.09	0.018332	0.076790	54.549	13.023	68.498	41.570	110.068	0.12635	0.19133	180
181	560.82	546.12	0.018447	0.075386	54.209	13.265	68.978	40.911	109.888	0.12707	0.19092	181
182	566.90	552.21	0.018566	0.073987	53.861	13.516	69.465	40.235	109.700	0.12779	0.19050	182
183	573.04	558.35	0.018690	0.072592	53.503	13.776	69.960	39.540	109.500	0.12853	0.19005	183
184	579.24	564.54	0.018820	0.071201	53.136	14.045	70.464	38.826	109.290	0.12928	0.18960	184
185	585.49	570.79	0.018954	0.069811	52.759	14.324	70.977	38.090	109.067	0.13004	0.18913	185
186	591.80	577.10	0.019095	0.068421	52.370	14.615	71.500	37.332	108.832	0.13082	0.18864	186
187	598.16	583.46	0.019243	0.067031	51.968	14.918	72.034	36.548	108.582	0.13161	0.18813	187
188	604.58	589.88	0.019397	0.065638	51.553	15.235	72.579	35.738	108.317	0.13242	0.18760	188
189	611.05	596.36	0.019561	0.064241	51.123	15.566	73.138	34.897	108.035	0.13325	0.18704	189
190	617.59	602.89	0.019733	0.062837	50.677	15.914	73.711	34.023	107.734	0.13409	0.18646	190
191	624.19	609.49	0.019915	0.061424	50.213	16.280	74.300	33.112	107.412	0.13496	0.18585	191
192	630.84	616.14	0.020110	0.059999	49.728	16.667	74.907	32.160	107.067	0.13585	0.18520	192
193	637.56	622.86	0.020317	0.058558	49.219	17.077	75.534	31.162	106.696	0.13678	0.18452	193
194	644.33	629.64	0.020540	0.057096	48.685	17.514	76.184	30.111	106.295	0.13773	0.18380	194
195	651.18	636.48	0.020782	0.055609	48.119	17.983	76.861	28.998	105.858	0.13873	0.18302	195
196	658.08	643.38	0.021045	0.054089	47.518	18.488	77.568	27.813	105.381	0.13977	0.18218	196
197	665.05	650.35	0.021334	0.052528	46.874	19.038	78.313	26.543	104.856	0.14086	0.18128	197
198	672.08	657.39	0.021655	0.050912	46.178	19.642	79.102	25.169	104.270	0.14202	0.18029	198
199	679.19	664.49	0.022018	0.049224	45.417	20.315	79.946	23.664	103.610	0.14326	0.17918	199
200	686.36	671.66	0.022436	0.047438	44.571	21.080	80.862	21.990	102.853	0.14460	0.17794	200
201	693.60	678.90	0.022931	0.045513	43.609	21.972	81.875	20.086	101.961	0.14609	0.17649	201
202	700.91	686.21	0.023543	0.043375	42.476	23.055	83.030	17.840	100.870	0.14779	0.17475	202
203	708.29	693.59	0.024358	0.040868	41.054	24.469	84.418	15.022	99.439	0.14984	0.17250	203
204	715.75	701.05	0.025647	0.037545	38.991	26.635	86.309	10.951	97.260	0.15264	0.16914	204
204.81	721.91	707.21	0.030525	0.030525	32.760	32.760	91.329	0.000	91.329	0.16016	0.16016	204.81

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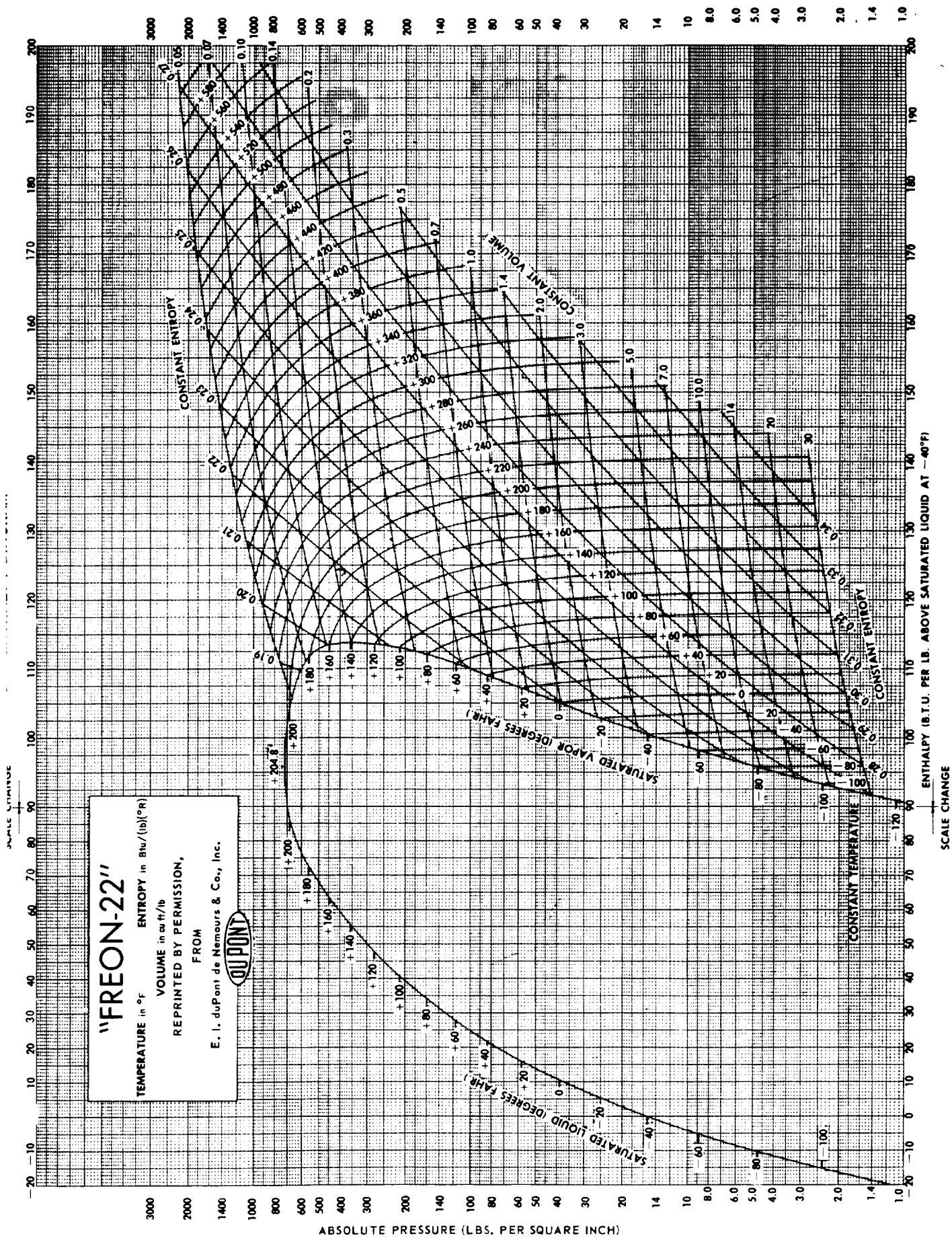
# "FREON-22"

TEMPERATURE in °F  
ENTROPY in Btu/(lb)(°R)  
VOLUME in cu ft/lb  
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ABSOLUTE PRESSURE (LBS. PER SQUARE INCH)

ENTHALPY (B.T.U. PER LB. ABOVE SATURATED LIQUID AT -40°F)



## SECTION III - REFRIGERANT 22

### SUCTION LINE CAPACITIES - TONS

LINE SIZE (inches)		Saturated Suction Temperature—F																				
		- 40			- 20			0			20			40								
		Pressure Drop—Psi Per 100 ft																				
IPS	OD	1/2	1	2	3	1/2	1	2	3	1/2	1	2	3	1/2	1	2	3	1/2	1	2	3	
1/2	1/2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	3/8	—	—	0.34	0.40	—	—	—	0.43	0.52	—	—	—	—	—	—	0.38	—	—	0.39	0.47	—
	3/4	—	0.39	0.56	0.69	0.37	0.52	0.74	0.90	0.46	0.67	0.94	1.17	0.57	0.84	1.21	1.53	0.73	1.16	1.54	1.90	2.35
3/4	7/8	0.42	0.61	0.87	1.07	0.53	0.79	1.12	1.41	0.70	1.02	1.46	1.84	0.88	1.28	1.90	2.33	1.13	1.64	2.35	2.93	3.58
	1 1/8	0.39	0.56	0.79	0.98	0.51	0.73	1.03	1.26	0.65	0.93	1.31	1.62	0.81	1.16	1.64	2.02	0.99	1.42	2.03	2.58	3.28
	1 1/4	0.83	1.19	1.73	2.16	1.09	1.56	2.29	2.81	1.40	2.02	2.90	3.77	1.78	2.61	3.86	4.72	2.28	3.28	4.80	5.83	7.00
1	1 1/8	0.74	1.05	1.50	1.81	0.98	1.38	1.95	2.42	1.25	1.78	2.51	3.12	1.56	2.25	3.18	3.92	1.96	2.72	4.04	4.90	5.93
	1 3/8	1.45	2.11	3.05	3.89	1.90	2.76	4.14	5.03	2.50	3.61	5.20	6.40	3.16	4.61	6.76	8.20	4.04	5.69	8.35	10.3	12.5
	1 1/2	1.53	2.20	3.18	3.86	1.98	2.84	4.05	5.00	2.53	3.74	5.15	6.37	3.21	4.50	6.43	7.97	4.04	5.69	8.05	9.94	12.0
1 1/2	1 5/8	2.30	3.38	4.76	5.91	2.96	4.35	6.23	7.77	3.93	5.60	8.10	9.96	4.95	7.17	10.8	12.9	6.23	8.94	13.1	16.2	19.9
	2	2.33	3.35	4.76	6.05	3.00	4.35	6.15	7.54	3.93	5.49	7.79	9.52	4.81	6.91	9.65	12.0	6.03	8.47	12.0	14.9	18.4
	2 1/8	4.79	6.9	10.1	12.4	6.24	9.05	13.2	16.3	8.11	11.7	17.0	21.5	10.3	14.9	22.2	27.0	13.1	19.0	27.1	34.4	42.5
2	2 1/4	4.47	6.4	8.95	10.8	5.70	8.19	11.7	14.1	7.37	10.3	14.9	18.4	9.31	13.0	18.7	22.8	11.5	16.4	23.2	28.5	35.0
	2 3/8	8.30	12.1	17.3	21.6	10.9	15.8	23.1	28.4	14.0	20.6	29.0	38.4	18.0	26.2	39.2	47.0	22.8	32.8	47.0	59.0	72.0
	2 1/2	7.15	10.1	14.1	17.3	9.1	12.9	18.6	23.0	11.7	16.5	24.0	29.3	14.7	20.9	29.4	38.0	18.2	26.2	37.7	46.3	56.0
3	3 1/8	13.2	19.4	27.7	35.2	17.7	25.2	36.8	45.8	22.6	33.0	47.7	58.3	28.9	41.8	60.0	76.6	35.7	52.9	76.2	94.4	115.0
	3 1/4	12.1	17.9	25.4	31.8	16.1	23.4	34.2	40.4	21.0	29.6	42.0	52.3	26.1	38.0	53.0	64.3	32.5	45.7	65.6	81.2	99.0
	3 3/8	20.0	28.9	41.3	50.8	25.8	38.1	53.8	67.7	33.7	49.2	70.4	86.2	43.2	62.7	89.0	113.	54.6	78.2	114.	139.	168.0
4	4 1/8	27.4	40.0	57.6	73.6	36.6	52.7	76.3	96.4	47.7	68.5	99.5	125.	59.5	87.5	128.	160.	77.2	112.	161.	199.	245.0
	4 1/4	25.6	36.4	50.5	63.5	32.0	47.1	65.9	81.7	42.7	59.1	84.5	107.	53.7	75.5	105.	129.	64.7	91.7	132.	162.	196.0
	4 3/8	50.0	73.7	107.	132.	66.0	96.5	138.	174.	89.3	124.	180.	222.	110.	159.	230.	286.	135.	199.	286.	357.	435.0
5	5 1/8	46.4	65.7	92.	114.	59.3	85.0	121.	149.	77.4	109.	154.	189.	96.5	133.	191.	234.	118.	167.	234.	291.	357.0
	5 1/4	79.6	117.	169.	207.	105.	151.	215.	272.	136.	193.	284.	359.	171.	251.	373.	450.	218.	314.	457.	573.	700.0
	5 3/8	156.	222.	317.	392.	206.	291.	410.	515.	262.	373.	530.	656.	331.	470.	660.	820.	407.	579.	827.	1010.	1240.0
10	10	274.	396.	533.	678.	365.	519.	719.	890.	458.	670.	920.	1120.	570.	817.	1140.	1400.	718.	1020.	1420.	1740.	2140.0
	12	442.	606.	822.	1060.	555.	810.	1140.	1420.	717.	1020.	1490.	1810.	901.	1290.	1830.	2250.	1130.	1600.	2280.	2810.	3440.0

<sup>1</sup> Based on fluid flow at 105F condensing temperature.  
<sup>2</sup> "IPS" data based on Schedule 40 steel piping.

<sup>3</sup> "OD" data based on Type L copper tubing.

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### DISCHARGE and LIQUID LINE CAPACITIES - TONS

LINE SIZE (inches)		DISCHARGE LINES				LIQUID LINES	
		Temperature 200 F				To Receiver	To System
		Pressure Drop Psi/100 ft				Velocity fpm	Pressure Drop Psi/100 ft
IPS	OD	1/2	1	2	3	100	2
1/2	1/2	0.33	0.48	0.69	0.86	2.34	2.89
	3/8	0.59	0.88	1.27	1.63	3.78	5.48
	3/4	0.71	1.00	1.40	1.71	3.81	4.65
3/4	3/4	1.05	1.53	2.22	2.74	5.55	9.20
	7/8	1.64	2.36	3.42	4.32	7.85	14.3
	1 1/8	1.50	2.09	3.00	3.82	7.05	10.3
1	1 1/8	3.29	4.71	6.91	8.64	13.4	29.2
	1 1/4	2.82	4.09	5.75	6.98	11.7	20.2
	1 3/8	5.71	8.37	12.1	15.1	20.4	51.5
1 1/4	1 3/8	5.75	8.21	11.6	13.8	20.9	44.1
	1 1/2	8.97	13.1	19.0	23.6	28.9	83.0
	1 3/4	8.64	12.4	17.2	21.6	28.8	66.4
2	2 1/8	19.3	27.2	40.5	49.8	50.4	168.
	2 1/4	16.6	23.6	33.1	41.9	54.6	159.
	2 3/8	32.9	48.2	68.8	87.0	77.6	296.
2 1/2	2 3/8	26.6	39.2	53.2	65.8	77.9	248.
	3	53.2	77.1	111.	136.	111.	475.
	3 1/8	47.2	66.4	93.7	116.	120.	459.
3	3 1/4	79.0	115.	165.	203.	150.	742.
	3 3/8	111.	163.	232.	291.	194.	981.
	3 1/2	95.0	133.	189.	232.	207.	911.
4	4 1/8	199.	292.	419.	522.	303.	—
	4 1/4	171.	239.	346.	425.	325.	—
	4 3/8	316.	459.	658.	823.	434.	—
6	6	281.	409.	572.	681.	471.	—
	8	588.	844.	1180.	1440.	815.	—
	10	1020.	1430.	2040.	2490.	1280.	—
12	12	1640.	2320.	3300.	4080.	1840.	—

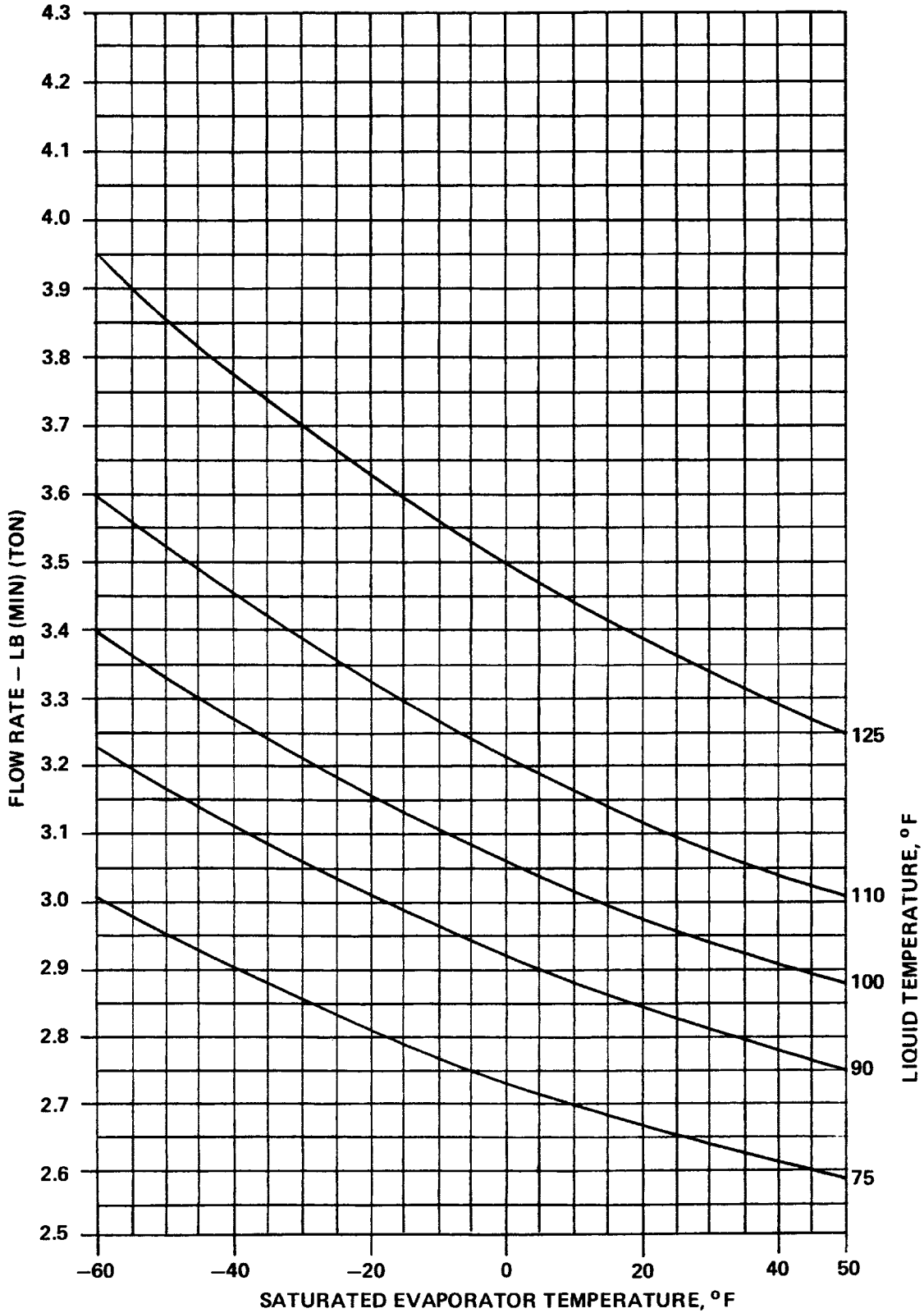
<sup>1</sup> Based on fluid flow at 105F condensing temperature and 40F saturated evaporating temperature.  
<sup>2</sup> "IPS" data based on Schedule 40 steel piping except that

liquid lines 1 1/2" and smaller are Schedule 80.  
 "OD" data based on Type L copper tubing.

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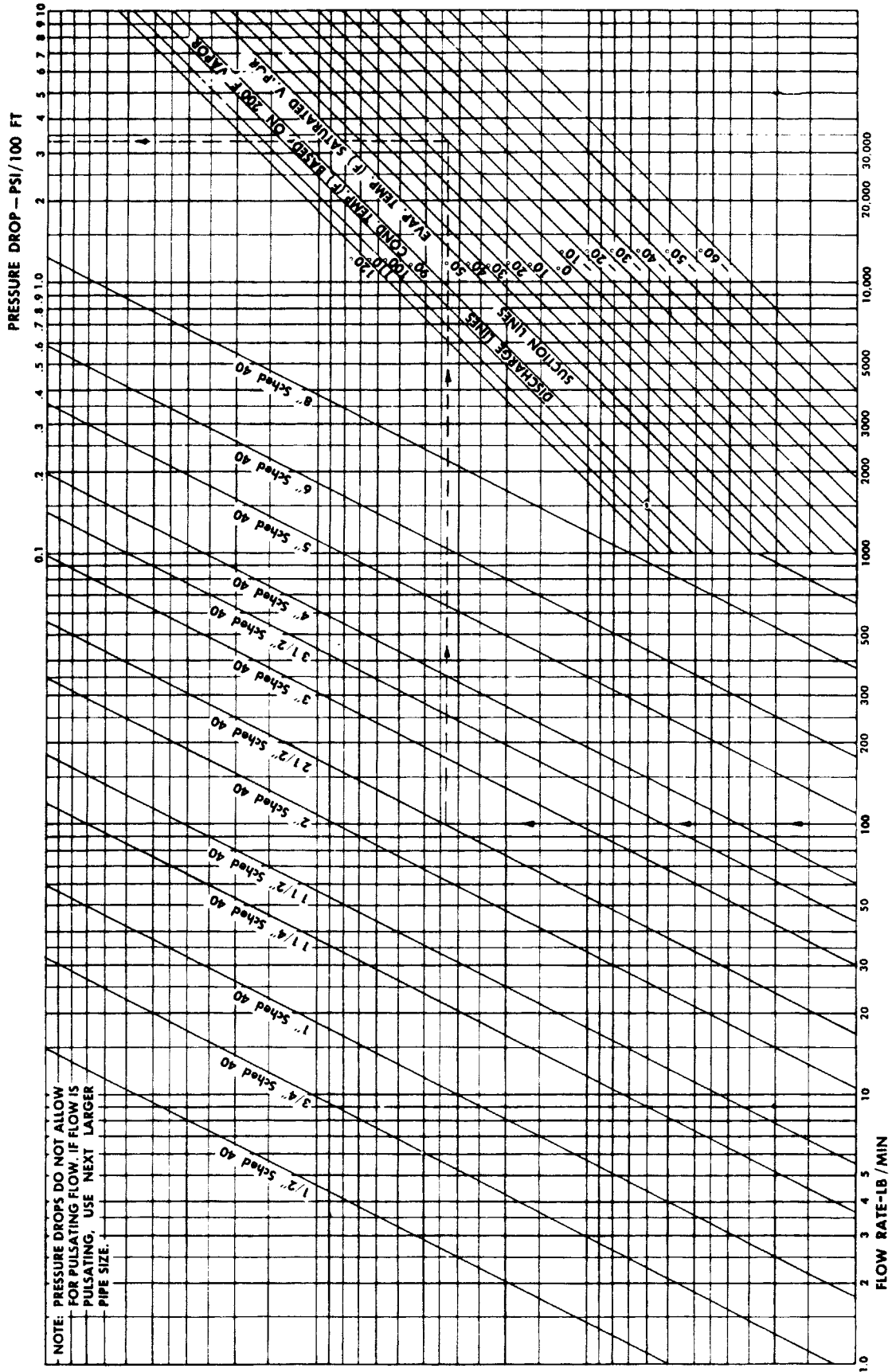
**SECTION III – REFRIGERANT 22**

**FLOW RATE PER TON**



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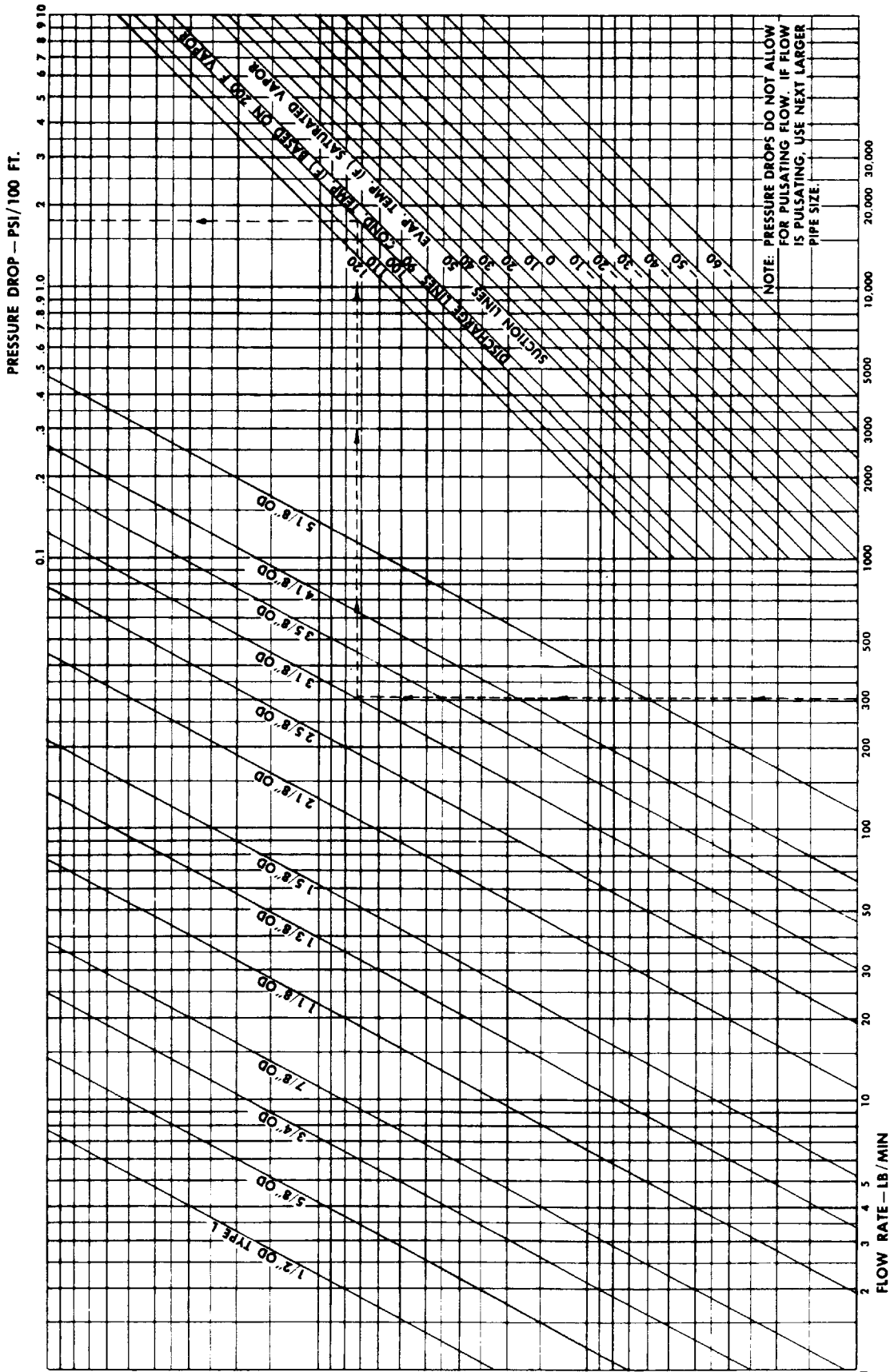
SECTION III - REFRIGERANT 22



PRESSURE DROP - STEEL PIPE

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# SECTION III - REFRIGERANT 22



## PRESSURE DROP - COPPER TUBING

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SECTION IV - BRINE

PROPERTIES of PURE CALCIUM CHLORIDE BRINE

Pure CaCl <sub>2</sub> % by wt	Specific gravity 60 F	Baumé density 60 F	Specific heat 60 F Btu per (lb)(F deg)	Crystal-lization starts F	Weight per gallon			Weight per cubic foot			Specific Gravity at Various Temperatures (Refers to water at 60 F)				
					CaCl <sub>2</sub> lb/gal	Water lb/gal	Brine lb/gal	CaCl <sub>2</sub> lb/cu ft	Water lb/cu ft	Brine lb/cu ft	-4 F -20 C	14 F -10 C	32 F 0 C	50 F 10 C	
	60 F														
0	1.000	0.0	1.000	32.0	0.000	8.34	8.34	0.00	62.40	62.40					
5	1.044	6.1	0.924	27.7	0.436	8.281	8.717	3.26	61.89	65.15				1.043	1.042
6	1.050	7.0	0.914	26.8	0.528	8.234	8.760	3.93	61.59	65.52				1.052	1.051
7	1.060	8.2	0.898	25.9	0.620	8.231	8.851	4.63	61.51	66.14				1.061	1.060
8	1.069	9.3	0.884	24.6	0.714	8.212	8.926	5.34	61.36	66.70				1.071	1.069
9	1.078	10.4	0.869	23.5	0.810	8.191	9.001	6.05	61.22	67.27				1.080	1.078
10	1.087	11.6	0.855	22.3	0.908	8.168	9.076	6.78	61.05	67.83				1.089	1.087
11	1.096	12.6	0.842	20.8	1.006	8.137	9.143	7.52	60.81	68.33				1.098	1.096
12	1.105	13.8	0.828	19.3	1.107	8.120	9.227	8.27	60.68	68.95				1.108	1.105
13	1.114	14.8	0.816	17.6	1.209	8.093	9.302	9.04	60.47	69.51				1.117	1.115
14	1.124	15.9	0.804	15.5	1.313	8.064	9.377	9.81	60.27	70.08				1.127	1.124
15	1.133	16.9	0.793	13.5	1.418	8.034	9.452	10.60	60.04	70.64			1.139	1.137	1.134
16	1.143	18.0	0.779	11.2	1.526	8.010	9.536	11.40	59.86	71.26			1.149	1.146	1.143
17	1.152	19.1	0.767	8.6	1.635	7.984	9.619	12.22	59.67	71.89			1.159	1.156	1.153
18	1.162	20.2	0.756	5.9	1.747	7.956	9.703	13.05	59.46	72.51			1.169	1.166	1.163
19	1.172	21.3	0.746	2.8	1.859	7.927	9.786	13.90	59.23	73.13			1.180	1.176	1.173
20	1.182	22.1	0.737	-0.4	1.970	7.883	9.853	14.73	58.99	73.63			1.190	1.186	1.183
21	1.192	23.0	0.729	-3.9	2.085	7.843	9.928	15.58	58.61	74.19					
22	1.202	24.4	0.716	-7.8	2.208	7.829	10.037	16.50	58.50	75.00	1.215	1.211	1.207	1.203	
23	1.212	25.5	0.707	-11.9	2.328	7.792	10.120	17.40	58.23	75.63					
24	1.223	26.4	0.697	-16.2	2.451	7.761	10.212	18.32	58.00	76.32	1.236	1.232	1.228	1.224	
25	1.233	27.4	0.689	-21.0	2.574	7.721	10.295	19.24	57.70	76.94					
26	1.244	28.3	0.682	-25.8	2.699	7.680	10.379	20.17	57.39	77.56					
27	1.254	29.3	0.673	-31.2	2.827	7.644	10.471	21.13	57.12	78.25					
28	1.265	30.4	0.665	-37.8	2.958	7.605	10.563	22.10	56.84	78.94					
29	1.276	31.4	0.658	-49.4	3.090	7.565	10.655	23.09	56.53	79.62					
29.87	1.290	32.6	0.655	-67.0	3.16	7.59	10.75	23.65	56.80	80.45					
30	1.295	33.0	0.653	-50.8	3.22	7.58	10.80	24.06	56.70	80.76					
32	1.317	34.9	0.640	-19.5	3.49	7.49	10.98	26.10	56.04	82.14					
34	1.340	36.8	0.630	+4.3	3.77	7.40	11.17	28.22	55.35	83.57					

\* Wt of flake CaCl<sub>2</sub> = Wt of pure CaCl<sub>2</sub> / 0.785  
 Wt of solid CaCl<sub>2</sub> = Wt of pure CaCl<sub>2</sub> / 0.74

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PROPERTIES of PURE SODIUM CHLORIDE BRINE

Pure NaCl % by wt	Specific gravity 59 F 39 F	Baumé density 60 F	Specific heat 59 F Btu/lb deg F	Crystal-lization starts F	Weight per gallon*			Weight per cubic foot*			Sp. Gravity at Other Temperatures Refers to water at 60 F				
					NaCl lb/gal	Water lb/gal	Brine lb/gal	NaCl lb/cu ft	Water lb/cu ft	Brine lb/cu ft	14 F -10 C	32 F 0 C	50 F 10 C	68 F 20 C	
0	1.000	0.0	1.000	32.0	0.000	8.34	8.34	0.000	62.40	62.4					
5	1.035	5.1	0.938	27.0	0.432	8.22	8.65	3.230	61.37	64.6			1.0382	1.0366	1.0341
6	1.043	6.1	0.927	25.5	0.523	8.19	8.71	3.906	61.19	65.1			1.0459	1.0440	1.0413
7	1.050	7.0	0.917	24.0	0.613	8.15	8.76	4.585	60.91	65.5			1.0536	1.0515	1.0486
8	1.057	8.0	0.907	23.2	0.706	8.11	8.82	5.280	60.72	66.0			1.0613	1.0590	1.0559
9	1.065	9.0	0.897	21.8	0.800	8.09	8.89	5.985	60.51	66.5			1.0691	1.0665	1.0633
10	1.072	10.1	0.888	20.4	0.895	8.05	8.95	6.690	60.21	66.9			1.0769	1.0741	1.0707
11	1.080	10.8	0.879	18.5	0.992	8.03	9.02	7.414	59.99	67.4			1.0849	1.0817	1.0782
12	1.087	11.8	0.870	17.2	1.090	7.99	9.08	8.136	59.66	67.8			1.0925	1.0897	1.0857
13	1.095	12.7	0.862	15.5	1.188	7.95	9.14	8.879	59.42	68.3			1.1004	1.0971	1.0933
14	1.103	13.6	0.854	13.9	1.291	7.93	9.22	9.632	59.17	68.8			1.1083	1.1048	1.1009
15	1.111	14.5	0.847	12.0	1.392	7.89	9.28	10.395	58.90	69.3	1.1195	1.1163	1.1126	1.1086	
16	1.118	15.4	0.840	10.2	1.493	7.84	9.33	11.168	58.63	69.8	1.1277	1.1243	1.1205	1.1163	
17	1.126	16.3	0.833	8.2	1.598	7.80	9.40	11.951	58.36	70.3	1.1359	1.1323	1.1284	1.1241	
18	1.134	17.2	0.826	6.1	1.705	7.76	9.47	12.744	58.06	70.8	1.1442	1.1404	1.1363	1.1319	
19	1.142	18.1	0.819	4.0	1.813	7.73	9.54	13.547	57.75	71.3	1.1535	1.1486	1.1444	1.1398	
20	1.150	19.0	0.813	+1.8	1.920	7.68	9.60	14.360	57.44	71.8	1.1608	1.1568	1.1542	1.1478	
21	1.158	19.9	0.807	-0.8	2.031	7.64	9.67	15.183	57.12	72.3	1.1692	1.1651	1.1606	1.1559	
22	1.166	20.8	0.802	-3.0	2.143	7.60	9.74	16.016	56.78	72.8	1.1777	1.1734	1.1688	1.1640	
23	1.175	21.7	0.796	-6.0	2.256	7.55	9.81	16.854	56.45	73.3	1.1862	1.1818	1.1771	1.1721	
24	1.183	22.5	0.791	+3.8	2.371	7.51	9.88	17.712	56.09	73.8	1.1948	1.1902	1.1854	1.1804	
25	1.191	23.4	0.786	+16.1	2.488	7.46	9.95	18.575	55.72	74.3					
25.2	1.200			+32.0											

\* Wt of commercial NaCl required = Wt of pure NaCl required / per cent purity

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SECTION V - PIPING DATA

EQUIVALENT LENGTHS of VALVES and FITTINGS

FERROUS VALVES AND FITTINGS <sup>2, 3</sup>

LINE SIZE Inches) IPS	GLOBE VALVE		ANGLE VALVE		SHORT-RADIUS ELL			LONG-RADIUS ELL			TEE, LINE-FLOW			TEE, BRANCH-FLOW		
	Screwed	Flanged	Screwed	Flanged	Screwed	Flanged	Welded	Screwed	Flanged	Welded	Screwed	Flanged	Welded	Screwed	Flanged	Welded
1/2	29.	—	16.	—	4.1	—	—	—	—	—	1.8	—	—	4.7	—	—
3/4	31.	—	16.	—	4.7	—	—	2.5	—	—	2.5	—	—	5.6	—	—
1	35.	57.	16.	19.	5.3	1.6	1.8	2.8	1.5	1.2	3.4	1.0	1.6	6.8	3.8	5.2
1 1/4	46.	69.	19.	22.	7.1	2.2	2.3	3.3	2.0	1.6	4.9	1.3	2.0	9.2	4.9	7.1
1 1/2	51.	76.	19.	22.	7.9	2.6	2.6	3.4	2.2	1.8	5.9	1.4	2.0	9.9	5.8	8.4
2	63.	89.	20.	25.	9.0	3.2	3.4	3.6	2.7	2.3	8.1	1.7	2.5	12.6	7.2	10.5
2 1/2	—	101.	—	28.	—	3.8	4.2	—	3.0	2.7	—	1.9	2.9	—	8.4	13.
3	—	123.	—	36.	—	4.9	5.3	—	3.7	3.4	—	2.4	3.6	—	11.	16.
4	—	155.	—	48.	—	6.2	7.2	—	4.5	4.5	—	2.9	4.5	—	14.	22.
5	—	190.	—	63.	—	8.1	9.2	—	5.4	5.7	—	3.5	5.1	—	17.	27.
6	—	227.	—	78.	—	9.5	11.	—	6.1	6.8	—	4.1	6.1	—	20.	33.
8	—	295.	—	110.	—	13.	15.	—	7.1	9.0	—	4.7	7.1	—	27.	44.
10	—	370.	—	142.	—	16.	18.	—	8.7	11.	—	5.6	8.7	—	32.	56.
12	—	465.	—	173.	—	19.	22.	—	10.	14.	—	6.2	10.	—	39.	68.

NON-FERROUS VALVES AND FITTINGS <sup>2</sup>

LINE SIZE (Inches) OD	GLOBE VALVE		ANGLE VALVE		SHORT-RADIUS ELL		LONG-RADIUS ELL		TEE, LINE-FLOW		TEE, BRANCH-FLOW	
	Screwed	Other <sup>4</sup>	Screwed	Other <sup>4</sup>	Screwed	Other <sup>4</sup>	Screwed	Other <sup>4</sup>	Screwed	Other <sup>4</sup>	Screwed	Other <sup>4</sup>
1/2	40.	70.	21.	24.	4.7	4.7	—	3.2	1.9	1.7	5.1	6.6
3/4	39.	72.	22.	25.	5.4	5.7	—	3.9	2.3	2.3	6.2	8.2
3/4	39.	75.	23.	25.	6.2	6.5	2.9	4.5	2.9	2.9	7.1	9.7
7/8	45.	78.	23.	28.	7.0	7.8	3.7	5.3	3.7	3.7	8.2	12.
1 1/4	54.	87.	25.	29.	8.1	2.7	4.2	1.9	5.2	2.5	11.	8.
1 1/4	64.	102.	27.	33.	9.9	3.2	4.6	2.2	6.9	2.7	13.	10.
1 1/4	75.	115.	28.	34.	12.	3.8	5.0	2.6	8.7	3.0	14.	12.
2 1/4	95.	141.	30.	39.	14.	5.2	5.4	3.4	12.	3.8	19.	16.
2 3/4	—	159.	—	44.	—	6.5	—	4.2	—	4.6	—	20.
3 1/4	—	185.	—	53.	—	8.0	—	5.1	—	5.4	—	25.
3 3/4	—	216.	—	66.	—	10.	—	6.3	—	6.6	—	30.
4 1/4	—	248.	—	76.	—	12.	—	7.3	—	7.3	—	35.
5 1/4	—	292.	—	96.	—	14.	—	8.8	—	7.9	—	42.
6 1/4	—	346.	—	119.	—	17.	—	10.	—	9.3	—	50.

<sup>1</sup> Le = K (D/f)

<sup>2</sup> Friction factors (f) determined at "practical" Reynolds Numbers based on 40F suction lines having pressure drop of 1.8 psi/100 ft.

<sup>3</sup> Based on Schedule 40 Steel pipe.

<sup>4</sup> Flare, sweat, flanged, etc., are based on Type L copper tubing

SECTION V - PIPING DATA  
STEEL PIPE DIMENSIONS

Nominal Size	ASTM <sup>b</sup> Schedule	Diameter		Wall Thickness in.	Surface Area Sq Ft/Lin Ft		Section Area Sq In.		Area of Metal Sq In.	Volume Gal/Lin Ft	Weight <sup>c</sup> (plain end) Lb/Lin Ft	Working Pressure <sup>d</sup> Psia
		OD in.	ID in.		OD	ID	OD	ID				
1/8	40 (s)	0.405	0.269	0.068	0.106	0.0704	0.120	0.0568	0.0720	0.00295	0.244	314 (a)
	80 (x)	0.405	0.215	0.095	0.106	0.0563	0.129	0.0363	0.0925	0.00189	0.314	1084 (a)
1/4	40 (s)	0.540	0.364	0.088	0.141	0.0953	0.229	0.104	0.125	0.00541	0.424	649 (a)
	80 (x)	0.540	0.302	0.119	0.141	0.0791	0.239	0.0716	0.157	0.00372	0.535	1353 (a)
3/8	40 (s)	0.675	0.493	0.091	0.177	0.129	0.358	0.191	0.167	0.00992	0.567	574 (a)
	80 (x)	0.675	0.423	0.126	0.177	0.111	0.358	0.140	0.217	0.00730	0.738	1191 (a)
1/2	40 (s)	0.840	0.622	0.109	0.220	0.163	0.554	0.304	0.250	0.0158	0.850	697 (a)
	80 (x)	0.840	0.546	0.147	0.220	0.143	0.554	0.234	0.320	0.0122	1.09	1266 (a)
	XX	0.840	0.252	0.294	0.220	0.0660	0.554	0.0499	0.504	0.00259	1.71	3824 (a)
3/4	40 (s)	1.050	0.824	0.113	0.275	0.216	0.886	0.533	0.333	0.0277	1.13	604 (a)
	80 (x)	1.050	0.742	0.154	0.275	0.194	0.886	0.432	0.434	0.0225	1.47	1078 (a)
	XX	1.050	0.434	0.308	0.275	0.114	0.886	0.148	0.718	0.00768	2.44	3134 (a)
1	40 (s)	1.315	1.049	0.133	0.344	0.275	1.36	0.864	0.494	0.0449	1.68	651 (a)
	80 (x)	1.315	0.957	0.179	0.344	0.251	1.36	0.719	0.639	0.0374	2.17	1083 (a)
	XX	1.315	0.599	0.358	0.344	0.157	1.36	0.282	1.08	0.0146	3.66	2963 (a)
1 1/4	40 (s)	1.660	1.380	0.140	0.435	0.361	2.16	1.50	0.669	0.0777	2.27	440 (a)
	80 (x)	1.660	1.278	0.191	0.435	0.335	2.16	1.28	0.881	0.0666	3.00	805 (a)
	XX	1.660	0.896	0.382	0.435	0.235	2.16	0.630	1.53	0.0328	5.21	2318 (a)
1 1/2	40 (s)	1.900	1.610	0.145	0.497	0.421	2.84	2.04	0.800	0.1058	2.72	417 (a)
	80 (x)	1.900	1.500	0.200	0.497	0.393	2.84	1.77	1.07	0.0918	3.65	756 (a)
	XX	1.900	1.100	0.400	0.497	0.288	2.84	0.950	1.89	0.0494	6.41	2122 (a)
2	40 (s)	2.375	2.067	0.154	0.622	0.541	4.43	3.36	1.07	0.174	3.65	376 (a)
	80 (x)	2.375	1.939	0.218	0.622	0.508	4.43	2.95	1.48	0.153	5.02	690 (a)
	XX	2.375	1.503	0.436	0.622	0.393	4.43	1.77	2.66	0.0922	9.03	1861 (a)
2 1/2	40 (s)	2.875	2.469	0.203	0.753	0.646	6.49	4.79	1.70	0.249	5.79	505 (a)
	80 (x)	2.875	2.323	0.276	0.753	0.608	6.49	4.24	2.25	0.220	7.66	806 (a)
	XX	2.875	1.771	0.552	0.753	0.364	6.49	2.46	4.03	0.128	13.7	2048 (a)
3	40 (s)	3.500	3.068	0.216	0.916	0.803	9.62	7.39	2.23	0.384	7.57	454 (a)
	80 (x)	3.500	2.900	0.300	0.916	0.759	9.62	6.61	3.02	0.343	10.3	734 (a)
	XX	3.500	2.300	0.600	0.916	0.602	9.62	4.15	5.47	0.216	18.5	1829 (a)
3 1/2	40 (s)	4.000	3.548	0.226	1.05	0.929	12.6	9.89	2.68	0.514	9.11	425 (a)
	80 (x)	4.000	3.364	0.318	1.05	0.881	12.6	8.89	3.68	0.462	12.5	692 (a)
	XX	4.000	2.728	0.636	1.05	0.714	12.6	5.85	6.72	0.304	22.9	1699 (a)
4	40 (s)	4.500	4.026	0.237	1.18	1.05	15.9	12.7	3.17	0.661	10.8	403 (a)
	80 (x)	4.500	3.826	0.337	1.18	1.00	15.9	11.5	4.41	0.597	14.9	663 (a)
	XX	4.500	3.152	0.674	1.18	0.825	15.9	7.80	8.10	0.405	27.5	1602 (a)
5	40 (s)	5.563	5.047	0.258	1.46	1.32	24.3	20.0	4.30	1.04	14.6	498 (b)
	80 (x)	5.563	4.813	0.375	1.46	1.26	24.3	18.2	6.11	0.945	20.8	825 (b)
	XX	5.563	4.063	0.750	1.46	1.06	24.3	13.0	11.3	0.673	38.6	1951 (b)
6	40 (s)	6.625	6.065	0.280	1.73	1.59	34.5	28.9	5.58	1.50	18.0	467 (b)
	80 (x)	6.625	5.761	0.432	1.73	1.51	34.5	26.1	8.40	1.35	28.6	825 (b)
	XX	6.625	4.897	0.864	1.73	1.28	34.5	18.8	15.6	0.978	53.1	1912 (b)
8	30 (s)	8.625	8.071	0.277	2.26	2.11	58.4	51.2	7.26	2.66	24.7	351 (b)
	40 (s)	8.625	7.981	0.322	2.26	2.09	58.4	50.0	8.40	2.60	28.6	431 (b)
	80 (x)	8.625	7.625	0.500	2.26	2.00	58.4	45.7	12.8	2.37	43.4	753 (b)
	XX	8.625	6.875	0.875	2.26	1.80	58.4	37.1	21.3	1.93	72.4	1460 (b)
10	(s)	10.750	10.192	0.279	2.81	2.67	90.8	81.6	9.18	4.24	31.2	255 (b)
	30 (s)	10.750	10.136	0.307	2.81	2.65	90.8	80.7	10.1	4.19	34.2	324 (b)
	40 (s)	10.750	10.020	0.365	2.81	2.62	90.8	78.9	11.9	4.10	40.5	405 (b)
	60 (x)	10.750	9.750	0.500	2.81	2.55	90.8	74.7	16.1	3.88	54.7	600 (b)
12	30 (s)	12.750	12.090	0.330	3.34	3.17	128.	115.	12.9	5.96	43.8	299 (b)
	(s)	12.750	12.000	0.375	3.34	3.14	128.	113.	14.6	5.88	49.6	352 (b)
	(x)	12.750	11.750	0.500	3.34	3.08	128.	108.	19.2	5.63	65.4	503 (b)
14	30 (s)	14.000	13.250	0.375	3.67	3.46	154.	138.	16.0	7.17	54.6	458 (c)
	(x)	14.000	13.000	0.500	3.67	3.15	154.	133.	21.2	6.70	72.1	653 (c)
16	30 (s)	16.000	15.250	0.375	4.18	3.99	201.	183.	18.4	9.48	62.4	400 (c)
	40 (x)	16.000	15.000	0.500	4.18	3.93	201.	177.	24.3	9.18	82.8	570 (c)
18	(s)	18.000	17.250	0.375	4.71	4.52	254.	234.	20.7	12.1	70.6	355 (c)
	(x)	18.000	17.000	0.500	4.71	4.45	254.	227.	27.4	11.8	93.5	506 (c)
20	20 (s)	20.000	19.250	0.375	5.23	4.51	314.	291.	23.2	15.2	78.6	319 (c)
	30 (s)	20.000	19.000	0.500	5.23	4.97	314.	284.	30.6	14.7	104.2	454 (c)
24	20	24.000	23.250	0.375	6.29	6.08	452.	426.	26.8	22.1	94.6	265 (c)
	(s)	24.000	23.000	0.500	6.29	6.03	452.	415.	36.9	21.5	125.5	378 (c)

A The sizes for wrought iron are approximately the same except wall thickness is slightly heavier (See ASTM A-72).  
 B American Society for Testing Materials Schedule. The numbers 30, 40, etc., refer to the ASTM Schedule; the letter (s) refers to the former designation Standard Weight; the letter (x) refers to the former designation Extra Strong; the letters (xx) refer to the former designation Double Extra Strong.  
 C Weight per foot is based on plain end pipe. Threaded and coupled (T and C) pipe is slightly heavier.  
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SECTION V - PIPING DATA

STEEL TUBE DIMENSIONS

Diameter, Inches		Thickness of Wall, Inches		Circumference, Inches		Transverse Area, Square Inches			Ft. of Tube per Sq. Ft. of Surface		Wt. per Pound
External	Internal	Decimal	B. W. Gauge	External	Internal	External	Internal	Metal	External	Internal	Manufgr's
3/4	0.652	0.049	18	2.356	2.060	0.442	0.338	0.108	5.093	5.825	0.370
3/4	.620	.065	16	2.356	1.950	.442	.301	.140	5.093	6.150	.480
3/4	.584	.083	14	2.356	1.840	.442	.268	.174	5.093	6.520	.590
3/4	.560	.095	13	2.356	1.760	.442	.249	.195	5.093	6.815	.665
1	.870	.065	16	3.141	2.740	.785	.595	.191	3.820	4.375	.650
1	.834	.083	14	3.141	2.620	.785	.546	.239	3.820	4.575	.813
1	.810	.095	13	3.141	2.550	.785	.515	.270	3.820	4.710	.918
1	.782	.109	12	3.141	2.460	.785	.480	.305	3.820	4.875	1.040
1 1/4	1.106	.072	15	3.927	3.450	1.227	.962	.265	3.056	3.487	0.910
1 1/4	1.084	.083	14	3.927	3.410	1.227	.922	.305	3.056	3.520	1.030
1 1/4	1.060	.095	13	3.927	3.330	1.227	.883	.344	3.056	3.600	1.170
1 1/4	1.032	.109	12	3.927	3.240	1.227	.836	.391	3.056	3.720	1.330
1 1/4	1.010	.120	11	3.927	3.170	1.227	.801	.425	3.056	3.790	1.450
1 1/4	0.982	.134	10	3.927	3.080	1.227	.757	.470	3.056	3.895	1.600
1 1/2	1.334	.083	14	4.712	4.190	1.767	1.400	.367	2.546	2.865	1.260
1 1/2	1.310	.095	13	4.712	4.110	1.767	1.349	.418	2.546	2.920	1.430
1 1/2	1.282	.109	12	4.712	4.030	1.767	1.293	.474	2.546	2.980	1.620
1 1/2	1.260	.120	11	4.712	3.960	1.767	1.248	.519	2.546	3.030	1.770
1 1/2	1.232	.134	10	4.712	3.870	1.767	1.192	.575	2.546	3.100	1.960
1 1/2	1.204	.148	9	4.712	3.770	1.767	1.140	.627	2.546	3.185	2.140
1 1/2	1.170	.165	8	4.712	3.670	1.767	1.076	.691	2.546	3.270	2.350
2	1.810	.095	13	6.690	5.690	3.141	2.576	.566	1.909	2.110	1.930
2	1.782	.109	12	6.283	5.600	3.141	2.497	.645	1.909	2.145	2.200
2	1.760	.120	11	6.283	5.530	3.141	2.438	.703	1.909	2.170	2.170
2	1.732	.134	10	6.283	5.440	3.141	2.360	.782	1.909	2.208	2.670
2	1.704	.148	9	6.283	5.340	3.141	2.285	.857	1.909	2.250	2.930
2	1.670	.165	8	6.283	5.250	3.141	2.193	.949	1.909	2.286	3.230
2	1.640	.180	7	6.283	5.150	3.141	2.117	1.025	1.909	2.330	3.500

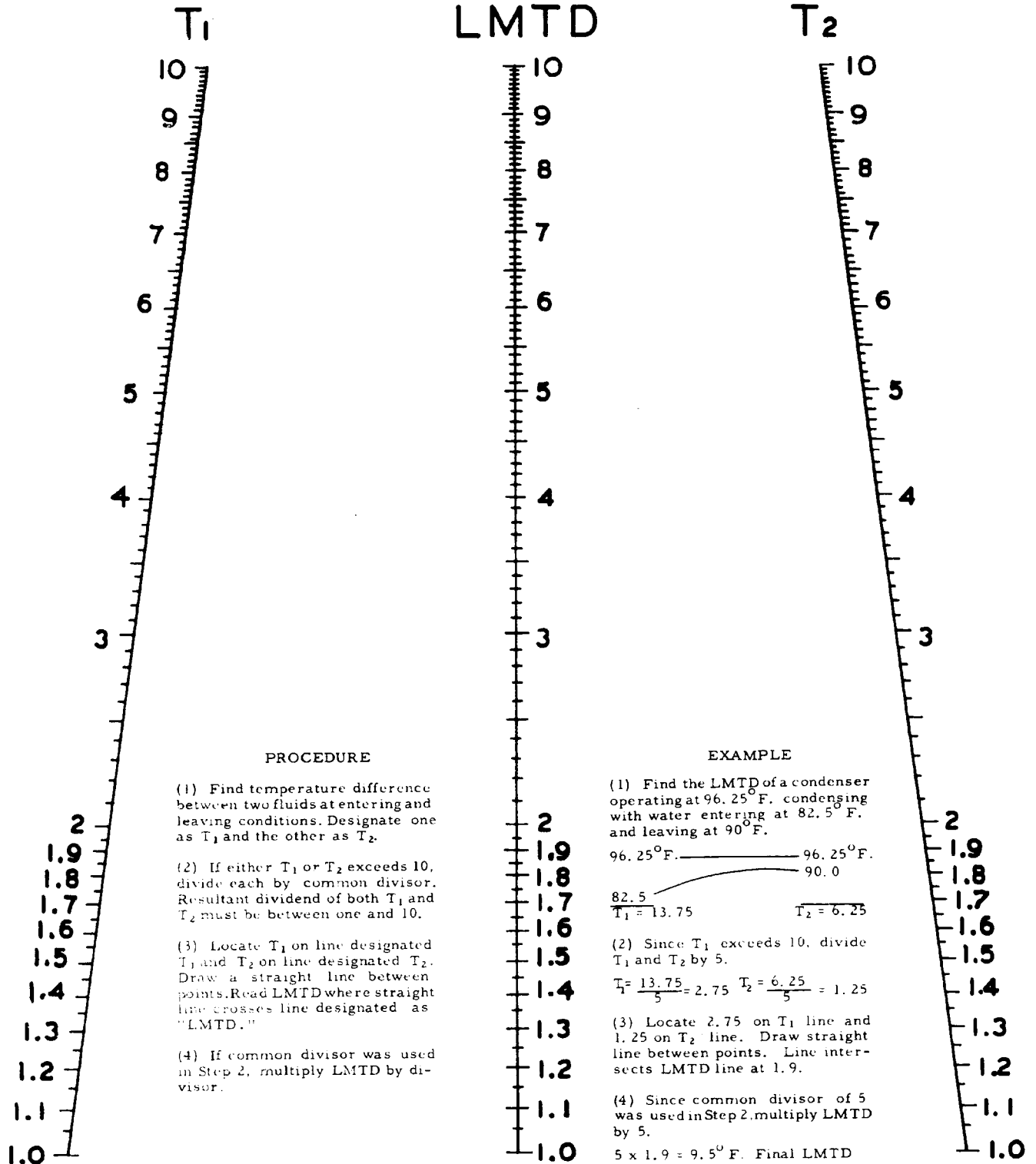
COPPER TUBE DIMENSIONS

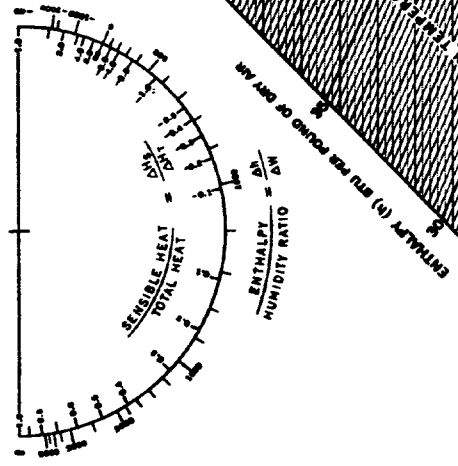
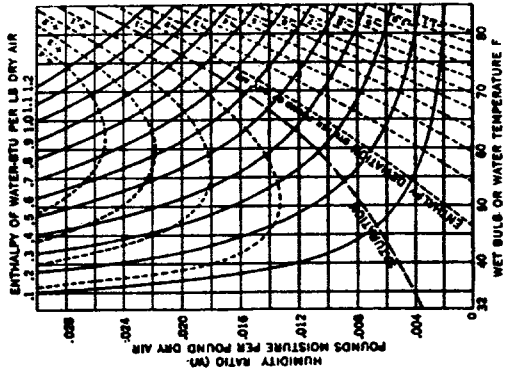
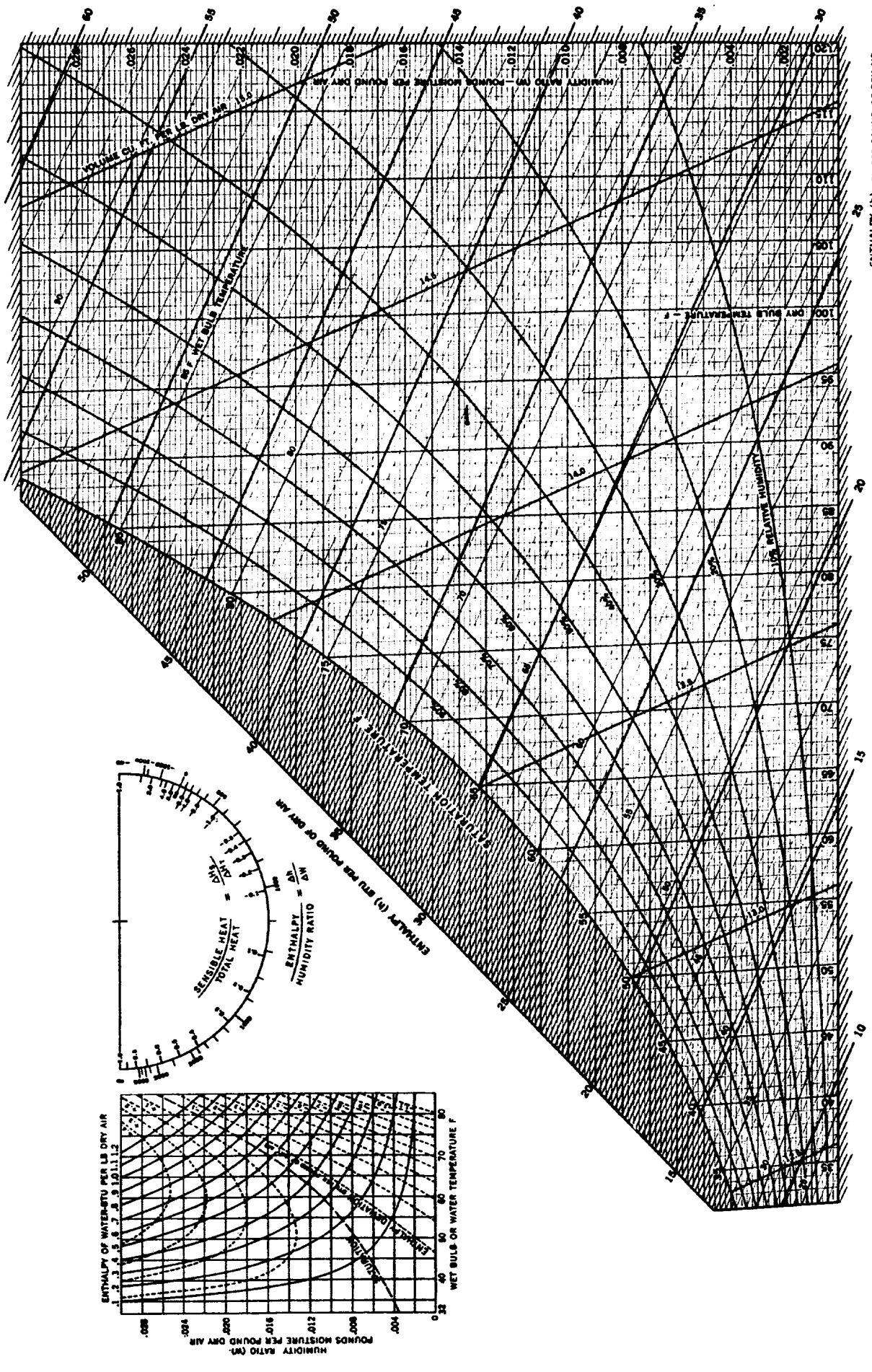
Nominal Size Inches	Outside Diameter Inches	Feet Length per Sq. Ft. Outside Area	Type K			Type L			Type M		
			Nominal Wall Thickness Inches	Theoretical Wt. per Linear Ft. Lb.	Inside Cross-Sectional Area Sq. In.	Nominal Wall Thickness Inches	Theoretical Wt. per Linear Ft. Lb.	Inside Cross-Sectional Area Sq. In.	Nominal Wall Thickness Inches	Theoretical Wt. per Linear Ft. Lb.	Inside Cross-Sectional Area Sq. In.
1/8	0.250	15.3	0.032	0.085	0.027	0.025	0.068	0.031	0.025	0.068	0.031
1/8	0.375	10.2	0.032	0.134	0.076	0.030	0.126	0.078	0.025	0.107	0.083
3/8	0.500	7.64	0.049	0.269	0.127	0.035	0.198	0.145	0.025	0.145	0.159
1/2	0.625	6.11	0.049	0.344	0.218	0.040	0.285	0.233	0.028	0.204	0.254
5/8	0.750	5.09	0.049	0.418	0.334	0.042	0.362	0.348	0.030	0.263	0.374
3/4	0.875	4.36	0.065	0.641	0.436	0.045	0.455	0.484	0.032	0.328	0.517
1	1.125	3.40	0.065	0.839	0.778	0.050	0.655	0.825	0.035	0.465	0.875
1 1/4	1.375	2.78	0.065	1.04	1.217	0.055	0.884	1.257	0.042	0.682	1.31
1 1/2	1.625	2.35	0.072	1.36	1.61	0.060	1.14	1.78	0.049	0.940	1.83
2	2.125	1.80	0.083	2.06	3.01	0.070	1.75	3.09	0.058	1.46	3.17
2 1/2	2.625	1.455	0.095	2.93	4.65	0.080	2.45	4.77	0.065	2.03	4.89
3	3.125	1.222	0.109	4.00	6.64	0.090	3.33	6.81	0.072	2.68	6.98
3 1/2	3.625	1.054	0.120	5.12	9.00	0.100	4.29	9.21	0.083	3.58	9.40
4	4.125	0.926	0.134	6.51	11.7	0.110	5.38	12.0	0.095	4.66	12.2
5	5.125	0.745	0.160	9.67	18.1	0.125	7.61	18.7	0.109	6.66	18.9
6	6.125	0.624	0.192	13.9	25.9	0.140	10.2	26.8	0.122	8.92	27.2
8	8.125	0.470	0.271	25.9	45.2	0.200	19.3	46.9	0.170	16.5	47.6
10	10.125	0.377	0.338	40.3	70.1	0.250	30.1	72.8	0.212	25.6	74.0
12	12.125	0.315	0.405	57.8	98.8	0.280	40.4	105.0	0.254	36.7	106.0

type K -- Heavy wall. Available in hard and soft temper.  
 type L -- Medium wall. Available in hard and soft temper.  
 type M -- Light wall. Available in hard temper only.

SECTION VI - MISCELLANEOUS

LMTD CHART







**SECTION VI – MISCELLANEOUS**

**ELECTRICAL FORMULAE**

To Find	Direct Current	Alternating Current		
		Single-Phase	Two-Phase* Four-Wire	Three-Phase
Amperes when K.V.A. is Known		$\frac{K.V.A. \times 1000}{E}$	$\frac{K.V.A. \times 1000}{2 \times E}$	$\frac{K.V.A. \times 1000}{1.73 \times E}$
Amperes when Kilowatts is Known	$\frac{KW \times 1000}{E}$	$\frac{KW \times 1000}{E \times P.F.}$	$\frac{KW \times 1000}{2 \times E \times P.F.}$	$\frac{KW \times 1000}{1.73 \times E \times P.F.}$
Amperes when Horsepower is Known	$\frac{HP \times 746}{E \times \% \text{ Eff.}}$	$\frac{HP \times 746}{E \times \% \text{ Eff.} \times P.F.}$	$\frac{HP \times 746}{2 \times E \times \% \text{ Eff.} \times P.F.}$	$\frac{HP \times 746}{1.73 \times E \times \% \text{ Eff.} \times P.F.}$
Kilowatts	$\frac{I \times E}{1000}$	$\frac{I \times E \times P.F.}{1000}$	$\frac{I \times E \times 2 \times P.F.}{1000}$	$\frac{I \times E \times 1.73 \times P.F.}{1000}$
K.V.A.		$\frac{I \times E}{1000}$	$\frac{I \times E \times 2}{1000}$	$\frac{I \times E \times 1.73}{1000}$
Horsepower (Output)	$\frac{I \times E \times \% \text{ Eff.}}{746}$	$\frac{I \times E \times \% \text{ Eff.} \times P.F.}{746}$	$\frac{I \times E \times 2 \times \% \text{ Eff.} \times P.F.}{746}$	$\frac{I \times E \times 1.73 \times \% \text{ Eff.} \times P.F.}{746}$

I=Amperes; E=Volts; % Eff.=per cent Efficiency; P.F.=Power Factor.

KW=Kilowatts; K.V.A.=Kilo-Volt-Amperes; HP=Horsepower.

\*For three-wire, two-phase circuits the current in the common conductor is 1.41 times that in either of the other two conductors.

**CONVERSIONS**

Multiply	By	To Obtain	Multiply	By	To Obtain
Atmospheres	29.92	Inches of mercury	Kilograms	2.2046	Pounds
Atmospheres	14.70	Pounds per sq inch	Kilogram-calories	3.968	British thermal units
British thermal units	777.5	Foot pounds	Kilowatts	56.92	Btu per min
Btu per min	.02356	Horsepower	Kilowatts	737.6	Foot-pounds per sec
Btu per min	0.01757	Kilowatts	Kilowatts	1.341	Horsepower
Btu per min	17.57	Watts	Kilowatt hours	3415	British thermal units
Bushels	1.244	Cubic feet	Kilowatt hours	1.341	Horsepower-hours
Centimeters	0.3937	Inches	Meters	3.2808	Feet
Cubic feet	1728	Cubic inches	Meters	39.37	Inches
Cubic feet	0.03704	Cubic yards	Ounces	28.35	Grams
Cubic feet	7.481	Gallons	Ounces (fluid)	1.805	Cubic inches
Cubic inches	16.39	Cubic centimeters	Pounds	453.6	Grams
Feet	0.3048	Meters	Pounds of water	0.01602	Cubic feet
Feet per minute	0.01667	Feet per sec	Pounds of water	27.68	Cubic inches
Gallons	3785	Cubic centimeters	Revolutions per min	0.01667	Revolutions per sec
Gallons	0.1337	Cubic feet	Square feet	144	Square inches
Horsepower	42.44	Btu per min	Temp (degs C) +273	1	abs temp (degs C)
Horsepower	33,000	Foot pounds per min	Temp (degs C) +17.8	1.8	Temp (degs F)
Horsepower	1.014	Horsepower (metric)	Temp (degs F) +460	1	abs temp (degs F)
Horsepower	0.7457	Kilowatts	Temp (degs F) -32	5/9	Temp (degs C)
Horsepower	745.7	Watts	Tons (long)	2240	Pounds
Horsepower (boiler)	33,520	Btu per hour	Tons (metric)	2205	Pounds
Horsepower—hours	2547	British thermal units	Watts	0.05692	Btu per min
Horsepower—hours	0.7457	Kilowatt hours	Watt hours	3.415	British thermal units
Inches	2.540	Centimeters	Yards	91.44	Centimeters

SECTION VI - MISCELLANEOUS  
TEMPERATURE COMPARISON

Kelvin	Cent.	Fahr.	*Rankine	Kelvin	Cent.	Fahr.	*Rankine	Kelvin	Cent.	Fahr.	*Rankine
0	-273.16	-459.69	0	260	-12.2	10	470	399.9	126.7	260	720
11	-262	-440	20	266	-6.7	20	480	411.0	137.8	280	740
22	-251	-420	40	272	-1.1	30	490	422.1	148.9	300	760
33	-240	-400	60	273.16	0.0	32	492	433.2	160.0	320	780
44	-229	-380	80	277.5	4.4	40	500	444.3	171.1	340	800
55	-218	-360	100	283.0	10.0	50	510	455.4	182.2	360	820
66	-207	-340	120	288.7	15.6	60	520	466.5	193.3	380	840
77	-196	-320	140	294.2	21.1	70	530	477.6	204.4	400	860
88	-184	-300	160	299.8	26.7	80	540	488.7	215.5	420	880
100	-173	-280	180	305.3	32.2	90	550	499.9	226.7	440	900
111	-162	-260	200	311.0	37.8	100	559.69	511.0	237.8	460	920
122	-151	-240	220	316.5	43.3	110	570	522.1	248.9	480	940
133	-140	-220	240	322.1	48.9	120	580	533.2	260.0	500	960
144	-129	-200	260	327.6	54.4	130	590	544.3	271.1	520	980
155	-118	-180	280	333.2	60.0	140	600	555.4	282.2	540	1000
166	-107	-160	300	338.8	65.6	150	610	566.5	293.3	560	1020
177	-95.6	-140	320	344.3	71.7	160	620	577.6	304.4	580	1040
188	-84.4	-120	340	349.9	76.7	170	630	588.8	315.6	600	1060
200	-73.3	-100	360	355.4	82.2	180	640	599.9	326.7	620	1080
211	-62.2	-80	380	361.0	87.8	190	650	611.0	337.8	640	1100
222	-51.1	-60	400	366.5	93.3	200	660				
233	-40.0	-40	420	372.0	98.8	210	670				
244	-28.9	-20	440	373.2	100.0	212	671.69				
250	-23.3	-10	450	377.6	104.4	220	680				
258	-17.8	0	459.69	388.7	115.5	240	700				

\* ANY RANKINE TEMPERATURE IS 1.8 TIMES THE CORRESPONDING KELVIN TEMPERATURE.

STANDARD ABBREVIATIONS

Term	Abbrev.
Absolute	abs
Alternating current	ac
Ampere	amp
Ampere-hour	amp-hr
Atmosphere	atm
Average	avg
Boiling point	bp
Brake horsepower	bhp
Brake horsepower-hour	bhp-hr
British thermal units (s)	Btu
Centimeter	cm
Cubic	cu
Cubic centimeter	cc
Cubic feet per minute	cfm
Cubic feet per second	cfs
Cubic foot	cu ft
Cubic inch	cu in.
Decibel	db
Degree Centigrade	C
Degree Fahrenheit	F
Degree Kelvin	K
Dew point temperature	dpt
Diameter	dia
Direct current	dc
Dry-bulb temperature	dbt
Feet per minute	fpm
Feet per second	fps
Foot	ft
Foot pound	ft lb
Foot-pound-second (system)	fps
Freezing point	fp
Gallon	gal
Gallons per hour	gph

Term	Abbrev.
Gallons per minute	gpm
Gallons per second	gps
Horsepower	hp
Horsepower-hour	hphr
Hour	hr
Inch	in.
Inch-pound	in.-lb
Indicated horsepower	ihp
Inside diameter	ID
Iron-pipe size	ips
Kilogram	kg
Kilowatt	kw
Kilowatt hour	kwh
Maximum	max
Minute	min
Outside diameter	OD
Pound	lb
Pounds per square foot	psf
Pounds per square inch	psi
Pounds per square inch absolute	psia
Pounds per square inch gage	psig
Relative humidity	rh
Revolutions per minute	rpm
Revolutions per second	rps
Second	sec
Specific gravity	sp gr
Specific heat	sp ht
Square foot	sq ft
Square inch	sq in.
Temperature	temp
Tons of refrigeration	TR
Velocity	vel
Viscosity	visc
Wet-bulb temperature	wbt

**AIR CONDITIONING • REFRIGERATION**