

TABLE 1. PROPERTIES OF AMMONIA

SAT. TEMP. F	ABS. PRESS. LB. PER SQ. IN.	VOLUME		HEAT CONTENT AND ENTROPY TAKEN FROM -40 F							
				Heat Content		Entropy		100 F Superheat		200 F Superheat	
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Ht. Ct.	Entropy	Ht. Ct.	Entropy
0	30.42	0.02419	9.116	42.9	611.8	0.0975	1.3352	666.8	1.4439	720.3	1.5317
5	34.27	0.02432	8.150	48.3	613.3	0.1092	1.3253	668.9	1.4339	722.7	1.5215
10	38.51	0.02446	7.304	53.8	614.9	0.1208	1.3157	670.9	1.4242	725.0	1.5115
15	43.14	0.02460	6.562	59.2	616.3	0.1323	1.3062	673.0	1.4148	727.3	1.5018
20	48.21	0.02474	5.910	64.7	617.8	0.1437	1.2969	675.0	1.4056	729.6	1.4925
25	53.73	0.02488	5.334	70.2	619.1	0.1551	1.2879	677.0	1.3965	731.9	1.4833
30	59.74	0.02503	4.825	75.7	620.5	0.1663	1.2790	678.9	1.3879	734.2	1.4744
35	66.26	0.02518	4.373	81.2	621.7	0.1775	1.2704	680.8	1.3794	736.5	1.4658
40	73.32	0.02533	3.971	86.8	623.0	0.1885	1.2618	682.7	1.3712	738.6	1.4575
45	80.96	0.02548	3.614	92.3	624.1	0.1996	1.2535	684.6	1.3630	740.9	1.4493
50	89.19	0.02564	3.294	97.9	625.2	0.2105	1.2453	686.4	1.3552	743.1	1.4412
55	98.06	0.02581	3.008	103.5	626.3	0.2214	1.2373	688.1	1.3474	745.3	1.4335
60	107.60	0.02597	2.751	109.2	627.3	0.2322	1.2294	689.9	1.3399	747.4	1.4260
65	117.80	0.02614	2.520	114.8	628.2	0.2430	1.2216	691.7	1.3326	749.5	1.4186
70	128.80	0.02632	2.312	120.5	629.1	0.2537	1.2140	693.3	1.3254	751.6	1.4114
75	140.50	0.02650	2.125	126.2	629.9	0.2643	1.2065	695.0	1.3184	753.7	1.4044
80	153.00	0.02668	1.955	132.0	630.7	0.2749	1.1991	696.6	1.3116	755.8	1.3976
85	166.40	0.02687	1.801	137.8	631.4	0.2854	1.1918	698.2	1.3048	757.9	1.3909
90	180.60	0.02707	1.661	143.5	632.0	0.2958	1.1846	699.7	1.2983	759.9	1.3843
95	195.80	0.02727	1.534	149.4	632.6	0.3062	1.1775	701.2	1.2919	761.9	1.3783
100	211.90	0.02747	1.419	155.2	633.0	0.3166	1.1705	702.7	1.2855	763.8	1.3718
105	228.90	0.02769	1.313	161.1	633.4	0.3269	1.1635	704.2	1.2793	765.7	1.3655

$$n = \frac{C_p}{C_v} = 1.3172$$

TABLE 2. PROPERTIES OF CARBON DIOXIDE

SAT. TEMP. F	ABS. PRESS. LB. PER SQ. IN.	VOLUME		HEAT CONTENT AND ENTROPY TAKEN FROM -40 F							
				Heat Content		Entropy		50 F Superheat		100 F Superheat	
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Ht. Ct.	Entropy	Ht. Ct.	Entropy
0	305.5	0.01570	0.29040	18.8	138.9	0.0418	0.3024	153.7	0.3342	167.5	0.3612
5	332.0	0.01592	0.26610	20.3	138.8	0.0472	0.3000	153.7	0.3312	167.8	0.3582
10	360.2	0.01614	0.24370	24.0	138.7	0.0526	0.2970	153.7	0.3281	168.0	0.3550
15	390.0	0.01637	0.22360	26.7	138.5	0.0581	0.2939	153.7	0.3257	168.3	0.3517
20	421.8	0.01663	0.20490	29.4	138.3	0.0638	0.2909	153.7	0.3227	168.6	0.3489
25	455.3	0.01690	0.18790	32.3	138.1	0.0697	0.2879	153.7	0.3196	168.8	0.3464
30	490.8	0.01719	0.17220	35.4	137.8	0.0758	0.2849	153.7	0.3164	169.1	0.3441
35	529.3	0.01752	0.15770	38.5	137.3	0.0817	0.2813	153.7	0.3147	169.3	0.3415
40	567.8	0.01787	0.14440	41.7	136.7	0.0874	0.2776	153.7	0.3132	169.6	0.3391
45	609.6	0.01826	0.13210	45.0	135.9	0.0935	0.2739	153.7	0.3112	169.9	0.3365
50	653.6	0.01868	0.12050	48.4	135.0	0.1000	0.2699	153.7	0.3081	170.1	0.3342
55	700.0	0.01917	0.10960	51.9	133.7	0.1062	0.2656	153.7	0.3051	170.4	0.3320
60	748.6	0.01970	0.09940	55.5	132.1	0.1135	0.2608	153.7	0.3022	170.7	0.3297
65	799.8	0.02034	0.08990	59.4	130.2	0.1206	0.2554	153.7	0.2995	170.9	0.3277
70	853.4	0.02112	0.08040	63.7	127.5	0.1282	0.2487	153.7	0.2971	171.2	0.3257
75	909.7	0.02217	0.07072	68.4	123.7	0.1370	0.2404	153.7	0.2947	171.4	0.3237
80	968.7	0.02370	0.06064	73.9	118.7	0.1476	0.2304	153.7	0.2927	171.7	0.3220
85	1030.3	0.02620	0.05006	81.4	112.2	0.1668	0.2169	153.7	0.2909	180.0	0.3204
87.8	1069.9	0.03454	0.03454	97.0	97.0	0.1880	0.1880	153.7	0.2901	180.1	0.3199

$$n = \frac{C_p}{C_v} = 1.28$$

flows to the evaporator through an expansion valve which reduces its pressure and regulates its flow. The evaporator absorbs heat from a medium which is to be cooled. When this medium is water or brine, the evaporator is known as a water or brine cooler and the refrigeration system, if used for air cooling, is known as an indirect system. When the medium cooled is air, the evaporator is known as a direct expansion cooler and the system is known as a direct expansion system.

Fundamentally, the function of the system is to absorb heat at one temperature and *pump* it to a higher temperature, where it may be removed by an available cooling medium. In order to conserve refrigerant,

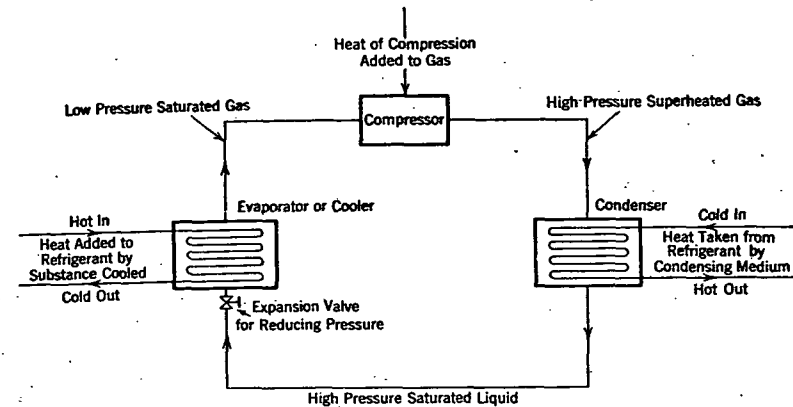


FIG. 1. MECHANICAL REFRIGERATION SYSTEM

virtually all refrigeration systems are completely closed and the same refrigerant is recirculated.

Theoretical Mechanical Refrigeration Cycle

The complete mechanical refrigeration cycle may be illustrated on the temperature-entropy diagram, and also on the pressure-volume diagram both of which are shown in Fig. 2.

Considering the theoretical cycle, saturated vapor is drawn into the compressor at *a* and compressed at constant entropy (adiabatically) and then delivered to the condenser at *b*. Condensation occurs at constant temperature T_2 from *b* to *c* with a contraction from the vapor to the liquid volume. The line *cd* represents cooling from the temperature of the condenser to that of the evaporator by an external cooling means. At the same time, the pressure is lowered to P_1 . Evaporation then occurs from *d* to *a* at temperature T_1 , completing the work cycle *abcd*. Since no external means of cooling the refrigerant liquid is normally available, the cooling is generally accomplished by evaporation of a portion of the refrigerant. Since the work of expansion is usually used up as friction in the expansion valve, this process is carried on at constant total heat, as represented by the line *ce* on the temperature-entropy diagram. Thus the refrigerating effect is represented by an area *ea*gfe. While the normal