TABLE 3. PROPERTIES OF DICHLORODIFLUOROMETHANE (F_{12})

Sat. Temp. F	Abs Press. Lb per Sq In.	Volume		Heat Content and Entropy Taken From −40 F							
				Heat Content		Entropy		25 F Superheat		50 F Superheat	
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Ht. Ct.	Entropy	Ht. Ct.	Entropy
0	23.87	0.0110	1.637	8.25	78.21	0.01869	0.17091	81.71	0.17829	85.26	0.18547
5	26.51	0.0111	1.485	9.32	78.79	0.02097	0.17052	82.29	0.17786	85.89	0.18502
10	29.35	0.0112	1.351	10.39	79.36	0.02328	0.17015	82.90	0.17747	86.51	0.18460
15	32.44	0.0112	1.230	11.48	79.94	0.02556	0.16981	83.49	0.17710	87.13	0.18420
20	35.75	0.0113	1.121	12.55	80.49	0.02783	0.16949	84.09	0.17679	87.76	0.18382
25	39.33	0.0114	1.025	13.66	81.06	0.03008	0.16920	84.67	0.17643	88.37	0.18349
30	43.16	0.0115	0.939	14.76	81.61	0.03233	0.16887	85.25	0.17612	88.97	0.18315
35	47.28	0.0116	0.863	15.88	82.16	0.03458	0.16860	85.83	0.17582	89.56	0.18285
40	51.68	0.0116	0.792	17.00	82.71	0.03680	0.16833	86.41	0.17554	90.16	0.18256
45	56.38	0.0117	0.730	18.14	83.26	0.03904	0.16808	86.96	0.17528	90.76	0.18227
50	61.39	0.0118	0.673	19.27	83.78	0.04126	0.16785	87.54	0.17505	91.38	0.18203
55	66.74	0.0119	0.622	20.41	84.31	0.04348	0.16763	88.09	0.17482	91.93	0.18181
60	72.41	0.0119	0.575	21.57	84.82	0.04568	0.16741	88.64	0.17458	92.51	0.18155
65	78.44	0.0120	0.532	22.72	85.32	0.04789	0.16721	89.18	0.17436	93.11	0.18132
70	84.82	0.0121	0.493	23.90	85.82	0.05009	0.16701	89.72	0.17417	93.66	0.18114
75	91.60	0.0122	0.458	25.08	86.32	0.05229	0.16681	90.25	0.17397	94.23	0.18092
80	98.76	0.0123	0.425	26.28	86.80	0.05446	0.16662	90.78	0.17379	94.80	0.18075
85	106.40	0.0124	0.395	27.48	87.28	0.05665	0.16644	91.27	0.17361	95.33	0.18056
90	114.30	0.0125	0.368	28.70	87.74	0.05882	0.16624	91.77	0.17344	95.86	0.18040
95	122.80	0.0126	0.343	29.93	88.19	0.06100	0.16604	92.27	0.17323	96.39	0.18020
100	131.60	0.0127	0.319	31.16	88.62	0.06316	0.16584	92.75	0.17308	96.92	0.18004
105	140.90	0.0128	0.298	32.40	89.03	0.06534	0.16564	93.24	0.17291	97.46	0.17991
110	150.70	0.0129	0.277	33.65	89.43	0.06749	0.16542	93.66	0.17274	97.93	0.17976
115	161.00	0.0130	0.258	34.90	89.80	0.06965	0.16520	94.07	0.17253	98.40	0.17955
120	171.80	0.0132	0.240	36.16	90.15	0.07180	0.16495	94.47	0.17233	98.84	0.17939

$n = \frac{C_p}{C_v} = 1.138$ at 25 C.

TABLE 4. PROPERTIES OF WATER

Sat. Temp. F	Abs Press. Lb per Sq In.	Volume		Heat Content and Entropy Taken From −32 F							
				Heat Content		Entropy		50 F Superheat		100 F Superheat	
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Ht. Ct.	Entropy	Ht. Ct.	Entropy
32	0.0887	0.01602	3296.0	0.00	1073.0	0.0000	2.1826	1096.9	2.2277	1120.8	2.2688
35	0.1000	0.01602	2941.0	3.02	1074.4	0.0062	2.1724	1098.3	2.2172	1122.2	2.2581
40	0.1217	0.01602	2441.0	8.05	1076.8	0.0163	2.1555	1100.6	2.2000	1124.5	2.2406
45	0.1475	0.01602	2034.0	13.07	1079.2	0.0262	2.1390	1102.9	2.1832	1126.7	2.2234
50	0.1780	0.01602	1702.0	18.08	1081.5	0.0361	2.1230	1105.2	2.1667	1129.0	2.2066
55	0.2140	0.01603	1430.0	23.08	1083.9	0.0459	2.1073	1107.5	2.1506	1131.3	2.1902
60	0.2561	0.01603	1206.0	28.08	1086.2	0.0556	2.0920	1109.8	2.1349	1133.5	2.1742
65	0.3054	0.01604	1021.0	33.08	1088.6	0.0652	2.0771	1112.2	2.1196	1135.8	2.1585
70	0.3628	0.01605	868.0	38.07	1090.9	0.0746	2.0625	1114.5	2.1046	1138.1	2.1432
75	0.4295	0.01606	740.0	43.06	1093.2	0.0840	2.0483	1116.7	2.0900	1140.3	2.1283
80	0.507	0.01607	632.9	48.05	1095.5	0.0933	2.0344	1119.0	2.0758	1142.5	2.1138
85	0.596	0.01609	543.3	53.04	1097.8	0.1025	2.0208	1121.2	2.0619	1144.7	2.0996
90	0.698	0.01610	467.9	58.03	1100.0	0.1116	2.0075	1123.4	2.0483	1146.8	2.0857
95	0.815	0.01612	404.2	63.01	1102.3	0.1206	1.9946	1125.6	2.0350	1148.9	2.0721
100	0.949	0.01613	350.3	68.00	1104.6	0.1296	1.9819	1127.9	2.0220	1151.1	2.0588
105	1.101	0.01615	304.4	72.98	1106.8	0.1384	1.9695	1130.2	2.0093	1153.2	2.0458

For properties of steam at high temperatures, see Page 28.

$n = \frac{C_p}{C_v} = 1.33$

theoretical cycle starts with saturated vapor, operation is common at a condition of superheated vapor (as at a_1). Moreover, expansion may start either with a mixture of liquid and vapor or with a sub-cooled liquid, as at c_1, with expansion to e_1. It is obvious that this latter is desirable as it increases the refrigerating effect. Area $a_1b_1cdaa_1$ represents the work of such a superheated cycle, while the area $e_1a_1g_1f_1e_1$ represents the refrigerating effect of the cycle with superheated vapor and sub-cooled refrigerant liquid.

It will be noted on the pressure-volume diagram the volume of the saturated liquid is indicated by a dotted line close to and parallel to the ordinate.

In the discussions in this chapter a slight error is introduced by not including all of the work of pumping the liquid from the low to the high pressure. This occurs because the liquid line is not a line of equal pressure but of saturation pressures. The error in work per pound of refrigerant

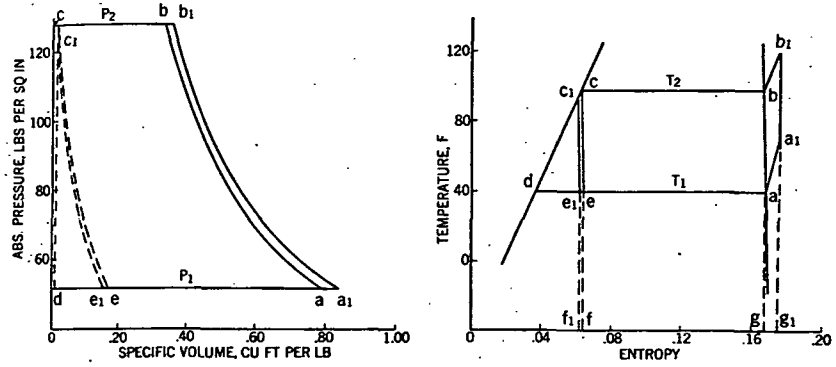

FIG. 2. THEORETICAL DICHLORODIFLUOROMETHANE (F_{12}) CYCLES

figured from total heats, which should be added to the indicated figures is roughly the specific volume of the liquid at the lower pressure and temperature multiplied by the pressure difference in appropriate units. This error may become of some importance in calculations involving carbon dioxide or in problems involving the liquid of any of the refrigerants, as in figuring expansion valve orifices.

Theoretical Work per Pound

The temperature-entropy and pressure-volume diagrams are based on one pound of the refrigerant. Likewise, the theoretical work and the refrigerating effects are conveniently based on a pound of refrigerant. The compression work per pound may be found by several methods.

The temperature-entropy method starts with state point *a*. Since the quality of *a* is known, the heat content of the vapor H_a is known, and also the entropy S_a. Since $S_a = S_b$ and with T_2 given, H_b can be determined. If W = work in foot-pounds per pound of refrigerant, then

$$W = (H_b - H_a) \times 778 \quad (1)$$