

Table 1.... Properties of Dichlorodifluoromethane (CCl₂F₂)^a

Sat. Temp. F	Abs. Press. Lb per Sq In.	Volume		Enthalpy and Entropy Taken From -40 F									
		Liquid	Vapor	Enthalpy		Entropy		25 F Superheat		50 F Superheat		Enthalpy	Entropy
				Liquid	Vapor	Liquid	Vapor	Enthalpy	Entropy	Enthalpy	Entropy		
0	23.87	0.0110	1.637	8.25	78.21	0.01869	0.17091	81.71	0.17829	85.26	0.18547		
2	24.89	0.0110	1.574	8.67	78.44	0.01961	0.17075	81.94	0.17812	85.51	0.18529		
4	25.96	0.0111	1.514	9.10	78.67	0.02052	0.17060	82.17	0.17795	85.76	0.18511		
5	26.51	0.0111	1.485	9.32	78.79	0.02097	0.17052	82.29	0.17786	85.89	0.18502		
6	27.05	0.0111	1.457	9.53	78.90	0.02143	0.17045	82.41	0.17778	86.01	0.18494		
8	28.18	0.0111	1.403	9.96	79.13	0.02235	0.17030	82.66	0.17763	86.26	0.18477		
10	29.35	0.0112	1.351	10.39	79.36	0.02328	0.17015	82.90	0.17747	86.51	0.18460		
12	30.56	0.0112	1.301	10.82	79.59	0.02419	0.17001	83.14	0.17733	86.76	0.18444		
14	31.80	0.0112	1.253	11.26	79.82	0.02510	0.16987	83.38	0.17720	87.01	0.18429		
16	33.08	0.0112	1.207	11.70	80.05	0.02601	0.16974	83.61	0.17706	87.26	0.18413		
18	34.40	0.0113	1.163	12.12	80.27	0.02692	0.16961	83.85	0.17693	87.51	0.18397		
20	35.75	0.0113	1.121	12.55	80.49	0.02783	0.16949	84.09	0.17679	87.76	0.18382		
22	37.15	0.0113	1.081	13.00	80.72	0.02873	0.16938	84.32	0.17666	88.00	0.18369		
24	38.58	0.0113	1.043	13.44	80.95	0.02963	0.16926	84.55	0.17652	88.24	0.18355		
26	40.07	0.0114	1.007	13.88	81.17	0.03053	0.16913	84.79	0.17639	88.49	0.18342		
28	41.59	0.0114	0.973	14.32	81.39	0.03143	0.16900	85.02	0.17625	88.73	0.18328		
30	43.16	0.0115	0.939	14.76	81.61	0.03233	0.16887	85.25	0.17612	88.97	0.18315		
32	44.77	0.0115	0.908	15.21	81.83	0.03323	0.16876	85.48	0.17600	89.21	0.18303		
34	46.42	0.0115	0.877	15.65	82.05	0.03413	0.16865	85.71	0.17589	89.45	0.18291		
36	48.13	0.0116	0.848	16.10	82.27	0.03502	0.16854	85.95	0.17577	89.68	0.18280		
38	49.88	0.0116	0.819	16.55	82.49	0.03591	0.16843	86.18	0.17566	89.92	0.18268		
39	50.78	0.0116	0.806	16.77	82.90	0.03635	0.16838	86.29	0.17560	90.04	0.18262		
40	51.68	0.0116	0.792	17.00	82.71	0.03680	0.16833	86.41	0.17554	90.16	0.18256		
41	52.70	0.0116	0.779	17.23	82.82	0.03725	0.16828	86.52	0.17549	90.28	0.18251		
42	53.51	0.0116	0.767	17.46	82.93	0.03770	0.16823	86.64	0.17544	90.40	0.18245		
44	55.40	0.0117	0.742	17.91	83.15	0.03859	0.16813	86.86	0.17534	90.65	0.18235		
46	57.35	0.0117	0.718	18.36	83.36	0.03948	0.16803	87.09	0.17525	90.89	0.18224		
48	59.35	0.0117	0.695	18.82	83.57	0.04037	0.16794	87.31	0.17515	91.14	0.18214		
50	61.39	0.0118	0.673	19.27	83.78	0.04126	0.16785	87.54	0.17505	91.38	0.18203		
52	63.49	0.0118	0.652	19.72	83.99	0.04215	0.16776	87.76	0.17496	91.61	0.18193		
54	65.63	0.0118	0.632	20.18	84.20	0.04304	0.16767	87.98	0.17488	91.83	0.18184		
56	67.94	0.0119	0.612	20.64	84.41	0.04392	0.16758	88.20	0.17477	92.06	0.18174		
58	70.10	0.0119	0.593	21.11	84.62	0.04480	0.16749	88.42	0.17467	92.28	0.18165		
60	72.41	0.0119	0.575	21.57	84.82	0.04568	0.16741	88.64	0.17458	92.51	0.18155		
62	74.77	0.0120	0.557	22.03	85.02	0.04657	0.16733	88.86	0.17450	92.74	0.18147		
64	77.20	0.0120	0.540	22.49	85.22	0.04745	0.16725	89.07	0.17442	92.97	0.18139		
66	79.67	0.0120	0.524	22.95	85.42	0.04833	0.16717	89.29	0.17433	93.20	0.18130		
68	82.24	0.0121	0.508	23.42	85.62	0.04921	0.16709	89.50	0.17425	93.43	0.18122		
70	84.82	0.0121	0.493	23.90	85.82	0.05009	0.16701	89.72	0.17417	93.66	0.18114		
72	87.50	0.0121	0.479	24.37	86.02	0.05097	0.16693	89.93	0.17409	93.99	0.18106		
74	90.20	0.0122	0.464	24.84	86.22	0.05185	0.16685	90.14	0.17402	94.12	0.18098		
76	93.00	0.0122	0.451	25.32	86.42	0.05272	0.16677	90.36	0.17394	94.34	0.18091		
78	95.85	0.0123	0.438	25.80	86.61	0.05359	0.16669	90.57	0.17387	94.57	0.18083		
80	98.76	0.0123	0.425	26.28	86.80	0.05446	0.16662	90.78	0.17379	94.80	0.18075		
82	101.70	0.0123	0.413	26.76	86.99	0.05534	0.16655	90.98	0.17372	95.01	0.18068		
84	104.8	0.0124	0.401	27.24	87.18	0.05621	0.16648	91.18	0.17365	95.22	0.18061		
86	107.9	0.0124	0.389	27.72	87.37	0.05708	0.16640	91.37	0.17358	95.44	0.18054		
88	111.1	0.0124	0.378	28.21	87.56	0.05795	0.16632	91.57	0.17351	95.65	0.18047		
90	114.3	0.0125	0.368	28.70	87.74	0.05882	0.16624	91.77	0.17344	95.86	0.18040		
92	117.7	0.0125	0.357	29.19	87.92	0.05969	0.16616	91.97	0.17337	96.07	0.18033		

Table 1.... Properties of Dichlorodifluoromethane (CCl₂F₂)^a (Continued)

Sat. Temp. F	Abs. Press. Lb per Sq In.	Volume		Enthalpy and Entropy Taken From -40 F									
		Liquid	Vapor	Enthalpy		Entropy		25 F Superheat		50 F Superheat		Enthalpy	Entropy
				Liquid	Vapor	Liquid	Vapor	Enthalpy	Entropy	Enthalpy	Entropy		
94	121.0	0.0126	0.347	29.68	88.10	0.06056	0.18608	92.16	0.17330	96.28	0.18028		
96	124.5	0.0126	0.338	30.18	88.28	0.06143	0.18600	92.36	0.17322	96.50	0.18018		
98	128.0	0.0126	0.328	30.67	88.45	0.06230	0.18592	92.55	0.17315	96.71	0.18011		
100	131.6	0.0127	0.319	31.16	88.62	0.06316	0.18584	92.75	0.17308	96.92	0.18004		
102	135.3	0.0127	0.310	31.65	88.79	0.06403	0.18576	92.93	0.17301	97.12	0.17998		
104	139.0	0.0128	0.302	32.15	88.95	0.06490	0.18568	93.11	0.17294	97.32	0.17993		
106	142.8	0.0128	0.293	32.65	89.11	0.06577	0.18560	93.30	0.17288	97.53	0.17987		
108	146.8	0.0129	0.285	33.15	89.27	0.06663	0.18551	93.48	0.17281	97.73	0.17982		
110	150.7	0.0129	0.277	33.65	89.43	0.06749	0.18542	93.66	0.17274	97.93	0.17976		
112	154.8	0.0130	0.269	34.15	89.58	0.06836	0.18533	93.82	0.17266	98.11	0.17969		
114	158.9	0.0130	0.262	34.65	89.73	0.06922	0.18524	93.98	0.17258	98.29	0.17961		
116	163.1	0.0131	0.254	35.15	89.87	0.07008	0.18515	94.16	0.17249	98.48	0.17954		
118	167.4	0.0131	0.247	35.65	90.01	0.07094	0.18505	94.31	0.17241	98.66	0.17946		
120	171.8	0.0132	0.240	36.16	90.15	0.07180	0.18495	94.47	0.17233	98.84	0.17939		
122	176.2	0.0132	0.233	36.66	90.28	0.07266	0.18484	94.63	0.17224	99.01	0.17931		
124	180.8	0.0133	0.227	37.16	90.40	0.07352	0.18473	94.78	0.17215	99.18	0.17922		
126	185.4	0.0133	0.220	37.67	90.52	0.07437	0.18462	94.94	0.17206	99.35	0.17914		
128	190.1	0.0134	0.214	38.18	90.64	0.07522	0.18450	95.09	0.17196	99.53	0.17906		
130	194.9	0.0134	0.208	38.69	90.76	0.07607	0.18438	95.25	0.17188	99.70	0.17897		
132	199.8	0.0135	0.202	39.19	90.88	0.07691	0.18425	95.41	0.17176	99.87	0.17889		
134	204.8	0.0135	0.196	39.70	90.96	0.07775	0.18411	95.56	0.17166	100.04	0.17881		
136	209.9	0.0136	0.191	40.21	91.06	0.07858	0.18396	95.72	0.17156	100.22	0.17873		
138	215.0	0.0137	0.185	40.72	91.15	0.07941	0.18380	95.87	0.17145	100.39	0.17864		
140	220.2	0.0138	0.180	41.24	91.24	0.08024	0.18363	96.03	0.17134	100.56	0.17856		

^a ASHRAE designation—Refrigerant 12.

to restore the refrigerant to a condition in which it will possess the ability to extract heat from the space to be cooled. For all compression-type systems the cycle consists of four processes: heat gain in the evaporator; pressure rise in the compressor; heat loss in the condenser; pressure loss in the expansion valve. The compression process is accomplished at the expense of energy added to the compressor in the form of shaft work, and the expansion process could be carried out, if the economics of the system would permit, in an expanding engine with consequent release of energy as shaft work. In ordinary systems, however, the additional first cost and maintenance cost of an expanding engine so greatly exceed the advantage resulting from the work realized, that such engines are not used, and instead, the pressure reduction is allowed to occur irreversibly in an expansion valve. Basically, then, a refrigeration cycle consists of two heat-transfer processes and two pressure-change processes, no work entering into the heat-transfer processes and—in the simple cycle—no heat transfer occurring during the pressure-change processes.

The most common and least complicated type of refrigeration cycle is called the simple saturation cycle, and is shown diagrammatically in Fig. 3 and plotted upon pressure-enthalpy coordinates in Fig. 4. For this system, saturated vapor flows without gain or loss of heat from the evaporator to the suction of the compressor. During passage through the compressor the energy added as shaft work goes entirely to increase the enthalpy of the refrigerant, and the compression

process, which is assumed to occur reversibly and without external heat transfer, is characterized by constant entropy. Thus, the state of the superheated vapor leaving the compressor can be determined from the tables of thermodynamic properties by noting the discharge pressure and fixing, also, the entropy of the saturated vapor at entrance to the compressor.

Superheated vapor from the compressor flows to the condenser where de-superheating and condensation take place. From the condenser the refrigerant flows to the expansion valve, undergoes a constant-enthalpy pressure reduction, and returns to the evaporator where it again removes a quantity of undesired heat. When the evaporator is arranged to permit direct cooling of room air by the refrigerant, the system is said to be of the *direct-expansion* type, while a system in which the evaporating refrigerant cools water or brine, which in turn cools the air, is said to be *indirect*. Although many differences exist between most actual systems and that of the simple saturation cycle, this latter is, nonetheless, of great value in that it provides an extremely simple method of rapidly achieving an approximate analysis of probable power requirements, compressor size