

Thermophysical Properties of Refrigerants

This section presents data for the thermodynamic and transport properties of refrigerants, arranged for the occasional users. The refrigerants have a thermodynamic property chart on pressure-enthalpy coordinates with an abbreviated set of tabular data for the saturated liquid and vapor on the facing page.

1. Refrigerant 717 (Ammonia)
2. Refrigerant 22 (Chlorodifluoromethane)
3. Refrigerant 134a (1,1,1,2-Tetrafluoroethane)
4. Refrigerant 404A [R-125/143a/134a (44/52/4)]
5. Refrigerant 507A [R-125/143a (50/50)]
6. Refrigerant 290 (Propane)
7. Refrigerant 744 (Carbon Dioxide)

**NOTE:**

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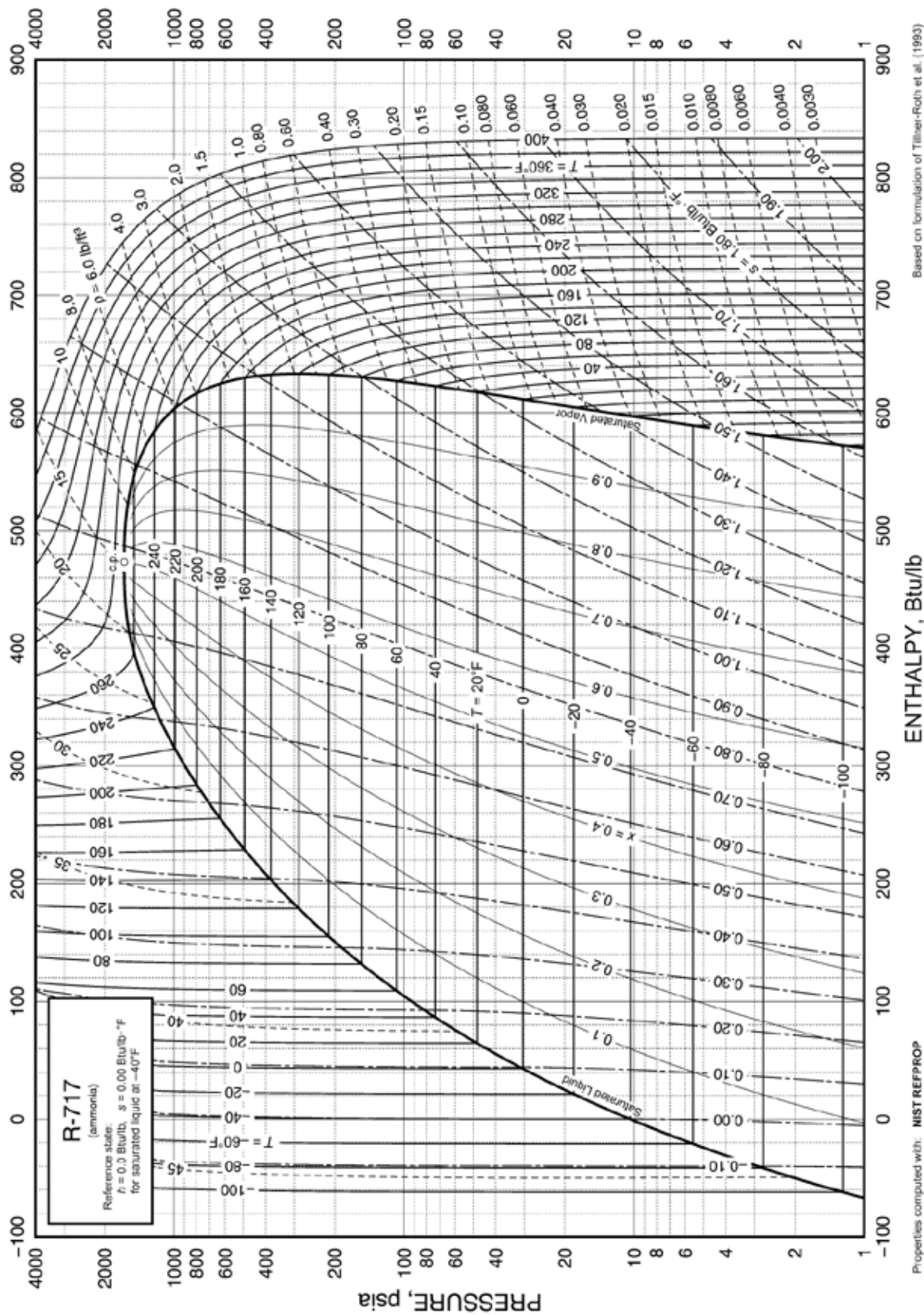


Fig. 19 Pressure-Enthalpy Diagram for Refrigerant 717 (Ammonia)

Thermophysical Properties of Refrigerants

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Refrigerant 717 (Ammonia) Properties of Saturated Liquid and Saturated Vapor

Temp., ^a °F	Pres- sure, psia	Density, Volume, lb/ft ³ , ft ³ /lb		Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat c_p , Btu/lb·°F		c_p/c_v	Vel. of sound, ft/s		Viscosity, lb _m /ft-h		Thermal Cond., Btu/h-ft-°F		Surface Tension, Temp., ^c dyne/cm °F	
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		
-107.78 ^a	0.883	45.75	249.92	-69.830	568.765	-0.18124	1.63351	1.0044	0.4930	1.3252	6969	1161.8	1.354	0.0165	0.4735	0.01135	62.26	-107.78
-100	1.237	45.47	182.19	-61.994	572.260	-0.15922	1.60421	1.0100	0.4959	1.3262	6830	1173.8	1.232	0.0168	0.4647	0.01138	60.47	-100
-90	1.864	45.09	124.12	-51.854	576.688	-0.13142	1.56886	1.0176	0.5003	1.3278	6666	1188.6	1.099	0.0171	0.4534	0.01143	58.19	-90
-80	2.739	44.71	86.546	-41.637	581.035	-0.10416	1.53587	1.0254	0.5056	1.3296	6513	1202.9	0.986	0.0175	0.4422	0.01149	55.94	-80
-70	3.937	44.31	61.647	-31.341	585.288	-0.07741	1.50503	1.0331	0.5118	1.3319	6367	1216.7	0.891	0.0179	0.4310	0.01158	53.73	-70
-60	5.544	43.91	44.774	-20.969	589.439	-0.05114	1.47614	1.0406	0.5190	1.3346	6228	1229.7	0.810	0.0182	0.4198	0.01168	51.54	-60
-50	7.659	43.50	33.105	-10.521	593.476	-0.02534	1.44900	1.0478	0.5271	1.3379	6092	1242.2	0.741	0.0186	0.4088	0.01180	49.39	-50
-40	10.398	43.08	24.881	0.000	597.387	0.00000	1.42347	1.0549	0.5364	1.3419	5959	1253.9	0.680	0.0190	0.3978	0.01193	47.26	-40
-30	13.890	42.66	18.983	10.592	601.162	0.02491	1.39938	1.0617	0.5467	1.3465	5827	1264.9	0.628	0.0194	0.3870	0.01209	45.17	-30
-27.99 ^b	14.696	42.57	18.007	12.732	601.904	0.02987	1.39470	1.0631	0.5490	1.3475	5801	1267.1	0.618	0.0195	0.3849	0.01212	44.75	-27.99
-25	15.962	42.45	16.668	15.914	602.995	0.03720	1.38784	1.0651	0.5524	1.3491	5762	1270.2	0.604	0.0196	0.3817	0.01217	44.14	-25
-20	18.279	42.23	14.684	21.253	604.789	0.04939	1.37660	1.0684	0.5583	1.3520	5697	1275.2	0.582	0.0198	0.3764	0.01226	43.11	-20
-15	20.858	42.01	12.976	26.609	606.544	0.06148	1.36567	1.0716	0.5646	1.3550	5632	1280.0	0.561	0.0200	0.3711	0.01236	42.09	-15
-10	23.723	41.79	11.502	31.982	608.257	0.07347	1.35502	1.0749	0.5711	1.3584	5567	1284.7	0.541	0.0202	0.3658	0.01246	41.08	-10
-5	26.895	41.57	10.226	37.372	609.928	0.08536	1.34463	1.0782	0.5781	1.3619	5503	1289.1	0.522	0.0204	0.3606	0.01256	40.08	-5
0	30.397	41.34	9.1159	42.779	611.554	0.09715	1.33450	1.0814	0.5853	1.3657	5438	1293.3	0.505	0.0206	0.3555	0.01267	39.08	0
5	34.253	41.12	8.1483	48.203	613.135	0.10885	1.32462	1.0847	0.5929	1.3698	5373	1297.3	0.488	0.0208	0.3503	0.01279	38.10	5
10	38.487	40.89	7.3020	53.644	614.669	0.12045	1.31496	1.0880	0.6009	1.3742	5308	1301.1	0.472	0.0210	0.3453	0.01291	37.12	10
15	43.126	40.66	6.5597	59.103	616.154	0.13197	1.30552	1.0914	0.6092	1.3789	5243	1304.7	0.457	0.0212	0.3402	0.01304	36.15	15
20	48.194	40.43	5.9067	64.579	617.590	0.14340	1.29629	1.0948	0.6179	1.3840	5178	1308.0	0.443	0.0214	0.3352	0.01317	35.19	20
25	53.720	40.20	5.3307	70.072	618.974	0.15474	1.28726	1.0983	0.6271	1.3894	5113	1311.1	0.429	0.0216	0.3302	0.01331	34.23	25
30	59.730	39.96	4.8213	75.585	620.305	0.16599	1.27842	1.1019	0.6366	1.3951	5048	1314.0	0.416	0.0218	0.3253	0.01345	33.29	30
35	66.255	39.72	4.3695	81.116	621.582	0.17717	1.26975	1.1056	0.6465	1.4012	4982	1316.6	0.404	0.0220	0.3204	0.01360	32.35	35
40	73.322	39.48	3.9680	86.666	622.803	0.18827	1.26125	1.1094	0.6569	1.4078	4916	1319.0	0.392	0.0222	0.3155	0.01376	31.42	40
45	80.962	39.24	3.6102	92.237	623.967	0.19929	1.25291	1.1134	0.6678	1.4147	4850	1321.1	0.381	0.0224	0.3107	0.01392	30.50	45
50	89.205	38.99	3.2906	97.828	625.072	0.21024	1.24472	1.1175	0.6791	1.4222	4784	1323.0	0.370	0.0227	0.3059	0.01409	29.59	50
55	98.083	38.75	3.0045	103.441	626.115	0.22111	1.23667	1.1218	0.6909	1.4301	4717	1324.6	0.360	0.0229	0.3012	0.01426	28.69	55
60	107.63	38.50	2.7479	109.076	627.097	0.23192	1.22875	1.126	0.703	1.438	4650	1325.9	0.350	0.0231	0.2965	0.01445	27.79	60
65	117.87	38.25	2.5172	114.734	628.013	0.24266	1.22095	1.131	0.716	1.447	4583	1327.0	0.340	0.0233	0.2918	0.01464	26.90	65
70	128.85	37.99	2.3094	120.417	628.864	0.25334	1.21327	1.136	0.730	1.457	4515	1327.8	0.331	0.0235	0.2872	0.01483	26.03	70
75	140.59	37.73	2.1217	126.126	629.647	0.26396	1.20570	1.141	0.744	1.467	4447	1328.3	0.322	0.0237	0.2825	0.01504	25.16	75
80	153.13	37.47	1.9521	131.861	630.359	0.27452	1.19823	1.147	0.758	1.478	4378	1328.6	0.313	0.0239	0.2780	0.01525	24.30	80
85	166.51	37.21	1.7983	137.624	630.999	0.28503	1.19085	1.153	0.774	1.490	4309	1328.5	0.305	0.0241	0.2734	0.01548	23.44	85
90	180.76	36.94	1.6588	143.417	631.564	0.29549	1.18356	1.159	0.790	1.502	4240	1328.2	0.297	0.0244	0.2689	0.01571	22.60	90
95	195.91	36.67	1.5319	149.241	632.052	0.30590	1.17634	1.166	0.807	1.515	4170	1327.5	0.289	0.0246	0.2644	0.01595	21.77	95
100	212.01	36.40	1.4163	155.098	632.460	0.31626	1.16920	1.173	0.824	1.529	4099	1326.6	0.282	0.0248	0.2600	0.01620	20.94	100
105	229.09	36.12	1.3108	160.990	632.785	0.32659	1.16211	1.180	0.843	1.544	4028	1325.3	0.274	0.0250	0.2556	0.01646	20.13	105
110	247.19	35.83	1.2144	166.919	633.025	0.33688	1.15508	1.188	0.862	1.561	3956	1323.7	0.267	0.0253	0.2512	0.01673	19.32	110
115	266.34	35.55	1.1262	172.887	633.175	0.34713	1.14809	1.197	0.883	1.578	3884	1321.8	0.260	0.0255	0.2468	0.01702	18.53	115
120	286.60	35.26	1.0452	178.896	633.232	0.35736	1.14115	1.206	0.905	1.597	3811	1319.5	0.254	0.0257	0.2424	0.01732	17.74	120
125	307.98	34.96	0.9710	184.949	633.193	0.36757	1.13423	1.216	0.928	1.617	3737	1316.9	0.247	0.0260	0.2381	0.01763	16.96	125
130	330.54	34.66	0.9026	191.049	633.053	0.37775	1.12733	1.227	0.952	1.638	3662	1313.9	0.241	0.0262	0.2338	0.01795	16.19	130
135	354.32	34.35	0.8397	197.199	632.807	0.38792	1.12044	1.239	0.978	1.662	3587	1310.6	0.235	0.0265	0.2295	0.01829	15.44	135
140	379.36	34.04	0.7817	203.403	632.451	0.39808	1.11356	1.251	1.006	1.687	3511	1306.9	0.229	0.0267	0.2253	0.01865	14.69	140
145	405.70	33.72	0.7280	209.663	631.978	0.40824	1.10666	1.265	1.035	1.715	3434	1302.8	0.223	0.0270	0.2210	0.01903	13.95	145
150	433.38	33.39	0.6785	215.984	631.383	0.41840	1.09975	1.280	1.067	1.745	3356	1298.3	0.217	0.0273	0.2168	0.01943	13.22	150
155	462.45	33.06	0.6325	222.370	630.659	0.42857	1.09281	1.296	1.101	1.778	3277	1293.4	0.211	0.0276	0.2125	0.01986	12.51	155
160	492.95	32.72	0.5899	228.827	629.798	0.43875	1.08582	1.313	1.138	1.813	3198	1288.1	0.206	0.0279	0.2083	0.02031	11.80	160
165	524.94	32.37	0.5504	235.359	628.791	0.44896	1.07878	1.333	1.178	1.853	3117	1282.4	0.200	0.0282	0.2041	0.02079	11.10	165
170	558.45	32.01	0.5136	241.973	627.630	0.45919	1.07167	1.354	1.222	1.896	3035	1276.2	0.195	0.0285	0.1999	0.02130	10.42	170
175	593.53	31.64	0.4793	248.675	626.302	0.46947	1.06447	1.377	1.270	1.944	2952	1269.6	0.190	0.0288	0.1957	0.02185	9.75	175
180	630.24	31.26	0.4473	255.472	624.797	0.47980	1.05717	1.403	1.322	1.998	2868	1262.4	0.185	0.0292	0.1916	0.02245	9.09	180
185	668.63	30.87	0.4174	262.374	623.100	0.49019	1.04974	1.432	1.381	2.058	2783	1254.8	0.179	0.0296	0.1874	0.02310	8.44	185
190	708.74	30.47	0.3895	269.390	621.195	0.50066	1.04217	1.465	1.446	2.126	2696	1246.7	0.174	0.0300	0.1832	0.02381	7.80	190
195	750.64	30.05	0.3633	276.530	619.064	0.51121	1.03443	1.502	1.519	2.203	2608	1238.0	0.169	0.0304	0.1790	0.02458	7.18	195
200	794.38	29.62	0.3387	283.809	616.686	0.52188	1.02649	1.543	1.602	2.290	2519	1228.7	0.165	0.0309	0.1748	0.02545	6.56	200
205	840.03	29.17	0.3156	291.240	614.035	0.53267	1.01831	1.591	1.697	2.392	2428	1218.9	0.160	0.0314	0.1706	0.02641	5.97	205
210	887.64	28.70	0.2938	298.842	611.081	0.54360	1.00986	1.646	1.806	2.50								

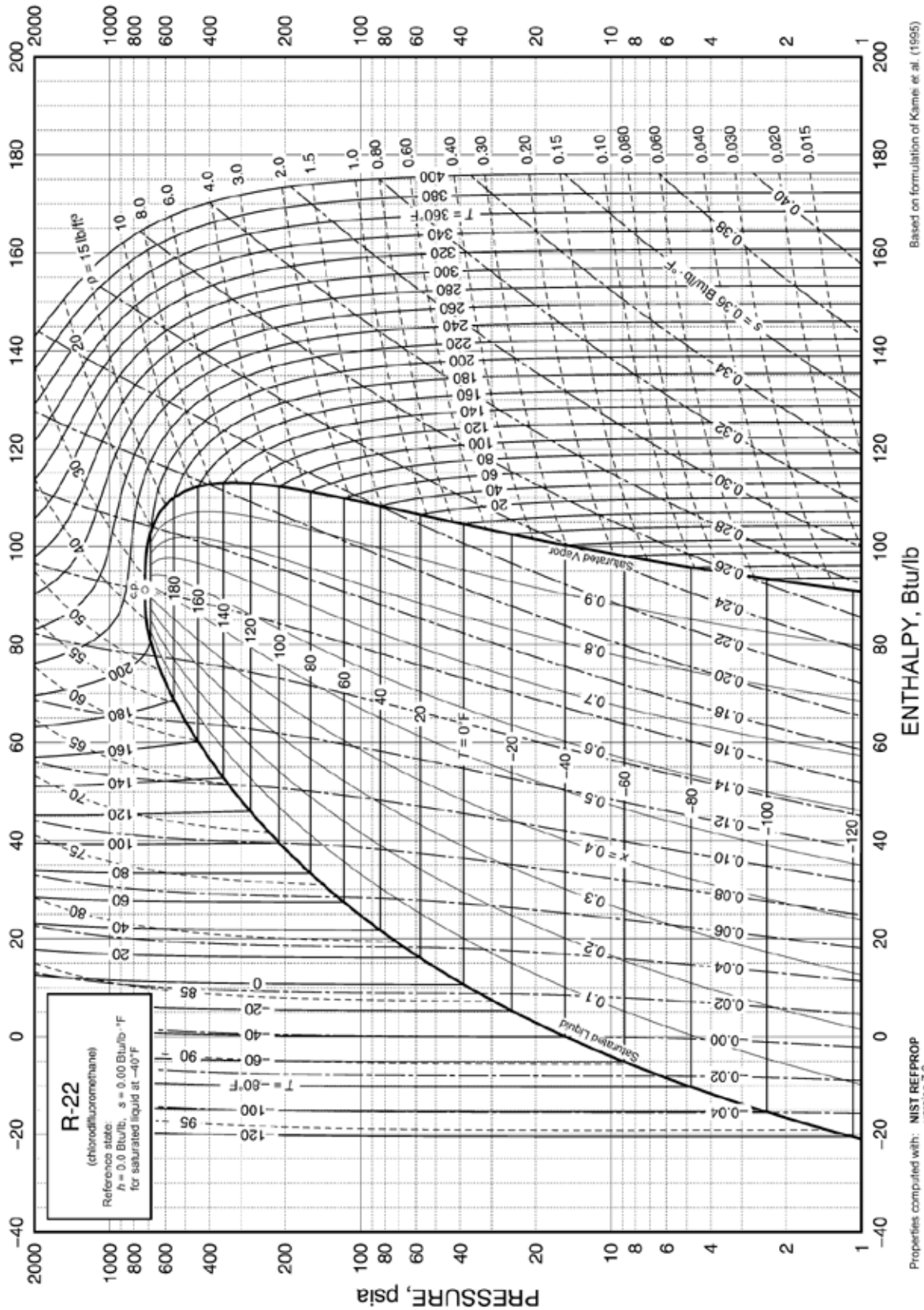


Fig. 2 Pressure-Enthalpy Diagram for Refrigerant 22

Thermophysical Properties of Refrigerants

Refrigerant 22 (Chlorodifluoromethane) Properties of Saturated Liquid and Saturated Vapor

Temp., ^a °F	Pres- sure, psia	Density, Volume, lb/ft ³ , ft ³ /lb		Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat c_p , Btu/lb·°F		c_p/c_v	Vel. of Sound, ft/s		Viscosity, lb _m /ft·h		Thermal Cond., Btu/h·ft·°F		Surface Tension, dyne/cm	Temp., ^c °F
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		
-150	0.263	98.28	146.06	-28.119	87.566	-0.07757	0.29600	0.2536	0.1185	1.2437	3716	469.7	2.093	0.0174	0.0831	0.00255	28.31	-150
-140	0.436	97.36	90.759	-25.583	88.729	-0.06951	0.28808	0.2536	0.1204	1.2404	3630	476.2	1.874	0.0180	0.0814	0.00267	27.34	-140
-130	0.698	96.44	58.384	-23.046	89.899	-0.06170	0.28090	0.2536	0.1223	1.2375	3544	482.4	1.692	0.0186	0.0797	0.00280	26.36	-130
-120	1.082	95.52	38.745	-20.509	91.074	-0.05412	0.27439	0.2537	0.1244	1.2350	3458	488.5	1.537	0.0191	0.0780	0.00293	25.40	-120
-110	1.629	94.59	26.444	-17.970	92.252	-0.04675	0.26846	0.2540	0.1265	1.2330	3373	494.2	1.405	0.0197	0.0763	0.00306	24.44	-110
-100	2.388	93.66	18.511	-15.427	93.430	-0.03959	0.26307	0.2543	0.1288	1.2315	3287	499.7	1.290	0.0203	0.0747	0.00320	23.49	-100
-95	2.865	93.19	15.623	-14.154	94.018	-0.03608	0.26055	0.2546	0.1300	1.2310	3245	502.4	1.238	0.0206	0.0739	0.00327	23.02	-95
-90	3.417	92.71	13.258	-12.880	94.605	-0.03261	0.25815	0.2549	0.1312	1.2307	3202	504.9	1.189	0.0208	0.0731	0.00334	22.55	-90
-85	4.053	92.24	11.309	-11.604	95.191	-0.02918	0.25585	0.2552	0.1324	1.2305	3160	507.4	1.144	0.0211	0.0723	0.00341	22.08	-85
-80	4.782	91.76	9.6939	-10.326	95.775	-0.02580	0.25366	0.2556	0.1337	1.2304	3118	509.8	1.101	0.0214	0.0715	0.00348	21.61	-80
-75	5.615	91.28	8.3487	-9.046	96.357	-0.02245	0.25155	0.2561	0.1350	1.2305	3075	512.2	1.060	0.0217	0.0708	0.00355	21.15	-75
-70	6.561	90.79	7.2222	-7.763	96.937	-0.01915	0.24954	0.2566	0.1363	1.2308	3033	514.4	1.021	0.0220	0.0700	0.00363	20.68	-70
-65	7.631	90.31	6.2744	-6.477	97.514	-0.01587	0.24761	0.2571	0.1377	1.2313	2990	516.5	0.985	0.0223	0.0692	0.00370	20.22	-65
-60	8.836	89.82	5.4730	-5.189	98.087	-0.01264	0.24577	0.2577	0.1392	1.2320	2948	518.6	0.951	0.0225	0.0684	0.00378	19.76	-60
-55	10.190	89.33	4.7924	-3.897	98.657	-0.00943	0.24400	0.2583	0.1406	1.2328	2906	520.5	0.918	0.0228	0.0677	0.00386	19.30	-55
-50	11.703	88.83	4.2119	-2.602	99.224	-0.00626	0.24230	0.2591	0.1422	1.2339	2863	522.4	0.887	0.0231	0.0669	0.00394	18.85	-50
-45	13.390	88.33	3.7147	-1.303	99.786	-0.00311	0.24067	0.2598	0.1438	1.2352	2821	524.1	0.857	0.0234	0.0661	0.00402	18.40	-45
-41.46 ^b	14.696	87.97	3.4054	-0.381	100.181	-0.00091	0.23955	0.2604	0.1449	1.2362	2791	525.3	0.837	0.0236	0.0656	0.00407	18.08	-41.46
-40	15.262	87.82	3.2872	0.000	100.343	0.00000	0.23910	0.2606	0.1454	1.2367	2778	525.8	0.829	0.0237	0.0654	0.00410	17.94	-40
-35	17.336	87.32	2.9181	1.308	100.896	0.00309	0.23759	0.2615	0.1471	1.2384	2736	527.3	0.802	0.0240	0.0646	0.00418	17.49	-35
-30	19.624	86.80	2.5984	2.620	101.443	0.00615	0.23615	0.2625	0.1488	1.2404	2694	528.7	0.776	0.0242	0.0639	0.00426	17.05	-30
-25	22.142	86.29	2.3204	3.937	101.984	0.00918	0.23475	0.2635	0.1506	1.2426	2651	530.0	0.751	0.0245	0.0631	0.00435	16.60	-25
-20	24.906	85.76	2.0778	5.260	102.519	0.01220	0.23341	0.2645	0.1525	1.2451	2609	531.2	0.728	0.0248	0.0624	0.00444	16.16	-20
-15	27.929	85.24	1.8656	6.588	103.048	0.01519	0.23211	0.2656	0.1544	1.2479	2566	532.3	0.705	0.0251	0.0617	0.00452	15.72	-15
-10	31.230	84.71	1.6792	7.923	103.570	0.01815	0.23086	0.2668	0.1564	1.2510	2524	533.2	0.683	0.0254	0.0609	0.00461	15.28	-10
-5	34.824	84.17	1.5150	9.263	104.085	0.02110	0.22965	0.2681	0.1585	1.2544	2481	534.0	0.662	0.0257	0.0602	0.00471	14.85	-5
0	38.728	83.63	1.3701	10.610	104.591	0.02403	0.22848	0.2694	0.1607	1.2581	2438	534.7	0.642	0.0260	0.0595	0.00480	14.41	0
5	42.960	83.08	1.2417	11.964	105.090	0.02694	0.22735	0.2708	0.1629	1.2622	2396	535.3	0.622	0.0262	0.0587	0.00489	13.98	5
10	47.536	82.52	1.1276	13.325	105.580	0.02983	0.22625	0.2722	0.1652	1.2666	2353	535.7	0.603	0.0265	0.0580	0.00499	13.55	10
15	52.475	81.96	1.0261	14.694	106.061	0.03270	0.22519	0.2737	0.1676	1.2714	2310	536.0	0.585	0.0268	0.0573	0.00509	13.13	15
20	57.795	81.39	0.9354	16.070	106.532	0.03556	0.22415	0.2753	0.1702	1.2767	2268	536.1	0.568	0.0271	0.0566	0.00519	12.70	20
25	63.514	80.82	0.8543	17.455	106.994	0.03841	0.22315	0.2770	0.1728	1.2824	2225	536.1	0.551	0.0274	0.0558	0.00530	12.28	25
30	69.651	80.24	0.7815	18.848	107.445	0.04124	0.22217	0.2787	0.1755	1.2886	2182	535.9	0.534	0.0277	0.0551	0.00540	11.86	30
35	76.225	79.65	0.7161	20.250	107.884	0.04406	0.22121	0.2806	0.1783	1.2953	2139	535.6	0.518	0.0280	0.0544	0.00551	11.45	35
40	83.255	79.05	0.6572	21.662	108.313	0.04686	0.22028	0.2825	0.1813	1.3026	2096	535.1	0.503	0.0283	0.0537	0.00562	11.04	40
45	90.761	78.44	0.6040	23.083	108.729	0.04966	0.21936	0.2845	0.1844	1.3105	2053	534.4	0.488	0.0286	0.0530	0.00574	10.63	45
50	98.763	77.83	0.5558	24.514	109.132	0.05244	0.21847	0.2866	0.1877	1.3191	2010	533.6	0.473	0.0289	0.0522	0.00586	10.22	50
55	107.28	77.20	0.5122	25.956	109.521	0.05522	0.21758	0.2889	0.1911	1.3284	1967	532.6	0.459	0.0292	0.0515	0.00598	9.82	55
60	116.33	76.57	0.4725	27.409	109.897	0.05798	0.21672	0.2913	0.1947	1.3385	1924	531.5	0.445	0.0296	0.0508	0.00611	9.41	60
65	125.94	75.92	0.4364	28.874	110.257	0.06074	0.21586	0.2938	0.1985	1.3495	1880	530.1	0.432	0.0299	0.0501	0.00625	9.02	65
70	136.13	75.27	0.4035	30.350	110.602	0.06350	0.21501	0.2964	0.2025	1.3615	1836	528.6	0.419	0.0302	0.0494	0.00638	8.62	70
75	146.92	74.60	0.3734	31.839	110.929	0.06625	0.21417	0.2992	0.2067	1.3746	1793	526.9	0.406	0.0305	0.0487	0.00653	8.23	75
80	158.33	73.92	0.3459	33.342	111.239	0.06899	0.21333	0.3022	0.2112	1.3889	1749	525.0	0.394	0.0309	0.0479	0.00668	7.84	80
85	170.38	73.23	0.3207	34.859	111.530	0.07173	0.21250	0.3054	0.2160	1.4046	1705	522.9	0.381	0.0312	0.0472	0.00684	7.46	85
90	183.09	72.52	0.2975	36.391	111.801	0.07447	0.21166	0.3089	0.2212	1.4218	1660	520.6	0.369	0.0316	0.0465	0.00701	7.08	90
95	196.50	71.80	0.2762	37.938	112.050	0.07721	0.21083	0.3126	0.2267	1.4407	1615	518.1	0.358	0.0320	0.0458	0.00718	6.70	95
100	210.61	71.06	0.2566	39.502	112.276	0.07996	0.20998	0.3166	0.2327	1.4616	1570	515.4	0.346	0.0324	0.0450	0.00737	6.33	100
105	225.46	70.30	0.2385	41.084	112.478	0.08270	0.20913	0.3209	0.2391	1.4849	1525	512.4	0.335	0.0328	0.0443	0.00757	5.96	105
110	241.06	69.52	0.2217	42.686	112.653	0.08545	0.20827	0.3257	0.2461	1.5107	1479	509.2	0.324	0.0332	0.0436	0.00778	5.60	110
115	257.45	68.72	0.2062	44.308	112.799	0.08821	0.20739	0.3309	0.2538	1.5396	1433	505.8	0.313	0.0336	0.0428	0.00801	5.24	115
120	274.65	67.90	0.1918	45.952	112.914	0.09098	0.20649	0.3367	0.2623	1.5722	1387	502.1	0.302	0.0341	0.0421	0.00825	4.88	120
125	292.69	67.05	0.1785	47.621	112.996	0.09376	0.20557	0.3431	0.2717	1.6090	1340	498.1	0.292	0.0346	0.0413	0.00851	4.53	125
130	311.58	66.18	0.1660	49.316	113.040	0.09656	0.20462	0.3504	0.2822	1.6509	1292	493.9	0.281	0.0351	0.0406	0.00880	4.19	130
135	331.37	65.27	0.1544	51.041	113.043	0.09937	0.20364	0.3585	0.2941	1.6990	1244	489.4	0.271	0.0356	0.0399	0.00911	3.85	135
140	352.08	64.32	0.1435	52.798	113.000	0.10222	0.20261	0.3679	0.3076	1.7548	1195	484.6	0.260	0.0362	0.0391	0.00946	3.51	140
145	373.74	63.34	0.1334	54.591	112.907	0.10509	0.20153	0.3787	0.3233	1.8201	1146	479.5	0.250	0.0369	0.0383	0.00984	3.18	145
150	396.38	62.31	0.1238	56.425	112.756	0.10800	0.20040	0.3913	0.3416	1.8976	1095	474.1	0.240	0.0375	0.0376	0.01027	2.86	150
155	420.04	61.22	0.1149	58.305	112.539	0.11096	0.19919	0.4063	0.3633	1.9907	1044	468.4	0.230	0.0383	0.0368			

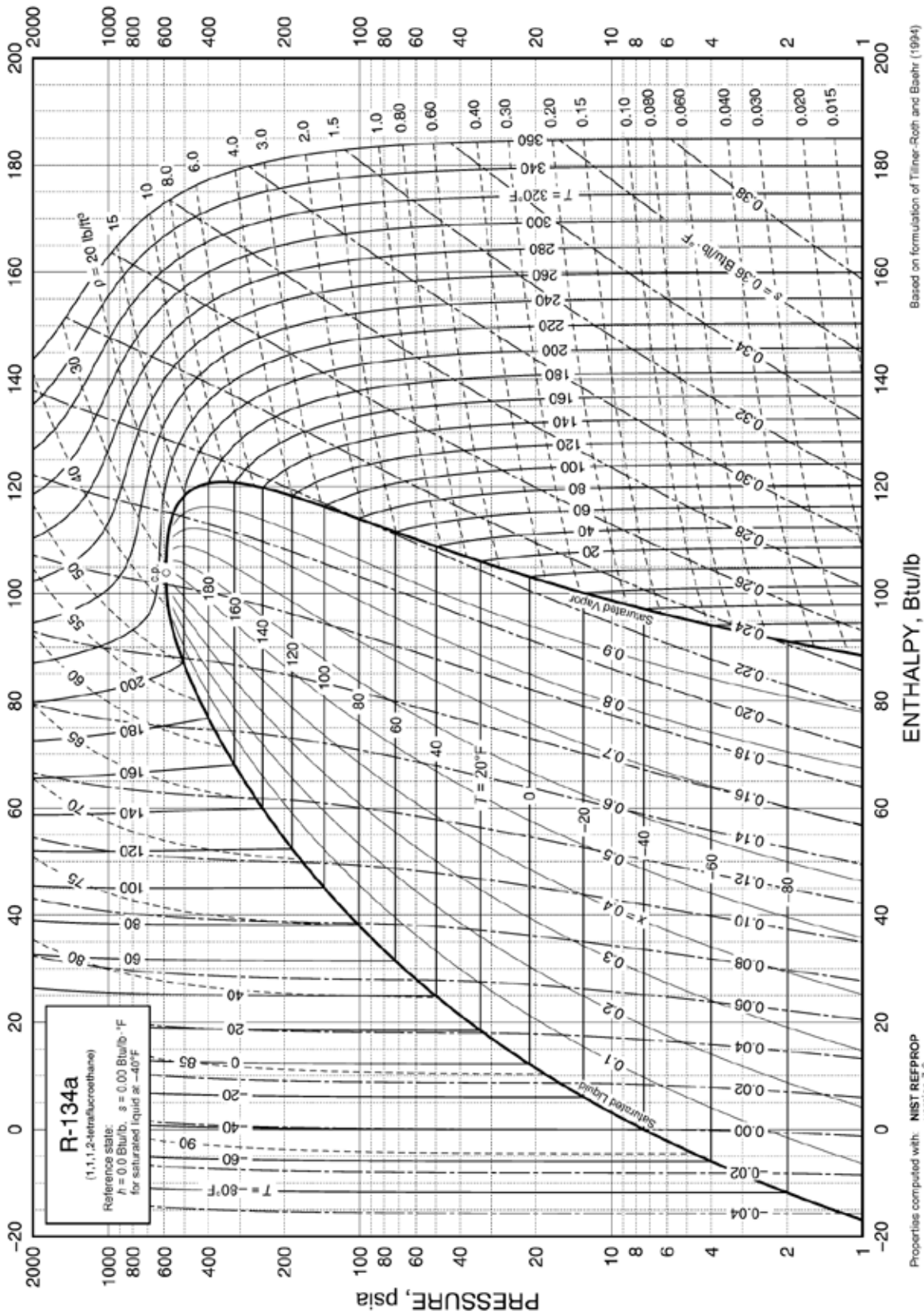


Fig. 8 Pressure-Enthalpy Diagram for Refrigerant 134a

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Thermophysical Properties of Refrigerants

30.17

Refrigerant 134a (1,1,1,2-Tetrafluoroethane) Properties of Saturated Liquid and Saturated Vapor

Temp., ^a °F	Pres- sure, psia	Density, Volume, lb/ft ³ , ft ³ /lb		Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat <i>c_p</i> , Btu/lb·°F		<i>c_p</i> / <i>c_v</i>	Vel. of Sound, ft/s		Viscosity, lb _m /ft·h		Thermal Cond., Btu/h·ft·°F		Surface Tension, Temp., ^c dyne/cm °F	
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		
-153.94 ^b	0.057	99.33	568.59	-32.992	80.362	-0.09154	0.27923	0.2829	0.1399	1.1637	3674	416.0	5.262	0.0156	0.0840	0.00178	28.07	-153.94
-150	0.072	98.97	452.12	-31.878	80.907	-0.08791	0.27629	0.2830	0.1411	1.1623	3638	418.3	4.790	0.0159	0.0832	0.00188	27.69	-150
-140	0.129	98.05	260.63	-29.046	82.304	-0.07891	0.26941	0.2834	0.1443	1.1589	3545	424.2	3.880	0.0164	0.0813	0.00214	26.74	-140
-130	0.221	97.13	156.50	-26.208	83.725	-0.07017	0.26329	0.2842	0.1475	1.1559	3452	429.9	3.238	0.0170	0.0794	0.00240	25.79	-130
-120	0.365	96.20	97.481	-23.360	85.168	-0.06166	0.25784	0.2853	0.1508	1.1532	3360	435.5	2.762	0.0176	0.0775	0.00265	24.85	-120
-110	0.583	95.27	62.763	-20.500	86.629	-0.05337	0.25300	0.2866	0.1540	1.1509	3269	440.8	2.396	0.0182	0.0757	0.00291	23.92	-110
-100	0.903	94.33	41.637	-17.626	88.107	-0.04527	0.24871	0.2881	0.1573	1.1490	3178	446.0	2.105	0.0187	0.0739	0.00317	22.99	-100
-90	1.359	93.38	28.381	-14.736	89.599	-0.03734	0.24490	0.2898	0.1607	1.1475	3087	450.9	1.869	0.0193	0.0722	0.00343	22.07	-90
-80	1.993	92.42	19.825	-11.829	91.103	-0.02959	0.24152	0.2916	0.1641	1.1465	2998	455.6	1.673	0.0199	0.0705	0.00369	21.16	-80
-75	2.392	91.94	16.711	-10.368	91.858	-0.02577	0.23998	0.2925	0.1658	1.1462	2954	457.8	1.587	0.0201	0.0696	0.00382	20.71	-75
-70	2.854	91.46	14.161	-8.903	92.614	-0.02198	0.23854	0.2935	0.1676	1.1460	2909	460.0	1.509	0.0204	0.0688	0.00395	20.26	-70
-65	3.389	90.97	12.060	-7.432	93.372	-0.01824	0.23718	0.2945	0.1694	1.1459	2866	462.1	1.436	0.0207	0.0680	0.00408	19.81	-65
-60	4.002	90.49	10.321	-5.957	94.131	-0.01452	0.23590	0.2955	0.1713	1.1460	2822	464.1	1.369	0.0210	0.0671	0.00420	19.36	-60
-55	4.703	90.00	8.8733	-4.476	94.890	-0.01085	0.23470	0.2965	0.1731	1.1462	2778	466.0	1.306	0.0212	0.0663	0.00433	18.92	-55
-50	5.501	89.50	7.6621	-2.989	95.650	-0.00720	0.23358	0.2976	0.1751	1.1466	2735	467.8	1.248	0.0215	0.0655	0.00446	18.47	-50
-45	6.406	89.00	6.6438	-1.498	96.409	-0.00358	0.23252	0.2987	0.1770	1.1471	2691	469.6	1.193	0.0218	0.0647	0.00460	18.03	-45
-40	7.427	88.50	5.7839	0.000	97.167	0.00000	0.23153	0.2999	0.1790	1.1478	2648	471.2	1.142	0.0221	0.0639	0.00473	17.60	-40
-35	8.576	88.00	5.0544	1.503	97.924	0.00356	0.23060	0.3010	0.1811	1.1486	2605	472.8	1.095	0.0223	0.0632	0.00486	17.16	-35
-30	9.862	87.49	4.4330	3.013	98.679	0.00708	0.22973	0.3022	0.1832	1.1496	2563	474.2	1.050	0.0226	0.0624	0.00499	16.73	-30
-25	11.299	86.98	3.9014	4.529	99.433	0.01058	0.22892	0.3035	0.1853	1.1508	2520	475.6	1.007	0.0229	0.0616	0.00512	16.30	-25
-20	12.898	86.47	3.4449	6.051	100.184	0.01406	0.22816	0.3047	0.1875	1.1521	2477	476.8	0.968	0.0231	0.0608	0.00525	15.87	-20
-15	14.671	85.95	3.0514	7.580	100.932	0.01751	0.22744	0.3060	0.1898	1.1537	2435	477.9	0.930	0.0234	0.0601	0.00538	15.44	-15
-14.93 ^b	16.696	85.94	3.0465	7.600	100.942	0.01755	0.22743	0.3061	0.1898	1.1537	2434	477.9	0.929	0.0234	0.0601	0.00538	15.44	-14.93
-10	16.632	85.43	2.7109	9.115	101.677	0.02093	0.22678	0.3074	0.1921	1.1554	2393	478.9	0.894	0.0237	0.0593	0.00552	15.02	-10
-5	18.794	84.90	2.4154	10.657	102.419	0.02433	0.22615	0.3088	0.1945	1.1573	2350	479.8	0.860	0.0240	0.0586	0.00565	14.60	-5
0	21.171	84.37	2.1579	12.207	103.156	0.02771	0.22557	0.3102	0.1969	1.1595	2308	480.5	0.828	0.0242	0.0578	0.00578	14.18	0
5	23.777	83.83	1.9330	13.764	103.889	0.03107	0.22502	0.3117	0.1995	1.1619	2266	481.1	0.798	0.0245	0.0571	0.00592	13.76	5
10	26.628	83.29	1.7357	15.328	104.617	0.03440	0.22451	0.3132	0.2021	1.1645	2224	481.6	0.769	0.0248	0.0564	0.00605	13.35	10
15	29.739	82.74	1.5623	16.901	105.339	0.03772	0.22403	0.3147	0.2047	1.1674	2182	482.0	0.741	0.0250	0.0556	0.00619	12.94	15
20	33.124	82.19	1.4094	18.481	106.056	0.04101	0.22359	0.3164	0.2075	1.1705	2140	482.2	0.715	0.0253	0.0549	0.00632	12.53	20
25	36.800	81.63	1.2742	20.070	106.767	0.04429	0.22317	0.3181	0.2103	1.1740	2098	482.2	0.689	0.0256	0.0542	0.00646	12.12	25
30	40.784	81.06	1.1543	21.667	107.471	0.04755	0.22278	0.3198	0.2132	1.1777	2056	482.2	0.665	0.0258	0.0535	0.00660	11.72	30
35	45.092	80.49	1.0478	23.274	108.167	0.05079	0.22241	0.3216	0.2163	1.1818	2014	481.9	0.642	0.0261	0.0528	0.00674	11.32	35
40	49.741	79.90	0.9528	24.890	108.856	0.05402	0.22207	0.3235	0.2194	1.1862	1973	481.5	0.620	0.0264	0.0521	0.00688	10.92	40
45	54.749	79.32	0.8680	26.515	109.537	0.05724	0.22174	0.3255	0.2226	1.1910	1931	481.0	0.598	0.0267	0.0514	0.00703	10.53	45
50	60.134	78.72	0.7920	28.150	110.209	0.06044	0.22144	0.3275	0.2260	1.1961	1889	480.3	0.578	0.0270	0.0507	0.00717	10.14	50
55	65.913	78.11	0.7238	29.796	110.871	0.06362	0.22115	0.3297	0.2294	1.2018	1847	479.4	0.558	0.0273	0.0500	0.00732	9.75	55
60	72.105	77.50	0.6625	31.452	111.524	0.06680	0.22088	0.3319	0.2331	1.2079	1805	478.3	0.539	0.0275	0.0493	0.00747	9.36	60
65	78.729	76.87	0.6072	33.120	112.165	0.06996	0.22062	0.3343	0.2368	1.2145	1763	477.0	0.520	0.0278	0.0486	0.00762	8.98	65
70	85.805	76.24	0.5572	34.799	112.796	0.07311	0.22037	0.3368	0.2408	1.2217	1721	475.6	0.503	0.0281	0.0479	0.00777	8.60	70
75	93.351	75.59	0.5120	36.491	113.414	0.07626	0.22013	0.3394	0.2449	1.2296	1679	474.0	0.485	0.0284	0.0472	0.00793	8.23	75
80	101.39	74.94	0.4710	38.195	114.019	0.07939	0.21989	0.3422	0.2492	1.2382	1636	472.2	0.469	0.0287	0.0465	0.00809	7.86	80
85	109.93	74.27	0.4338	39.913	114.610	0.08252	0.21966	0.3451	0.2537	1.2475	1594	470.1	0.453	0.0291	0.0458	0.00825	7.49	85
90	119.01	73.58	0.3999	41.645	115.186	0.08565	0.21944	0.3482	0.2585	1.2578	1551	467.9	0.437	0.0294	0.0451	0.00842	7.13	90
95	128.65	72.88	0.3690	43.392	115.746	0.08877	0.21921	0.3515	0.2636	1.2690	1509	465.4	0.422	0.0297	0.0444	0.00860	6.77	95
100	138.85	72.17	0.3407	45.155	116.289	0.09188	0.21898	0.3551	0.2690	1.2813	1466	462.7	0.407	0.0301	0.0437	0.00878	6.41	100
105	149.65	71.44	0.3148	46.934	116.813	0.09500	0.21875	0.3589	0.2747	1.2950	1423	459.8	0.393	0.0304	0.0431	0.00897	6.06	105
110	161.07	70.69	0.2911	48.731	117.317	0.09811	0.21851	0.3630	0.2809	1.3101	1380	456.7	0.378	0.0308	0.0424	0.00916	5.71	110
115	173.14	69.93	0.2693	50.546	117.799	0.10123	0.21826	0.3675	0.2875	1.3268	1337	453.2	0.365	0.0312	0.0417	0.00936	5.36	115
120	185.86	69.14	0.2493	52.382	118.258	0.10435	0.21800	0.3723	0.2948	1.3456	1294	449.6	0.351	0.0316	0.0410	0.00958	5.03	120
125	199.28	68.32	0.2308	54.239	118.690	0.10748	0.21772	0.3775	0.3026	1.3666	1250	445.6	0.338	0.0320	0.0403	0.00981	4.69	125
130	213.41	67.49	0.2137	56.119	119.095	0.11062	0.21742	0.3833	0.3112	1.3903	1206	441.4	0.325	0.0324	0.0396	0.01005	4.36	130
135	228.28	66.62	0.1980	58.023	119.468	0.11376	0.21709	0.3897	0.3208	1.4173	1162	436.8	0.313	0.0329	0.0389	0.01031	4.04	135
140	243.92	65.73	0.1833	59.954	119.807	0.11692	0.21673	0.3968	0.3315	1.4481	1117	432.0	0.301	0.0334	0.0382	0.01058	3.72	140
145	260.36	64.80	0.1697	61.915	120.108	0.12010	0.21634	0.4048	0.3435	1.4837	1072	426.8	0.288	0.0339	0.0375	0.01089	3.40	145
150	277.61	63.83	0.1571	63.908	120.366	0.12330	0.21591	0.4138	0.3571	1.5250	1027	421.2	0.276	0.0344	0.0368	0.01122	3.09	150
155	295.73	62.82	0.1453	65.936	120.576	0.12653	0.21542	0.4242	0.3729	1.5738	980	415.3	0.264	0.0350	0.0361	0.01158	2.79	155
160	314.73	61.76	0.1343	68.005	120.731	0.12979	0.21488	0.4362	0.3914	1.6318	934	409.1	0.253	0.0				

Refrigerant 134a Properties of Superheated Vapor

Pressure = 14.696 psia Saturation temperature = -14.92°F					Pressure = 25.00 psia Saturation temperature = 7.22°F					Pressure = 50.00 psia Saturation temperature = 40.29°F				
Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s
Saturated					Saturated					Saturated				
Liquid	85.7972	7.53	0.01739	2451.2	Liquid	83.4823	14.32	0.03224	2263.9	Liquid	79.8125	24.79	0.05377	1982.3
Vapor	0.3283	100.81	0.22713	478.0	Vapor	0.5426	104.07	0.22446	481.5	Vapor	1.0545	108.74	0.22170	481.7
0	0.3158	103.62	0.23335	487.2										
20	0.3008	107.45	0.24149	499.0	20	0.5245	106.60	0.22982	489.9	60	0.9982	113.00	0.23005	496.2
40	0.2874	111.34	0.24944	510.2	40	0.4991	110.61	0.23800	502.4	80	0.9489	117.32	0.23822	509.8
60	0.2753	115.31	0.25723	521.0	60	0.4765	114.66	0.24596	514.1	100	0.9055	121.68	0.24614	522.5
80	0.2642	119.35	0.26486	531.5	80	0.4563	118.78	0.25373	525.4	120	0.8670	126.07	0.25385	534.5
100	0.2541	123.47	0.27236	541.6	100	0.4379	122.96	0.26135	536.2	140	0.8322	130.51	0.26139	545.8
120	0.2448	127.68	0.27974	551.4	120	0.4212	127.22	0.26881	546.6	160	0.8008	135.01	0.26877	556.7
140	0.2362	131.96	0.28700	561.0	140	0.4058	131.55	0.27615	556.7	180	0.7718	139.57	0.27601	567.2
160	0.2282	136.32	0.29416	570.4	160	0.3916	135.95	0.28337	566.5	200	0.7454	144.20	0.28313	577.4
180	0.2208	140.77	0.30122	579.5	180	0.3786	140.43	0.29048	576.0	220	0.7208	148.89	0.29014	587.2
200	0.2139	145.30	0.30819	588.5	200	0.3663	144.98	0.29750	585.3	240	0.6980	153.65	0.29704	596.8
220	0.2074	149.90	0.31507	597.3	220	0.3549	149.61	0.30441	594.4	260	0.6768	158.48	0.30385	606.1
240	0.2013	154.59	0.32187	606.0	240	0.3443	154.32	0.31124	603.3	280	0.6569	163.38	0.31056	615.2
260	0.1955	159.36	0.32858	614.5	260	0.3343	159.10	0.31798	612.0	300	0.6383	168.35	0.31719	624.1
280	0.1901	164.20	0.33522	622.8	280	0.3248	163.96	0.32464	620.6					
300	0.1850	169.12	0.34178	631.1	300	0.3160	168.90	0.33122	629.0					
Pressure = 75.00 psia Saturation temperature = 62.24°F					Pressure = 100.00 psia Saturation temperature = 79.17°F					Pressure = 125.00 psia Saturation temperature = 93.15°F				
Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s
Saturated					Saturated					Saturated				
Liquid	77.1862	31.98	0.06775	1793.6	Liquid	75.0245	37.69	0.07840	1646.8	Liquid	73.1279	42.53	0.08715	1524.7
Vapor	1.5686	111.67	0.22042	478.1	Vapor	2.0917	113.78	0.21960	472.8	Vapor	2.6279	115.41	0.21898	466.7
80	1.4873	115.74	0.22809	492.7	80	2.0858	113.98	0.21998	473.6	100	2.5638	117.16	0.22212	473.9
100	1.4092	120.30	0.23639	507.7	100	1.9576	118.80	0.22874	491.6	120	2.4025	122.16	0.23090	492.9
120	1.3416	124.85	0.24439	521.6	120	1.8509	123.55	0.23709	507.8	140	2.2694	127.08	0.23924	509.7
140	1.2822	129.43	0.25215	534.5	140	1.7597	128.29	0.24512	522.4	160	2.1561	131.96	0.24725	525.0
160	1.2294	134.04	0.25971	546.6	160	1.6800	133.02	0.25288	536.0	180	2.0577	136.83	0.25498	539.0
180	1.1817	138.69	0.26710	558.2	180	1.6094	137.78	0.26044	548.8	200	1.9710	141.71	0.26250	552.2
200	1.1383	143.39	0.27434	569.2	200	1.5463	142.57	0.26781	560.8	220	1.8935	146.62	0.26983	564.6
220	1.0984	148.15	0.28145	579.8	220	1.4891	147.40	0.27502	572.3	240	1.8233	151.56	0.27700	576.4
240	1.0620	152.97	0.28843	590.1	240	1.4368	152.27	0.28210	583.3	260	1.7592	156.55	0.28402	587.6
260	1.0280	157.85	0.29531	600.0	260	1.3886	157.21	0.28905	593.9	280	1.7006	161.59	0.29093	598.4
280	0.9966	162.79	0.30208	609.7	280	1.3444	162.19	0.29588	604.1	300	1.6463	166.67	0.29771	608.8
300	0.9671	167.80	0.30876	619.0	300	1.3031	167.24	0.30261	614.0	320	1.5959	171.82	0.30440	618.9
320	0.9398	172.87	0.31535	628.2	320	1.2647	172.35	0.30925	623.6	340	1.5492	177.02	0.31098	628.7
340	0.9138	178.01	0.32186	637.1	340	1.2287	177.52	0.31579	632.9	360	1.5055	182.27	0.31747	638.2
360	0.8895	183.21	0.32828	645.9	360	1.1950	182.75	0.32225	642.1	380	1.4644	187.59	0.32388	647.5
380	0.8665	188.48	0.33463	654.5	380	1.1633	188.04	0.32863	651.0	400	1.4258	192.97	0.33021	656.6
400	0.8448	193.82	0.34091	662.9	400	1.1334	193.39	0.33494	659.8					
Pressure = 150.00 psia Saturation temperature = 105.17°F					Pressure = 175.00 psia Saturation temperature = 115.76°F					Pressure = 200.00 psia Saturation temperature = 125.27°F				
Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s
Saturated					Saturated					Saturated				
Liquid	71.4013	46.78	0.09464	1419.1	Liquid	69.7902	50.62	0.10126	1325.3	Liquid	68.2602	54.14	0.10721	1240.5
Vapor	3.1801	116.71	0.21844	460.0	Vapor	3.7511	117.76	0.21794	453.0	Vapor	4.3437	118.61	0.21743	445.6
120	3.0077	120.64	0.22530	476.6	120	3.6836	118.95	0.21999	458.4	140	4.0726	122.86	0.22460	465.2
140	2.8181	125.78	0.23403	496.0	140	3.4148	124.38	0.22921	481.3	160	3.7850	128.36	0.23363	487.8
160	2.6620	130.83	0.24231	513.3	160	3.2025	129.64	0.23783	500.9	180	3.5561	133.70	0.24210	507.2
180	2.5295	135.83	0.25026	528.9	180	3.0271	134.79	0.24602	518.3	200	3.3656	138.94	0.25018	524.5
200	2.4146	140.82	0.25794	543.3	200	2.8785	139.90	0.25388	534.0	220	3.2036	144.14	0.25793	540.2
220	2.3132	145.82	0.26539	556.7	220	2.7494	144.99	0.26148	548.5	240	3.0623	149.31	0.26544	554.7
240	2.2223	150.83	0.27267	569.3	240	2.6349	150.08	0.26887	562.1	260	2.9371	154.50	0.27274	568.3
260	2.1401	155.88	0.27978	581.3	260	2.5328	155.19	0.27607	574.8	280	2.8247	159.69	0.27987	581.1
280	2.0658	160.97	0.28675	592.7	280	2.4403	160.34	0.28312	586.9	300	2.7234	164.92	0.28684	593.2
300	1.9971	166.10	0.29360	603.7	300	2.3558	165.51	0.29003	598.5	320	2.6305	170.18	0.29368	604.8
320	1.9338	171.28	0.30033	614.2	320	2.2785	170.73	0.29681	609.5	340	2.5455	175.49	0.30039	615.9
340	1.8751	176.51	0.30696	624.5	340	2.2071	176.73	0.30348	620.2	360	2.4668	180.83	0.30700	626.7
360	1.8208	181.80	0.31349	634.4	360	2.1411	181.32	0.31004	630.5	380	2.3934	186.23	0.31350	637.0
380	1.7695	187.14	0.31993	644.0	380	2.0795	186.69	0.31651	640.5	400	2.3254	191.68	0.31991	647.1
400	1.7216	192.54	0.32628	653.4	400	2.0216	192.11	0.32290	650.3	420	2.2614	197.18	0.32624	656.9
420	1.6766	198.00	0.33256	662.6	420	1.9675	197.59	0.32920	659.7	440	2.2017	202.73	0.33248	666.4
440	1.6241	203.51	0.33876	671.6	440	1.9164	203.12	0.33542	669.0	460	2.1453	208.34	0.33864	675.7
460	1.5940	209.08	0.34488	680.4	460	1.8683	208.71	0.34156	678.0	480	2.0920	214.00	0.34473	684.8
480	1.5558	214.71	0.35094	689.0	480	1.8228	214.36	0.34763	686.9	500	2.0417	219.71	0.35075	693.7
500	1.5197	220.40	0.35692	697.4	500	1.7797	220.05	0.35363	695.6					

*Temperatures on ITS-90 scale

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Refrigerant 134a Properties of Superheated Vapor (Concluded)

Pressure = 225.00 psia Saturation temperature = 133.93°F					Pressure = 250.00 psia Saturation temperature = 141.89°F					Pressure = 275.00 psia Saturation temperature = 149.27°F				
Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s
Saturated					Saturated					Saturated				
Liquid	66.7870	57.42	0.11266	1162.8	Liquid	65.3526	60.50	0.11770	1090.7	Liquid	63.9423	63.43	0.12241	1023.4
Vapor	4.9609	119.30	0.21690	438.1	Vapor	5.6060	119.84	0.21634	430.3	Vapor	6.2831	120.25	0.21572	422.3
140	4.8123	121.16	0.22002	447.3										
160	4.4191	126.99	0.22959	473.6	160	5.1189	125.49	0.22560	458.2	160	5.9060	123.82	0.22155	441.2
180	4.1206	132.54	0.23840	495.5	180	4.7275	131.31	0.23484	483.1	180	5.3869	129.98	0.23133	469.9
200	3.8796	137.94	0.24671	514.6	200	4.4239	136.89	0.24343	504.2	200	5.0031	135.78	0.24026	493.4
220	3.6784	143.25	0.25465	531.6	220	4.1756	142.34	0.25156	522.8	220	4.6978	141.38	0.24862	513.7
240	3.5058	148.52	0.26229	547.2	240	3.9664	147.71	0.25935	539.5	240	4.4465	146.87	0.25658	531.7
260	3.3542	153.78	0.26970	561.6	260	3.7854	153.05	0.26688	554.9	260	4.2314	152.30	0.26423	548.0
280	3.2202	159.04	0.27691	575.1	280	3.6265	158.37	0.27418	569.2	280	4.0446	157.69	0.27162	563.1
300	3.0995	164.32	0.28395	587.9	300	3.4847	163.71	0.28129	582.6	300	3.8803	163.08	0.27881	577.2
320	2.9899	169.62	0.29084	600.0	320	3.3571	169.06	0.28824	595.3	320	3.7317	168.49	0.28583	590.5
340	2.8897	174.97	0.29761	611.7	340	3.2408	174.44	0.29506	607.4	340	3.5987	173.91	0.29270	603.1
360	2.7978	180.35	0.30425	622.8	360	3.1342	179.85	0.30175	618.9	360	3.4764	179.36	0.29943	615.1
380	2.7122	185.77	0.31079	633.6	380	3.0359	185.31	0.30832	630.1	380	3.3646	184.84	0.30604	626.6
400	2.6330	191.24	0.31723	644.0	400	2.9451	190.81	0.31479	640.8	400	3.2612	190.37	0.31254	637.7
420	2.5592	196.77	0.32358	654.0	420	2.8604	196.35	0.32117	651.2	420	3.1653	195.93	0.31894	648.4
440	2.4900	202.34	0.32984	663.9	440	2.7813	201.94	0.32745	661.3	440	3.0758	201.55	0.32525	658.8
460	2.4249	207.96	0.33603	673.4	460	2.7072	207.58	0.33365	671.1	460	2.9922	207.20	0.33147	668.9
480	2.3636	213.64	0.34213	682.8	480	2.6374	213.27	0.33977	680.7	480	2.9136	212.91	0.33761	678.7
500	2.3057	219.36	0.34816	691.9	500	2.5717	219.02	0.34582	690.1	500	2.8397	218.67	0.34368	688.3
Pressure = 300.00 psia Saturation temperature = 156.16°F					Pressure = 325.00 psia Saturation temperature = 162.62°F					Pressure = 350.00 psia Saturation temperature = 168.71°F				
Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s
Saturated					Saturated					Saturated				
Liquid	62.5436	66.23	0.12686	959.8	Liquid	61.1446	68.92	0.13110	899.5	Liquid	59.7334	71.54	0.13516	841.7
Vapor	6.9967	120.54	0.21505	414.2	Vapor	7.7526	120.71	0.21431	405.9	Vapor	8.5577	120.76	0.21349	397.5
160	6.8168	121.92	0.21730	422.0										
180	6.1118	128.55	0.22782	455.8	180	6.9220	126.96	0.22423	440.3	180	7.8491	125.18	0.22046	423.2
200	5.6239	134.61	0.23715	482.1	200	6.2928	133.36	0.23408	470.2	200	7.0242	132.01	0.23098	457.6
220	5.2494	140.39	0.24578	504.3	220	5.8341	139.34	0.24301	494.5	220	6.4561	138.24	0.24029	484.4
240	4.9472	146.00	0.25393	523.7	240	5.4723	145.10	0.25136	515.5	240	6.0219	144.17	0.24888	507.1
260	4.6939	151.52	0.26171	541.1	260	5.1741	150.73	0.25930	534.0	260	5.6728	149.91	0.25698	526.9
280	4.4758	157.00	0.26921	557.0	280	4.9208	156.29	0.26692	550.9	280	5.3805	155.56	0.26472	544.7
300	4.2852	162.45	0.27649	571.8	300	4.7017	161.81	0.27428	566.4	300	5.1295	161.15	0.27218	561.0
320	4.1160	167.90	0.28357	585.7	320	4.5082	167.31	0.28144	580.9	320	4.9098	166.72	0.27941	576.1
340	3.9631	173.37	0.29049	598.8	340	4.3352	172.82	0.28841	594.5	340	4.7148	172.27	0.28644	590.2
360	3.8247	178.85	0.29727	611.2	360	4.1790	178.35	0.29524	607.4	360	4.5396	177.84	0.29332	603.6
380	3.6981	184.37	0.30392	623.1	380	4.0368	183.90	0.30193	619.7	380	4.3807	183.42	0.30005	616.3
400	3.5816	189.92	0.31045	634.6	400	3.9063	189.48	0.30849	631.5	400	4.2355	189.03	0.30665	628.4
420	3.4737	195.51	0.31688	645.6	420	3.7859	195.09	0.31495	642.8	420	4.1019	194.67	0.31313	640.1
440	3.3735	201.15	0.32321	656.3	440	3.6743	200.75	0.32131	653.8	440	3.9784	200.35	0.31952	651.4
460	3.2799	206.83	0.32945	666.6	460	3.5703	206.44	0.32757	664.4	460	3.8636	206.06	0.32580	662.2
480	3.1922	212.55	0.33561	676.7	480	3.4731	212.19	0.33375	674.7	480	3.7564	211.82	0.33199	672.8
500	3.1098	218.32	0.34169	686.5	500	3.3819	217.97	0.33984	684.7	500	3.6561	217.62	0.33811	683.0
Pressure = 375.00 psia Saturation temperature = 174.46°F					Pressure = 400.00 psia Saturation temperature = 197.93°F					Pressure = 600.00 psia Saturation temperature = n/a (supercritical)				
Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s	Temp., °F	Density, lb/ft ³	Enthalpy, Btu/lb	Entropy, Btu/lb·°F	Vel. Sound, ft/s
Saturated					Saturated									
Liquid	58.2974	74.09	0.13908	785.9	Liquid	56.8213	76.60	0.14289	731.8					
Vapor	9.4209	120.69	0.21256	389.0	Vapor	10.3541	120.50	0.21152	380.4					
180	8.9498	123.10	0.21634	403.8	180	10.3454	120.53	0.21158	380.6					
200	7.8311	130.54	0.22781	444.1	200	8.7370	128.93	0.22451	429.5					
220	7.1211	137.08	0.23758	474.0	220	7.8399	135.85	0.23484	463.0	220	19.6784	118.27	0.20421	340.3
240	6.6028	143.19	0.24644	498.5	240	7.2145	142.18	0.24403	489.7	240	14.2159	131.50	0.22343	409.1
260	6.1926	149.07	0.25473	519.6	260	6.7351	148.21	0.25252	512.3	260	12.2674	139.92	0.23530	449.7
280	5.8555	154.82	0.26260	538.4	280	6.3472	154.06	0.26055	532.1	280	11.0672	147.15	0.24522	480.8
300	5.5694	160.49	0.27016	555.5	300	6.0221	159.81	0.26821	550.0	300	10.2049	153.83	0.25413	506.7
320	5.3212	166.11	0.27747	571.3	320	5.7425	165.49	0.27560	566.5	320	9.5351	160.21	0.26241	529.2
340	5.1022	171.72	0.28457	586.0	340	5.4977	171.15	0.28277	581.7	340	8.9895	166.39	0.27024	549.2
360	4.9066	177.32	0.29149	599.8	360	5.2802	176.80	0.28975	596.0	360	8.5305	172.45	0.27774	567.5
380	4.7300	182.94	0.29826	612.9	380	5.0848	182.45	0.29656	609.5	380	8.1351	178.45	0.28496	584.4
400	4.5692	188.58	0.30490	625.4	400	4.9075	188.12	0.30323	622.4	400	7.7885	184.40	0.29197	600.1
420	4.4217	194.24	0.31141	637.4	420	4.7454	193.82	0.30978	634.7	420	7.4804	190.34	0.29879	615.0
440	4.2857	199.94	0.31782	648.9	440	4.5964	199.54	0.31621	646.5	440	7.2035	196.26	0.30546	629.0
460	4.1596	205.68	0.32413	660.1	460	4.4584	205.30	0.32254	657.9	460	6.9523	202.20	0.31198	642.4
480	4.0421	211.46	0.33034	670.8	480	4.3303	211.09	0.32878	669.0	480	6.7229	208.15	0.31838	655.3
500	3.9323	217.28	0.33647	681.3	500	4.2107	216.93	0.33492	679.6	500	6.5118	214.12	0.32467	667.6

*Temperatures on ITS-90 scale

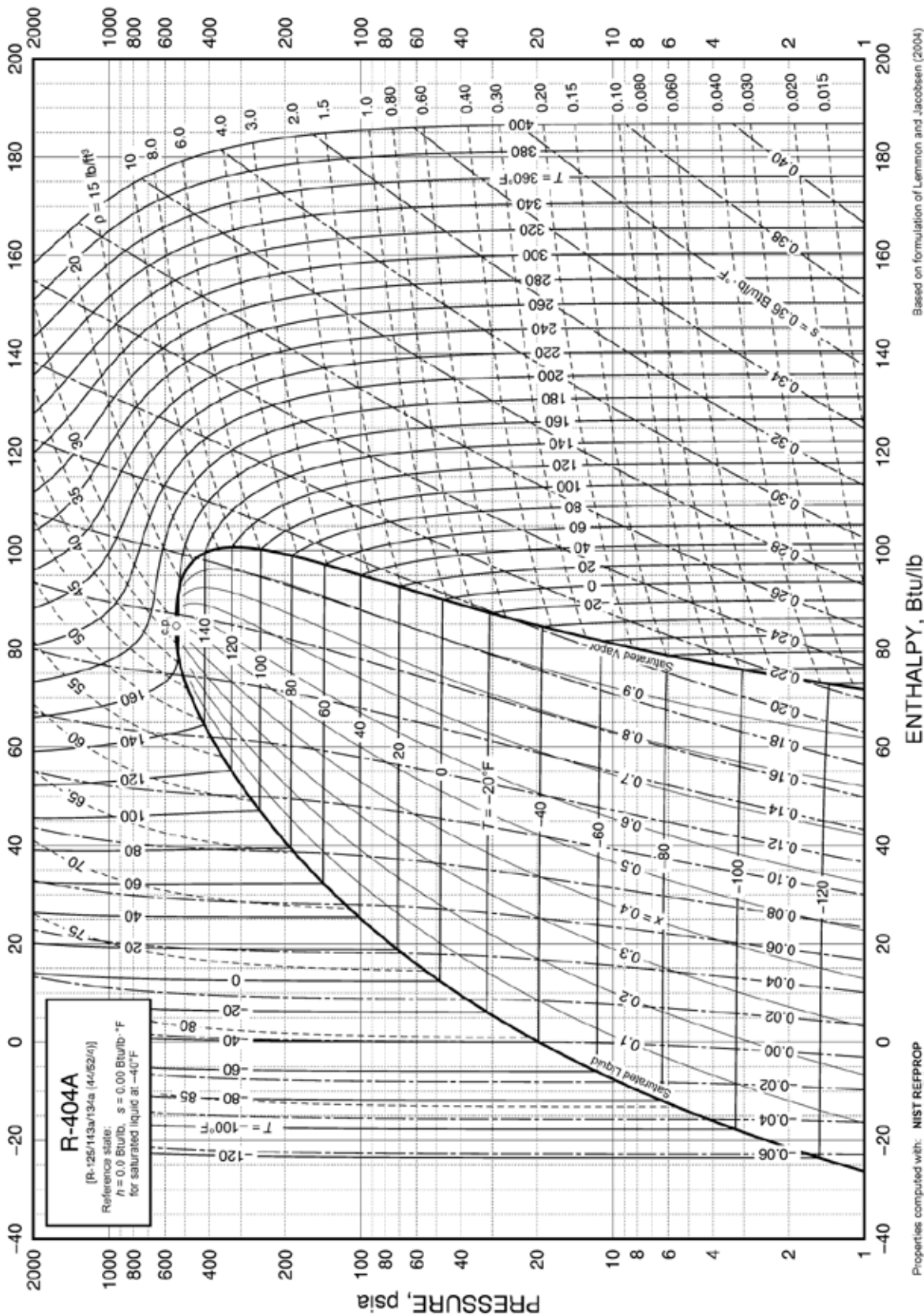


Fig. 15 Pressure-Enthalpy Diagram for Refrigerant 404A

Thermophysical Properties of Refrigerants

Refrigerant 404A [R-125/143a/134a (44/52/4)] Properties of Liquid on Bubble Line and Vapor on Dew Line

Pres- sure, psia	Temp., °F		Density, Volume, lb/ft ³		Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat c_p , Btu/lb·°F			Vel. of Sound, ft/s		Viscosity, lb _m /ft·h		Thermal Cond., Btu/h·ft·°F		Surface Tension, sure, dyne/cm	Pres- sure, psia
	Bubble	Dew	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		
	c_p/c_v																		
1	-129.56	-127.50	89.61	36.2311	-26.33	71.76	-0.07039	0.22616	0.2907	0.1554	1.161	3173	439.8	1.695	0.0181	0.0695	0.00369	17.42	1
1.5	-120.05	-118.11	88.64	24.7754	-23.56	73.11	-0.06215	0.22201	0.2901	0.1589	1.160	3050	444.6	1.518	0.0186	0.0678	0.00388	16.92	1.5
2	-112.90	-111.03	87.92	18.9245	-21.49	74.14	-0.05611	0.21920	0.2900	0.1615	1.159	2964	448.1	1.403	0.0190	0.0666	0.00403	16.53	2
2.5	-107.10	-105.29	87.33	15.3578	-19.81	74.98	-0.05129	0.21710	0.2902	0.1637	1.159	2898	450.7	1.320	0.0193	0.0657	0.00414	16.22	2.5
3	-102.18	-100.42	86.83	12.9493	-18.38	75.69	-0.04727	0.21544	0.2905	0.1656	1.159	2845	452.9	1.255	0.0195	0.0647	0.00425	15.94	3
4	-94.08	-92.40	86.01	9.8941	-16.02	76.86	-0.04076	0.21292	0.2912	0.1688	1.159	2760	456.3	1.159	0.0199	0.0634	0.00442	15.49	4
5	-87.49	-85.87	85.33	8.0300	-14.10	77.82	-0.03555	0.21106	0.2920	0.1715	1.159	2694	458.9	1.088	0.0203	0.0623	0.00456	15.11	5
6	-81.89	-80.32	84.76	6.7705	-12.46	78.64	-0.03119	0.20960	0.2929	0.1738	1.159	2639	461.0	1.033	0.0205	0.0614	0.00468	14.79	6
7	-77.00	-75.46	84.25	5.8607	-11.02	79.35	-0.02742	0.20841	0.2937	0.1758	1.160	2592	462.7	0.989	0.0208	0.0606	0.00478	14.50	7
8	-72.64	-71.14	83.80	5.1716	-9.74	79.98	-0.02409	0.20741	0.2944	0.1777	1.161	2551	464.1	0.952	0.0210	0.0599	0.00488	14.25	8
10	-65.08	-63.64	83.01	4.1954	-7.51	81.07	-0.01839	0.20581	0.2959	0.1811	1.162	2481	466.4	0.892	0.0214	0.0587	0.00505	13.79	10
12	-58.65	-57.25	82.34	3.5353	-5.60	82.00	-0.0136	0.20457	0.2974	0.1840	1.164	2422	468.1	0.845	0.0217	0.0577	0.00519	13.41	12
14	-53.01	-51.65	81.74	3.0582	-3.91	82.81	-0.00944	0.20357	0.2987	0.1866	1.166	2372	469.4	0.806	0.0220	0.0568	0.00532	13.06	14
14.7 ^b	-51.20	-49.85	81.55	2.9217	-3.37	83.07	-0.00812	0.20326	0.2991	0.1875	1.166	2355	469.8	0.795	0.0221	0.0566	0.00536	12.95	14.7
16	-47.98	-46.65	81.20	2.6968	-2.41	83.53	-0.00577	0.20273	0.3000	0.1891	1.167	2327	470.4	0.774	0.0222	0.0561	0.00544	12.75	16
18	-43.42	-42.11	80.71	2.4132	-1.03	84.18	-0.00246	0.20203	0.3012	0.1913	1.169	2286	471.2	0.747	0.0225	0.0554	0.00554	12.47	18
20	-39.24	-37.96	80.26	2.1845	0.23	84.78	0.00055	0.20141	0.3024	0.1935	1.171	2249	471.9	0.723	0.0227	0.0548	0.00564	12.20	20
22	-35.37	-34.11	79.83	1.9960	1.40	85.32	0.00332	0.20088	0.3035	0.1955	1.173	2215	472.4	0.701	0.0229	0.0542	0.00573	11.96	22
24	-31.77	-30.53	79.44	1.8379	2.50	85.83	0.00588	0.20041	0.3046	0.1974	1.175	2184	472.8	0.682	0.0230	0.0537	0.00582	11.73	24
26	-28.39	-27.17	79.06	1.7033	3.53	86.30	0.00827	0.19998	0.3056	0.1992	1.176	2154	473.1	0.665	0.0232	0.0532	0.00590	11.52	26
28	-25.21	-24.01	78.71	1.5873	4.51	86.75	0.01051	0.19960	0.3067	0.2010	1.178	2127	473.3	0.649	0.0234	0.0527	0.00598	11.31	28
30	-22.20	-21.02	78.37	1.4863	5.44	87.16	0.01263	0.19925	0.3077	0.2027	1.180	2101	473.5	0.634	0.0235	0.0523	0.00605	11.12	30
32	-19.34	-18.17	78.05	1.3974	6.32	87.56	0.01463	0.19894	0.3086	0.2043	1.182	2076	473.6	0.621	0.0237	0.0519	0.00612	10.94	32
34	-16.62	-15.46	77.74	1.3187	7.16	87.93	0.01653	0.19864	0.3096	0.2059	1.184	2052	473.6	0.608	0.0238	0.0515	0.00619	10.76	34
36	-14.01	-12.87	77.44	1.2484	7.97	88.29	0.01834	0.19838	0.3105	0.2074	1.186	2030	473.6	0.597	0.0239	0.0511	0.00625	10.59	36
38	-11.52	-10.39	77.15	1.1852	8.75	88.62	0.02007	0.19813	0.3115	0.2089	1.188	2008	473.5	0.586	0.0241	0.0507	0.00632	10.43	38
40	-9.12	-8.01	76.87	1.1281	9.50	88.95	0.02172	0.19790	0.3124	0.2104	1.190	1987	473.4	0.576	0.0242	0.0504	0.00638	10.27	40
42	-6.81	-5.71	76.60	1.0763	10.22	89.26	0.02331	0.19768	0.3133	0.2119	1.192	1967	473.3	0.566	0.0243	0.0501	0.00644	10.12	42
44	-4.59	-3.50	76.34	1.0290	10.92	89.56	0.02484	0.19748	0.3141	0.2133	1.194	1948	473.1	0.557	0.0244	0.0497	0.00649	9.97	44
46	-2.44	-1.36	76.09	0.9857	11.60	89.84	0.02632	0.19729	0.3150	0.2146	1.196	1930	472.9	0.548	0.0245	0.0494	0.00655	9.83	46
48	-0.36	0.71	75.84	0.9459	12.25	90.12	0.02774	0.19711	0.3158	0.2160	1.198	1912	472.7	0.540	0.0246	0.0492	0.00660	9.70	48
50	1.65	2.71	75.60	0.9091	12.89	90.38	0.02911	0.19694	0.3167	0.2173	1.200	1894	472.5	0.532	0.0247	0.0489	0.00665	9.56	50
55	6.43	7.47	75.03	0.8285	14.41	91.01	0.03237	0.19655	0.3188	0.2206	1.205	1853	471.8	0.514	0.0250	0.0482	0.00678	9.25	55
60	10.89	11.90	74.48	0.7609	15.84	91.58	0.03539	0.19621	0.3208	0.2237	1.210	1814	471.0	0.498	0.0252	0.0476	0.00690	8.95	60
65	15.07	16.07	73.97	0.7033	17.19	92.11	0.03822	0.19590	0.3228	0.2267	1.215	1778	470.1	0.483	0.0254	0.0470	0.00701	8.67	65
70	19.02	20.00	73.47	0.6537	18.47	92.61	0.04088	0.19562	0.3247	0.2297	1.220	1744	469.2	0.470	0.0257	0.0463	0.00712	8.41	70
75	22.76	23.72	72.99	0.6104	19.69	93.07	0.04339	0.19537	0.3267	0.2325	1.226	1712	468.1	0.457	0.0259	0.0460	0.00723	8.16	75
80	26.32	27.27	72.54	0.5724	20.86	93.50	0.04578	0.19514	0.3286	0.2354	1.231	1681	467.0	0.446	0.0261	0.0455	0.00733	7.92	80
85	29.71	30.64	72.09	0.5387	21.98	93.91	0.04804	0.19492	0.3305	0.2382	1.236	1651	465.9	0.435	0.0263	0.0450	0.00742	7.70	85
90	32.96	33.88	71.67	0.5085	23.05	94.30	0.05021	0.19471	0.3324	0.2409	1.242	1623	464.7	0.425	0.0264	0.0446	0.00753	7.48	90
95	36.07	36.98	71.25	0.4815	24.09	94.66	0.05229	0.19452	0.3342	0.2436	1.248	1596	463.5	0.416	0.0266	0.0442	0.00763	7.27	95
100	39.07	39.96	70.84	0.4570	25.10	95.00	0.05428	0.19434	0.3361	0.2464	1.254	1569	462.2	0.407	0.0268	0.0438	0.00772	7.07	100
110	44.73	45.60	70.06	0.4145	27.01	95.64	0.05804	0.19400	0.3399	0.2518	1.266	1520	459.6	0.391	0.0271	0.0430	0.00792	6.69	110
120	50.02	50.86	69.32	0.3789	28.82	96.21	0.06155	0.19368	0.3437	0.2572	1.279	1473	456.8	0.376	0.0275	0.0423	0.00810	6.34	120
130	54.99	55.81	68.60	0.3485	30.53	96.73	0.06485	0.19338	0.3475	0.2626	1.292	1429	454.0	0.363	0.0278	0.0416	0.00829	6.01	130
140	59.68	60.48	67.90	0.3222	32.16	97.20	0.06795	0.19309	0.3514	0.2682	1.306	1387	451.1	0.351	0.0281	0.0410	0.00848	5.69	140
150	64.13	64.91	67.23	0.2994	33.73	97.62	0.07090	0.19281	0.3553	0.2739	1.321	1347	448.2	0.339	0.0284	0.0404	0.00866	5.4	150
160	68.36	69.13	66.57	0.2793	35.23	98.01	0.07371	0.19253	0.3594	0.2797	1.336	1309	445.2	0.329	0.0288	0.0399	0.00885	5.12	160
170	72.40	73.15	65.93	0.2614	36.68	98.37	0.07639	0.19226	0.3635	0.2857	1.353	1273	442.1	0.319	0.0291	0.0394	0.00904	4.85	170
180	76.26	76.99	65.30	0.2454	38.08	98.69	0.07896	0.19198	0.3678	0.2919	1.370	1238	439.0	0.310	0.0294	0.0388	0.00922	4.60	180
190	79.97	80.68	64.68	0.2311	39.44	98.98	0.08143	0.19170	0.3722	0.2984	1.388	1204	435.8	0.301	0.0297	0.0384	0.00941	4.36	190
200	83.53	84.23	64.07	0.2181	40.76	99.25	0.08381	0.19143	0.3767	0.3051	1.408	1171	432.6	0.293	0.0300	0.0379	0.00961	4.13	200
220	90.27	90.94	62.87	0.1955	43.29	99.70	0.08833	0.19085	0.3864	0.3194	1.450	1108	426.1	0.277	0.0307	0.0370	0.01000	3.70	220
240	96.57	97.21	61.70	0.1764	45.70	100.05	0.09259	0.19026	0.3969	0.3353	1.498	1048	419.4	0.263	0.0313	0.0362	0.01041	3.30	240
260	102.48	103.09	60.53	0.1601	48.02	100.32	0.09663	0.18962	0.4086	0.3530	1.553	991	412.6	0.250	0.0320	0.0354	0.01084	2.93	260
280	108.06	108.64	59.37	0.1460	50.25	100.51	0.10047	0.18895	0.4216	0.3730	1.616	936	405.7	0.238	0.0328	0.0347	0.01131	2.59	280
300	113.34	113.90	58.20	0.13															

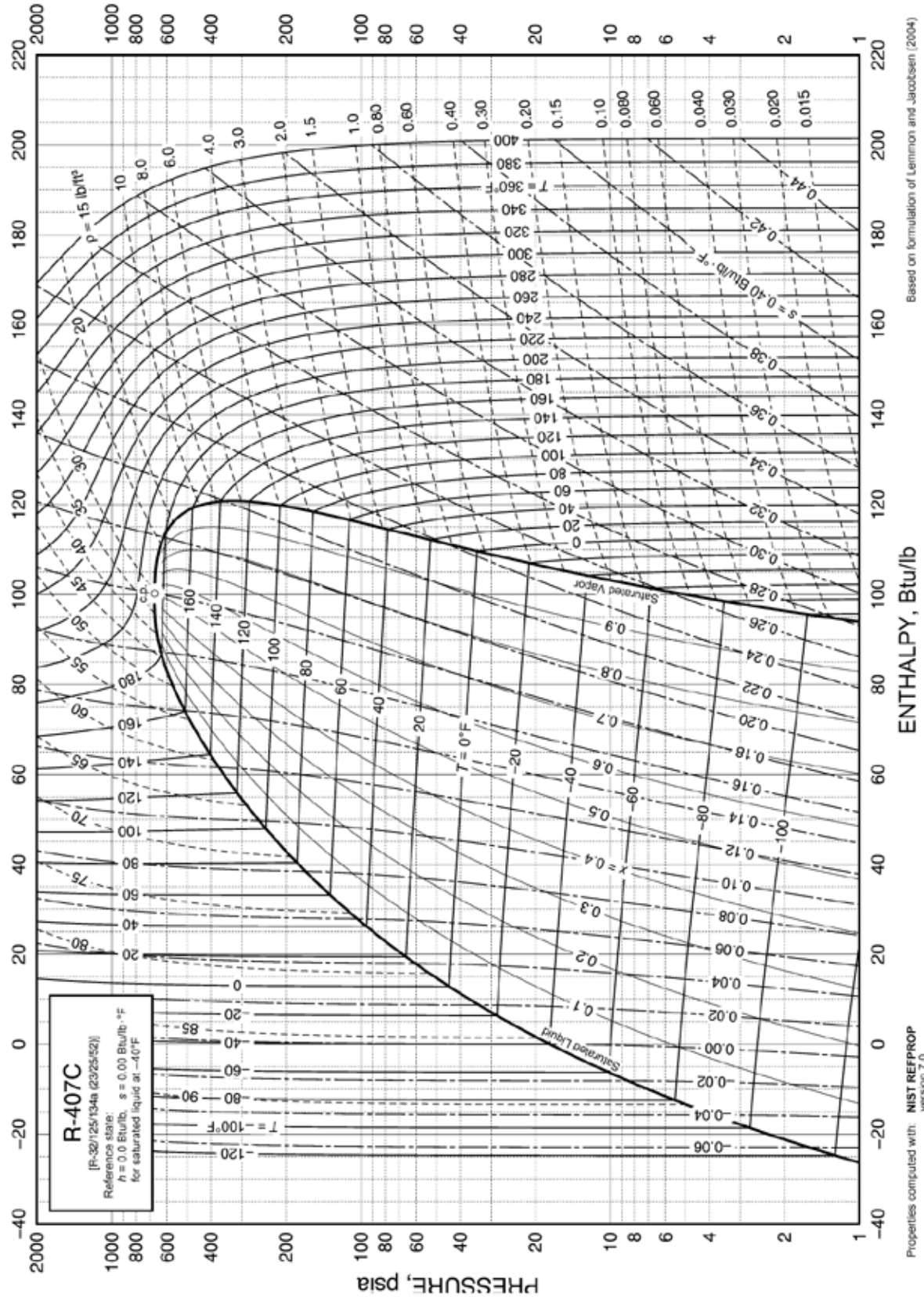


Fig. 16 Pressure-Enthalpy Diagram for Refrigerant 407C

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Thermophysical Properties of Refrigerants

Refrigerant 407C [R-32/125/134a (23/25/52)] Properties of Liquid on Bubble Line and Vapor on Dew Line

Pres- sure, psia	Temp., °F		Dens- ity, lb/ft ³	Volume, ft ³ /lb	Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat c_p , Btu/lb·°F		Vel. of Sound, ft/s		Viscosity, lb _m /ft·h		Thermal Cond., Btu/h-ft·°F		Surface Tension, sur- face, dyne/cm	Pres- sure, psia	
	Bubble	Dew			Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor			Liquid
1	-125.19	-111.30	94.24	43.0887	-26.34	93.96	-0.07002	0.28254	0.3065	0.1568	1.183	3404	484.3	2.112	0.0199	0.0894	0.00385	25.65	1
1.5	-115.58	-101.85	93.28	29.4430	-23.40	95.34	-0.06135	0.27716	0.3063	0.1600	1.182	3300	489.5	1.867	0.0204	0.0874	0.00403	24.66	1.5
2	-108.36	-94.75	92.55	22.4776	-21.18	96.37	-0.05499	0.27346	0.3063	0.1624	1.181	3225	493.3	1.712	0.0208	0.0860	0.00416	23.93	2
2.5	-102.52	-88.99	91.97	18.2333	-19.39	97.21	-0.04994	0.27066	0.3065	0.1644	1.181	3166	496.2	1.601	0.0212	0.0848	0.00427	23.34	2.5
3	-97.57	-84.12	91.47	15.3685	-17.87	97.92	-0.04572	0.26841	0.3068	0.1662	1.181	3117	498.6	1.515	0.0214	0.0839	0.00436	22.84	3
4	-89.43	-76.11	90.64	11.7361	-15.37	99.09	-0.03889	0.26495	0.3074	0.1693	1.181	3037	502.4	1.389	0.0219	0.0823	0.00452	22.02	4
5	-82.81	-69.61	89.97	9.5211	-13.34	100.03	-0.03345	0.26234	0.3081	0.1719	1.182	2974	505.3	1.299	0.0222	0.0810	0.00465	21.36	5
6	-77.20	-64.09	89.40	8.0252	-11.60	100.83	-0.02889	0.26025	0.3087	0.1742	1.182	2921	507.6	1.229	0.0225	0.0799	0.00476	20.81	6
7	-72.30	-59.27	88.89	6.9450	-10.09	101.52	-0.02496	0.25852	0.3094	0.1762	1.183	2875	509.5	1.172	0.0228	0.0789	0.00485	20.32	7
8	-67.94	-54.97	88.44	6.1272	-8.74	102.13	-0.02149	0.25705	0.3100	0.1781	1.184	2835	511.1	1.125	0.0230	0.0781	0.00494	19.90	8
10	-60.38	-47.55	87.66	4.9690	-6.39	103.19	-0.01556	0.25464	0.3112	0.1814	1.186	2765	513.8	1.050	0.0234	0.0766	0.00509	19.16	10
12	-53.96	-41.23	86.98	4.1864	-4.38	104.08	-0.01059	0.25272	0.3123	0.1844	1.188	2707	515.8	0.992	0.0238	0.0754	0.00522	18.54	12
14	-48.34	-35.71	86.39	3.6210	-2.62	104.85	-0.00629	0.25114	0.3133	0.1871	1.189	2656	517.4	0.945	0.0241	0.0743	0.00534	18.00	14
14.7 ^a	-46.53	-33.93	86.19	3.4593	-2.06	105.10	-0.00492	0.25065	0.3137	0.1880	1.190	2639	517.9	0.930	0.0241	0.0739	0.00537	17.82	14.7
16	-43.32	-30.78	85.85	3.1928	-1.05	105.54	-0.00249	0.24979	0.3143	0.1896	1.191	2610	518.7	0.906	0.0243	0.0733	0.00544	17.52	16
18	-38.77	-26.31	85.36	2.8570	0.39	106.15	0.00092	0.24863	0.3153	0.1919	1.193	2570	519.8	0.872	0.0246	0.0725	0.00553	17.08	18
20	-34.61	-22.23	84.91	2.5862	1.70	106.71	0.00402	0.24760	0.3162	0.1941	1.195	2532	520.7	0.843	0.0248	0.0717	0.00562	16.69	20
22	-30.76	-18.45	84.50	2.3632	2.92	107.22	0.00687	0.24668	0.3172	0.1961	1.197	2498	521.4	0.817	0.0250	0.0710	0.00570	16.33	22
24	-27.18	-14.93	84.10	2.1761	4.06	107.70	0.00950	0.24586	0.3180	0.1981	1.199	2466	522.0	0.794	0.0252	0.0703	0.00578	15.99	24
26	-23.83	-11.64	83.73	2.0169	5.13	108.14	0.01196	0.24510	0.3189	0.1999	1.201	2436	522.6	0.773	0.0253	0.0697	0.00585	15.68	26
28	-20.66	-8.54	83.38	1.8798	6.15	108.55	0.01426	0.24442	0.3197	0.2017	1.203	2408	523.0	0.754	0.0255	0.0691	0.00592	15.38	28
30	-17.67	-5.60	83.05	1.7603	7.10	108.93	0.01643	0.24378	0.3205	0.2034	1.205	2382	523.4	0.737	0.0257	0.0685	0.00598	15.11	30
32	-14.84	-2.82	82.73	1.6553	8.02	109.30	0.01848	0.24319	0.3213	0.2051	1.207	2356	523.6	0.721	0.0258	0.0680	0.00605	14.84	32
34	-12.13	-0.17	82.43	1.5622	8.89	109.64	0.02042	0.24265	0.3221	0.2067	1.209	2332	523.9	0.706	0.0260	0.0675	0.00610	14.59	34
36	-9.55	2.37	82.14	1.4791	9.72	109.97	0.02227	0.24213	0.3229	0.2083	1.211	2309	524.1	0.692	0.0261	0.0670	0.00616	14.36	36
38	-7.07	4.79	81.85	1.4045	10.53	110.28	0.02404	0.24165	0.3236	0.2098	1.213	2288	524.2	0.679	0.0262	0.0666	0.00622	14.13	38
40	-4.70	7.12	81.58	1.3371	11.30	110.58	0.02573	0.24120	0.3244	0.2113	1.215	2267	524.3	0.667	0.0263	0.0661	0.00627	13.91	40
42	-2.41	9.37	81.32	1.2759	12.04	110.86	0.02735	0.24077	0.3251	0.2127	1.217	2246	524.3	0.656	0.0265	0.0657	0.00632	13.71	42
44	-0.20	11.53	81.06	1.2201	12.76	111.13	0.02891	0.24036	0.3258	0.2141	1.219	2227	524.4	0.645	0.0266	0.0653	0.00637	13.51	44
46	1.93	13.61	80.82	1.1690	13.46	111.39	0.03041	0.23998	0.3265	0.2155	1.221	2208	524.4	0.635	0.0267	0.0649	0.00642	13.31	46
48	3.98	15.63	80.58	1.1220	14.13	111.64	0.03186	0.23961	0.3272	0.2169	1.223	2190	524.3	0.626	0.0268	0.0646	0.00646	13.13	48
50	5.98	17.58	80.34	1.0786	14.79	111.88	0.03326	0.23926	0.3279	0.2182	1.225	2172	524.3	0.617	0.0269	0.0642	0.00651	12.95	50
55	10.71	22.21	79.78	0.9835	16.34	112.44	0.03656	0.23844	0.3296	0.2214	1.230	2130	524.0	0.596	0.0272	0.0633	0.00663	12.53	55
60	15.13	26.53	79.25	0.9037	17.81	112.96	0.03963	0.23771	0.3313	0.2246	1.235	2091	523.6	0.577	0.0274	0.0626	0.00673	12.13	60
65	19.27	30.58	78.75	0.8359	19.19	113.44	0.04250	0.23703	0.3329	0.2276	1.240	2054	523.2	0.560	0.0276	0.0618	0.00684	11.77	65
70	23.18	34.40	78.27	0.7774	20.49	113.88	0.04519	0.23641	0.3346	0.2305	1.245	2019	522.6	0.544	0.0278	0.0611	0.00694	11.43	70
75	26.88	38.02	77.82	0.7264	21.74	114.29	0.04773	0.23584	0.3362	0.2333	1.250	1986	522.0	0.530	0.0280	0.0605	0.00703	11.10	75
80	30.39	41.46	77.38	0.6816	22.92	114.67	0.05014	0.23530	0.3378	0.2361	1.255	1955	521.3	0.517	0.0282	0.0600	0.00712	10.80	80
85	33.75	44.73	76.95	0.6419	24.06	115.03	0.05243	0.23480	0.3393	0.2389	1.260	1925	520.6	0.505	0.0284	0.0593	0.00721	10.51	85
90	36.96	47.87	76.54	0.6064	25.16	115.37	0.05462	0.23432	0.3409	0.2416	1.266	1896	519.8	0.493	0.0286	0.0587	0.00730	10.23	90
95	40.04	50.87	76.15	0.5746	26.21	115.68	0.05671	0.23387	0.3424	0.2442	1.271	1869	519.0	0.483	0.0288	0.0582	0.00739	9.97	95
100	43.00	53.75	75.76	0.5458	27.23	115.98	0.05871	0.23344	0.3440	0.2468	1.276	1842	518.1	0.473	0.0289	0.0576	0.00747	9.72	100
110	48.60	59.21	75.02	0.4959	29.16	116.53	0.06250	0.23265	0.3471	0.2520	1.287	1792	516.3	0.454	0.0293	0.0567	0.00763	9.25	110
120	53.83	64.30	74.32	0.4540	30.99	117.03	0.06602	0.23191	0.3502	0.2570	1.298	1745	514.3	0.438	0.0296	0.0558	0.00780	8.81	120
130	58.75	69.08	73.64	0.4183	32.72	117.47	0.06932	0.23122	0.3533	0.2621	1.310	1700	512.3	0.423	0.0299	0.0549	0.00796	8.41	130
140	63.39	73.59	72.99	0.3875	34.36	117.88	0.07244	0.23058	0.3564	0.2671	1.321	1658	510.2	0.409	0.0302	0.0541	0.00812	8.03	140
150	67.79	77.86	72.37	0.3607	35.94	118.24	0.07538	0.22997	0.3596	0.2721	1.334	1618	508.0	0.396	0.0304	0.0534	0.00828	7.67	150
160	71.98	81.92	71.76	0.3372	37.45	118.57	0.07818	0.22938	0.3628	0.2772	1.346	1580	505.7	0.385	0.0307	0.0527	0.00844	7.33	160
170	75.97	85.79	71.17	0.3163	38.90	118.87	0.08086	0.22882	0.3660	0.2824	1.359	1543	503.4	0.374	0.0310	0.0520	0.00860	7.01	170
180	79.80	89.49	70.59	0.2976	40.30	119.15	0.08341	0.22828	0.3693	0.2876	1.373	1508	501.1	0.364	0.0312	0.0514	0.00876	6.71	180
190	83.47	93.04	70.02	0.2808	41.66	119.39	0.08587	0.22776	0.3727	0.2929	1.387	1474	498.7	0.354	0.0315	0.0507	0.00893	6.42	190
200	87.00	96.45	69.47	0.2656	42.97	119.61	0.08823	0.22725	0.3761	0.2983	1.401	1441	496.3	0.345	0.0317	0.0501	0.00909	6.15	200
220	93.69	102.90	68.40	0.2393	45.49	119.99	0.09271	0.22625	0.3832	0.3095	1.432	1379	491.4	0.328	0.0323	0.0490	0.00942	5.64	220
240	99.94	108.92	67.35	0.2171	47.88	120.29	0.09691	0.22529	0.3907	0.3213	1.466	1320	486.3	0.313	0.0328	0.0480	0.00976	5.17	240
260	105.82	114.56	66.33	0.1982	50.17	120.52	0.10088	0.22434	0.3986	0.3338	1.502	1265	481.2	0.299	0.0333	0.0470	0.01011	4.73	260
280	111.37	119.88	65.33	0.1819	52.36	120.68	0.10464	0.22340	0.4070	0.3473	1.542	1211	475.9	0.287	0.0339	0.0461	0.01048	4.33	280

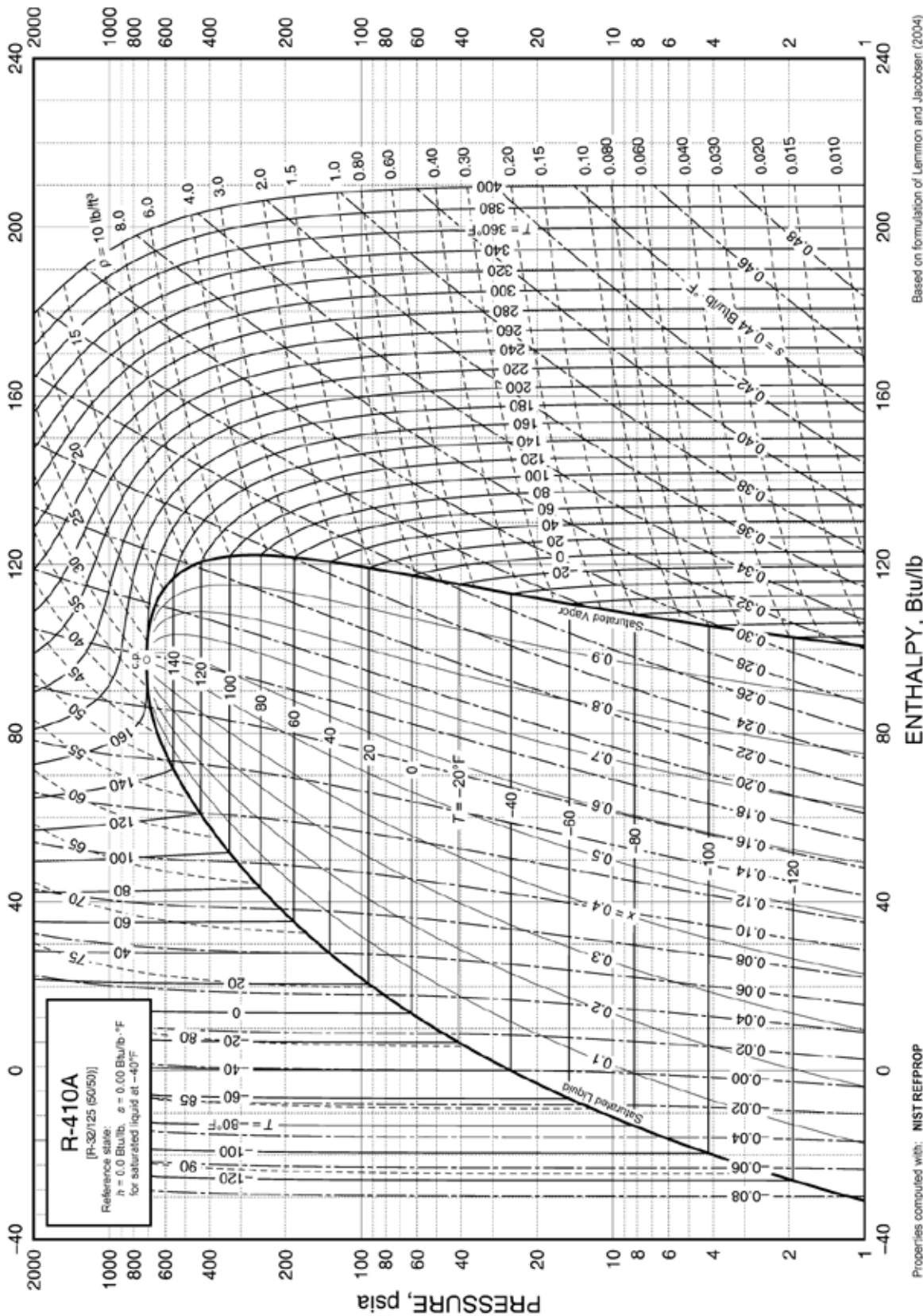


Fig. 17 Pressure-Enthalpy Diagram for Refrigerant 410A

Refrigerant 410A [R-32/125 (50/50)] Properties of Liquid on Bubble Line and Vapor on Dew Line

Pres- sure, psia	Temp., °F		Density, Volume, lb/ft ³ ft ³ /lb		Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat c_p , Btu/lb·°F			Vel. of Sound, ft/s		Viscosity, lb _m /ft·h		Thermal Cond., Btu/h·ft·°F		Surface Tension, dyne/cm	Pres- sure, psia
	Bubble	Dew	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor			
									c_p/c_v										
1	-135.16	-134.98	92.02	47.6458	-30.90	100.62	-0.08330	0.32188	0.3215	0.1568	1.228	3369	518.6	1.795	0.0196	0.1043	0.00421	25.62	1
1.5	-126.03	-125.87	91.10	32.5774	-27.97	101.90	-0.07439	0.31477	0.3212	0.1600	1.227	3287	524.5	1.605	0.0201	0.1023	0.00431	24.64	1.5
2	-119.18	-119.02	90.41	24.8810	-25.76	102.86	-0.06786	0.30981	0.3213	0.1626	1.227	3226	528.7	1.483	0.0205	0.1008	0.00439	23.91	2
2.5	-113.63	-113.48	89.84	20.1891	-23.98	103.63	-0.06267	0.30602	0.3214	0.1648	1.228	3176	531.9	1.394	0.0208	0.0996	0.00446	23.32	2.5
3	-108.94	-108.78	89.36	17.0211	-22.47	104.27	-0.05834	0.30296	0.3216	0.1668	1.228	3135	534.6	1.325	0.0211	0.0985	0.00451	22.82	3
4	-101.22	-101.07	88.57	13.0027	-19.98	105.33	-0.05133	0.29820	0.3221	0.1703	1.229	3066	538.8	1.222	0.0216	0.0968	0.00461	22.01	4
5	-94.94	-94.80	87.92	10.5514	-17.96	106.18	-0.04574	0.29455	0.3226	0.1733	1.230	3010	542.0	1.148	0.0219	0.0954	0.00469	21.35	5
6	-89.63	-89.48	87.36	8.8953	-16.24	106.89	-0.04107	0.29162	0.3231	0.1760	1.232	2963	544.6	1.090	0.0223	0.0942	0.00476	20.80	6
7	-84.98	-84.84	86.87	7.6992	-14.74	107.50	-0.03704	0.28916	0.3236	0.1785	1.233	2922	546.7	1.043	0.0225	0.0931	0.00482	20.32	7
8	-80.85	-80.71	86.44	6.7935	-13.40	108.05	-0.03349	0.28705	0.3241	0.1807	1.234	2885	548.5	1.003	0.0228	0.0922	0.00488	19.90	8
10	-73.70	-73.56	85.67	5.5105	-11.08	108.97	-0.02743	0.28356	0.3251	0.1848	1.237	2821	551.5	0.940	0.0232	0.0905	0.00498	19.16	10
12	-67.62	-67.48	85.02	4.6434	-9.10	109.75	-0.02235	0.28075	0.3261	0.1884	1.240	2767	553.8	0.891	0.0235	0.0891	0.00507	18.55	12
14	-62.31	-62.16	84.44	4.0168	-7.36	110.42	-0.01795	0.27840	0.3270	0.1917	1.243	2720	555.6	0.850	0.0238	0.0879	0.00515	18.01	14
14.70 ^b	-60.60	-60.46	84.26	3.8375	-6.80	110.63	-0.01655	0.27766	0.3274	0.1928	1.244	2704	556.2	0.838	0.0239	0.0875	0.00517	17.84	14.7
16	-57.56	-57.42	83.93	3.5423	-5.80	111.01	-0.01407	0.27638	0.3279	0.1947	1.245	2677	557.1	0.817	0.0241	0.0868	0.00522	17.53	16
18	-53.27	-53.13	83.45	3.1699	-4.39	111.54	-0.01059	0.27461	0.3288	0.1975	1.248	2639	558.4	0.788	0.0244	0.0858	0.00528	17.10	18
20	-49.34	-49.19	83.02	2.8698	-3.09	112.01	-0.00743	0.27305	0.3297	0.2002	1.251	2603	559.4	0.763	0.0246	0.0849	0.00535	16.71	20
22	-45.70	-45.56	82.61	2.6225	-1.89	112.45	-0.00452	0.27164	0.3305	0.2027	1.254	2571	560.3	0.740	0.0248	0.0841	0.00540	16.35	22
24	-42.32	-42.18	82.23	2.4151	-0.77	112.85	-0.00184	0.27036	0.3313	0.2050	1.256	2540	561.1	0.720	0.0250	0.0833	0.00546	16.02	24
26	-39.15	-39.01	81.87	2.2386	0.28	113.22	0.00067	0.26919	0.3321	0.2073	1.259	2512	561.7	0.702	0.0252	0.0826	0.00551	15.71	26
28	-36.17	-36.02	81.54	2.0865	1.27	113.56	0.00301	0.26811	0.3329	0.2094	1.261	2485	562.3	0.686	0.0254	0.0819	0.00556	15.42	28
30	-33.35	-33.20	81.21	1.9540	2.22	113.88	0.00522	0.26711	0.3337	0.2115	1.264	2459	562.7	0.671	0.0255	0.0813	0.00561	15.14	30
32	-30.68	-30.53	80.90	1.8375	3.11	114.19	0.00730	0.26617	0.3345	0.2135	1.267	2435	563.1	0.657	0.0257	0.0806	0.00565	14.88	32
34	-28.13	-27.98	80.61	1.7343	3.97	114.47	0.00928	0.26530	0.3352	0.2154	1.269	2412	563.4	0.644	0.0258	0.0801	0.00570	14.63	34
36	-25.69	-25.54	80.33	1.6422	4.79	114.74	0.01116	0.26448	0.3360	0.2173	1.272	2390	563.7	0.632	0.0260	0.0795	0.00574	14.40	36
38	-23.36	-23.20	80.05	1.5594	5.57	115.00	0.01296	0.26371	0.3367	0.2191	1.274	2368	563.9	0.621	0.0261	0.0790	0.00578	14.17	38
40	-21.12	-20.96	79.79	1.4847	6.33	115.24	0.01467	0.26297	0.3374	0.2208	1.277	2348	564.1	0.610	0.0262	0.0785	0.00582	13.96	40
42	-18.96	-18.81	79.54	1.4168	7.06	115.47	0.01632	0.26228	0.3382	0.2226	1.279	2328	564.3	0.600	0.0264	0.0780	0.00586	13.75	42
44	-16.89	-16.73	79.29	1.3549	7.76	115.69	0.01791	0.26162	0.3389	0.2242	1.282	2309	564.4	0.591	0.0265	0.0775	0.00589	13.55	44
46	-14.88	-14.73	79.05	1.2982	8.45	115.90	0.01943	0.26098	0.3396	0.2259	1.284	2291	564.4	0.582	0.0266	0.0771	0.00593	13.36	46
48	-12.94	-12.79	78.82	1.2460	9.11	116.10	0.02090	0.26038	0.3403	0.2275	1.287	2273	564.5	0.574	0.0267	0.0766	0.00597	13.18	48
50	-11.07	-10.91	78.59	1.1979	9.75	116.30	0.02232	0.25980	0.3410	0.2290	1.289	2256	564.5	0.566	0.0268	0.0762	0.00600	13.00	50
55	-6.62	-6.45	78.05	1.0925	11.27	116.75	0.02568	0.25845	0.3427	0.2328	1.295	2215	564.4	0.547	0.0271	0.0752	0.00610	12.58	55
60	-2.46	-2.30	77.54	1.0040	12.70	117.16	0.02880	0.25722	0.3445	0.2365	1.301	2176	564.2	0.530	0.0273	0.0743	0.00619	12.20	60
65	1.43	1.30	77.06	0.9287	14.05	117.53	0.03171	0.25610	0.3462	0.2400	1.308	2140	563.9	0.515	0.0275	0.0734	0.00628	11.83	65
70	5.10	5.27	76.60	0.8638	15.33	117.88	0.03444	0.25505	0.3478	0.2434	1.314	2105	563.5	0.502	0.0278	0.0726	0.00636	11.49	70
75	8.58	8.75	76.15	0.8073	16.54	118.20	0.03702	0.25408	0.3495	0.2467	1.320	2073	563.0	0.489	0.0280	0.0719	0.00645	11.17	75
80	11.88	12.06	75.73	0.7576	17.70	118.49	0.03946	0.25316	0.3512	0.2499	1.326	2042	562.4	0.477	0.0282	0.0711	0.00653	10.87	80
85	15.03	15.21	75.32	0.7135	18.81	118.77	0.04178	0.25231	0.3528	0.2531	1.333	2012	561.8	0.467	0.0284	0.0704	0.00661	10.59	85
90	18.05	18.22	74.93	0.6742	19.88	119.02	0.04400	0.25149	0.3545	0.2562	1.339	1983	561.2	0.457	0.0285	0.0698	0.00669	10.31	90
95	20.93	21.11	74.54	0.6389	20.91	119.26	0.04611	0.25072	0.3561	0.2592	1.345	1956	560.4	0.447	0.0287	0.0692	0.00677	10.05	95
100	23.71	23.89	74.17	0.6070	21.90	119.48	0.04815	0.24999	0.3578	0.2622	1.352	1929	559.7	0.438	0.0289	0.0685	0.00684	9.80	100
110	28.96	29.14	73.46	0.5515	23.79	119.89	0.05198	0.24862	0.3611	0.2681	1.365	1879	558.1	0.422	0.0292	0.0674	0.00700	9.34	110
120	33.86	34.05	72.78	0.5051	25.57	120.24	0.05555	0.24736	0.3644	0.2738	1.378	1832	556.3	0.407	0.0295	0.0664	0.00715	8.91	120
130	38.46	38.65	72.13	0.4655	27.25	120.56	0.05890	0.24618	0.3678	0.2795	1.392	1787	554.5	0.394	0.0298	0.0654	0.00730	8.50	130
140	42.80	42.99	71.51	0.4314	28.85	120.83	0.06205	0.24508	0.3712	0.2852	1.406	1744	552.6	0.381	0.0301	0.0645	0.00745	8.13	140
150	46.91	47.11	70.90	0.4016	30.38	121.08	0.06503	0.24403	0.3746	0.2908	1.420	1704	550.6	0.370	0.0304	0.0636	0.00760	7.78	150
160	50.82	51.02	70.32	0.3755	31.85	121.29	0.06787	0.24304	0.3781	0.2965	1.435	1666	548.6	0.360	0.0306	0.0628	0.00775	7.44	160
170	54.56	54.76	69.75	0.3523	33.27	121.48	0.07057	0.24210	0.3816	0.3022	1.451	1629	546.5	0.350	0.0309	0.0620	0.00791	7.13	170
180	58.13	58.33	69.20	0.3316	34.63	121.65	0.07316	0.24119	0.3851	0.3080	1.467	1593	544.4	0.341	0.0311	0.0612	0.00807	6.83	180
190	61.55	61.76	68.66	0.3130	35.95	121.79	0.07565	0.24031	0.3888	0.3139	1.483	1559	542.2	0.332	0.0314	0.0605	0.00823	6.55	190
200	64.84	65.05	68.13	0.2962	37.22	121.91	0.07804	0.23946	0.3925	0.3200	1.500	1526	540.0	0.324	0.0317	0.0598	0.00839	6.28	200
220	71.07	71.28	67.10	0.2669	39.67	122.09	0.08258	0.23783	0.4001	0.3325	1.537	1462	535.6	0.309	0.0321	0.0585	0.00873	5.77	220
240	76.89	77.10	66.11	0.2424	41.99	122.20	0.08683	0.23628	0.4081	0.3457	1.576	1403	531.0	0.296	0.0326	0.0573	0.00908	5.31	240
260	82.35	82.57	65.14	0.2215	44.21	122.25	0.09084	0.23478	0.4165	0.3599	1.619	1346	526.3	0.283	0.0330	0.0562	0.00945	4.88	260
280	87.51	87.73	64.19	0.2034	46.34	122.24	0.09464	0.23333	0.4255	0.3751	1.665	1293	521.5	0.2					

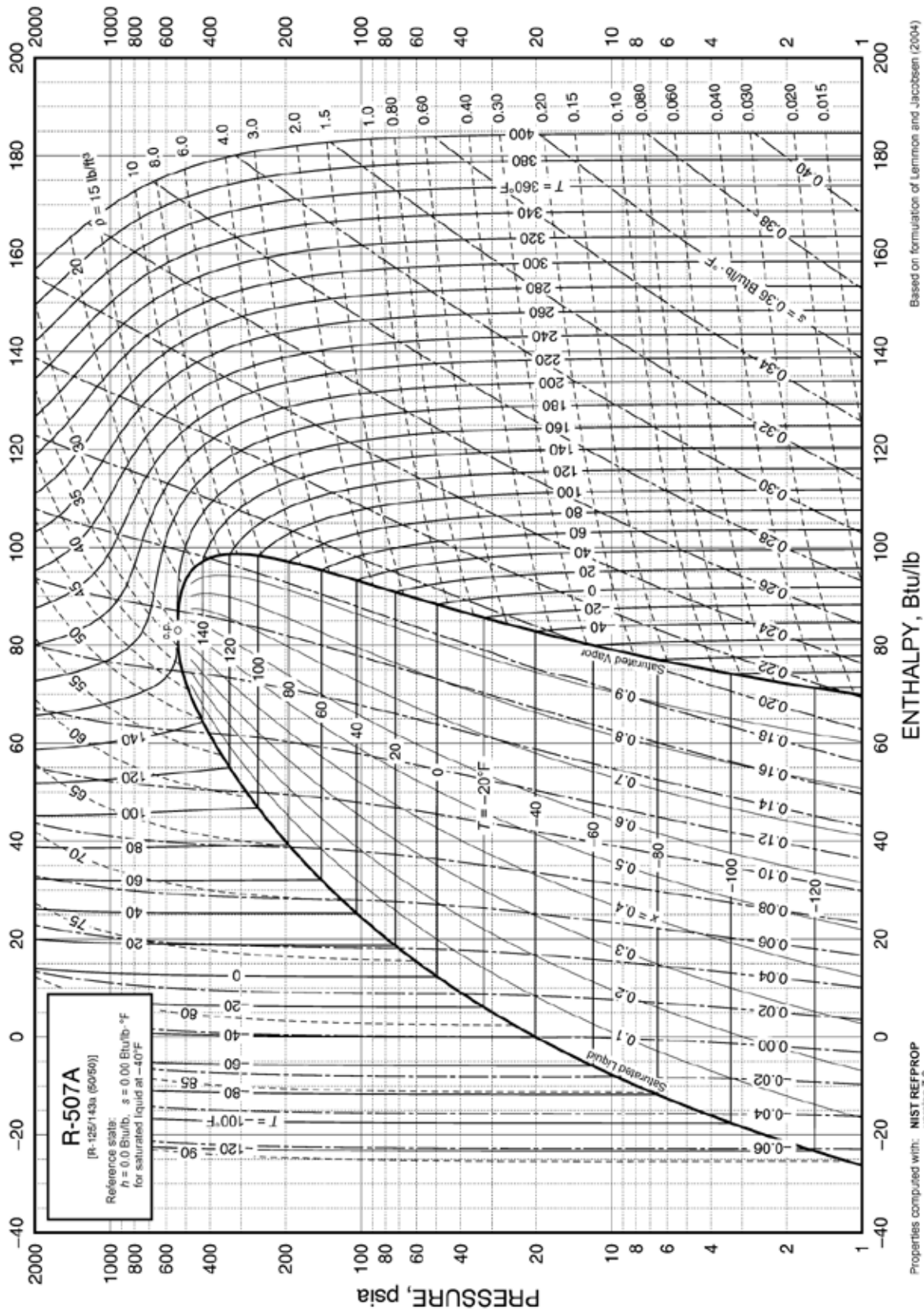


Fig. 18 Pressure-Enthalpy Diagram for Refrigerant 507A

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Thermophysical Properties of Refrigerants

Refrigerant 507A [R-125/143a (50/50)] Properties of Saturated Liquid and Saturated Vapor

Temp., ^a °F	Pres- sure, ^{**} psia	Density, Volume, lb/ft ³		Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat c _p , Btu/lb·°F		c _p /c _v	Vel. of Sound, ft/s		Viscosity, lb _m /ft·h		Thermal Cond., Btu/h·ft·°F		Surface Tension, Temp., ^a dyne/cm °F	
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor
-150	0.386	92.41	86.952	-32.027	67.009	-0.08831	0.23154	0.2919	0.1470	1.1650	3468	424.1	—	—	0.0724	0.00330	18.45	-150
-145	0.497	91.88	86.522	-30.571	67.711	-0.08365	0.22872	0.2904	0.1487	1.1637	3379	427.0	2.053	—	0.0715	0.00339	18.20	-145
-140	0.634	91.36	86.101	-29.121	68.416	-0.07908	0.22607	0.2893	0.1504	1.1626	3298	429.8	1.922	0.0176	0.0705	0.00349	17.94	-140
-135	0.801	90.84	85.729	-27.677	69.126	-0.07460	0.22358	0.2885	0.1522	1.1616	3222	432.5	1.804	0.0179	0.0696	0.00358	17.67	-135
-130	1.004	90.32	85.377	-26.235	69.838	-0.07019	0.22125	0.2879	0.1540	1.1607	3151	435.2	1.697	0.0181	0.0687	0.00368	17.41	-130
-125	1.249	89.80	85.044	-24.796	70.554	-0.06586	0.21906	0.2876	0.1558	1.1599	3084	437.8	1.600	0.0184	0.0678	0.00378	17.14	-125
-120	1.541	89.29	84.729	-23.359	71.272	-0.06160	0.21701	0.2874	0.1576	1.1593	3021	440.3	1.512	0.0186	0.0670	0.00388	16.87	-120
-115	1.887	88.77	84.429	-21.921	71.993	-0.05740	0.21509	0.2874	0.1595	1.1588	2961	442.7	1.431	0.0189	0.0661	0.00398	16.59	-115
-110	2.295	88.26	84.131	-20.484	72.716	-0.05326	0.21328	0.2875	0.1614	1.1584	2904	445.1	1.356	0.0192	0.0652	0.00408	16.31	-110
-105	2.773	87.75	83.839	-19.045	73.440	-0.04918	0.21159	0.2878	0.1633	1.1581	2848	447.4	1.288	0.0194	0.0644	0.00418	16.03	-105
-100	3.329	87.23	83.551	-17.604	74.166	-0.04515	0.21001	0.2882	0.1652	1.1580	2795	449.6	1.225	0.0197	0.0636	0.00429	15.75	-100
-95	3.974	86.72	83.264	-16.161	74.892	-0.04117	0.20852	0.2887	0.1672	1.1581	2743	451.7	1.166	0.0199	0.0627	0.00439	15.46	-95
-90	4.715	86.20	82.981	-14.716	75.619	-0.03723	0.20713	0.2893	0.1692	1.1583	2692	453.7	1.112	0.0202	0.0619	0.00450	15.17	-90
-85	5.566	85.68	82.702	-13.266	76.346	-0.03335	0.20583	0.2900	0.1712	1.1586	2643	455.6	1.061	0.0205	0.0611	0.00461	14.88	-85
-80	6.535	85.16	82.426	-11.813	77.073	-0.02950	0.20462	0.2908	0.1733	1.1592	2595	457.4	1.014	0.0207	0.0603	0.00471	14.58	-80
-75	7.636	84.64	82.154	-10.356	77.800	-0.02569	0.20348	0.2917	0.1754	1.1599	2547	459.0	0.969	0.0210	0.0595	0.00482	14.28	-75
-70	8.879	84.11	81.886	-8.894	78.525	-0.02192	0.20242	0.2926	0.1776	1.1607	2501	460.6	0.928	0.0212	0.0587	0.00493	13.98	-70
-65	10.280	83.58	81.621	-7.427	79.248	-0.01819	0.20143	0.2937	0.1798	1.1618	2454	462.1	0.889	0.0215	0.0579	0.00504	13.68	-65
-60	11.849	83.05	81.359	-5.954	79.970	-0.01449	0.20050	0.2948	0.1821	1.1631	2409	463.4	0.852	0.0217	0.0572	0.00516	13.37	-60
-55	13.603	82.51	81.101	-4.475	80.690	-0.01082	0.19963	0.2960	0.1844	1.1646	2364	464.6	0.818	0.0220	0.0564	0.00527	13.06	-55
-52.13 ^b	14.696	82.20	81.000	-3.625	81.101	-0.00873	0.19916	0.2967	0.1858	1.1655	2338	465.2	0.799	0.0221	0.0560	0.00534	12.88	-52.13
-50	15.554	81.97	81.000	-2.990	81.406	-0.00719	0.19882	0.2972	0.1868	1.1663	2319	465.6	0.785	0.0222	0.0557	0.00538	12.75	-50
-45	17.719	81.43	81.000	-1.499	82.119	-0.00358	0.19807	0.2985	0.1893	1.1682	2275	466.6	0.754	0.0225	0.0549	0.00550	12.43	-45
-40	20.112	80.88	81.000	0.000	82.829	0.00000	0.19737	0.30000	0.1918	1.1704	2231	467.4	0.725	0.0227	0.0542	0.00562	12.12	-40
-35	22.750	80.33	81.000	1.506	83.534	0.00355	0.19671	0.3014	0.1944	1.1728	2187	468.0	0.697	0.0230	0.0534	0.00574	11.80	-35
-30	25.649	79.77	81.000	3.020	84.235	0.00708	0.19610	0.3030	0.1971	1.1755	2143	468.5	0.671	0.0232	0.0527	0.00585	11.48	-30
-25	28.827	79.20	81.000	4.541	84.931	0.01058	0.19553	0.3046	0.1998	1.1785	2100	468.8	0.646	0.0235	0.0520	0.00598	11.15	-25
-20	32.300	78.63	81.000	6.071	85.621	0.01407	0.19500	0.3063	0.2026	1.1818	2056	469.0	0.622	0.0238	0.0512	0.00610	10.83	-20
-15	36.086	78.05	81.000	7.610	86.304	0.01753	0.19450	0.3081	0.2056	1.1854	2013	469.0	0.599	0.0240	0.0505	0.00622	10.50	-15
-10	40.203	77.46	81.000	9.158	86.981	0.02097	0.19404	0.3100	0.2086	1.1894	1970	468.9	0.578	0.0243	0.0498	0.00635	10.17	-10
-5	44.671	76.87	81.000	10.716	87.651	0.02439	0.19360	0.3119	0.2117	1.1938	1926	468.5	0.557	0.0245	0.0491	0.00647	9.84	-5
0	49.508	76.27	81.000	12.284	88.313	0.02779	0.19319	0.3140	0.2149	1.1986	1883	468.0	0.537	0.0248	0.0484	0.00660	9.51	0
5	54.733	75.66	81.000	13.862	88.966	0.03118	0.19281	0.3161	0.2183	1.2038	1840	467.3	0.518	0.0250	0.0477	0.00673	9.18	5
10	60.367	75.04	81.000	15.452	89.610	0.03455	0.19245	0.3184	0.2218	1.2095	1797	466.4	0.499	0.0253	0.0470	0.00687	8.85	10
15	66.429	74.41	81.000	17.052	90.245	0.03791	0.19211	0.3208	0.2254	1.2157	1753	465.3	0.482	0.0256	0.0463	0.00700	8.51	15
20	72.941	73.77	81.000	18.665	90.868	0.04126	0.19179	0.3233	0.2291	1.2226	1710	464.0	0.464	0.0258	0.0457	0.00714	8.18	20
25	79.923	73.12	81.000	20.290	91.480	0.04459	0.19148	0.3260	0.2330	1.2301	1666	462.5	0.448	0.0261	0.0450	0.00728	7.84	25
30	87.396	72.45	81.000	21.929	92.079	0.04791	0.19118	0.3288	0.2371	1.2384	1623	460.8	0.432	0.0264	0.0443	0.00743	7.51	30
35	95.384	71.78	81.000	23.581	92.664	0.05123	0.19089	0.3318	0.2414	1.2476	1579	458.8	0.417	0.0267	0.0436	0.00759	7.17	35
40	103.91	71.09	81.000	25.249	93.234	0.05454	0.19061	0.3350	0.2460	1.2577	1535	456.6	0.402	0.0270	0.0430	0.00775	6.84	40
45	112.99	70.38	81.000	26.931	93.788	0.05784	0.19032	0.3384	0.2508	1.2690	1491	454.2	0.388	0.0273	0.0423	0.00792	6.50	45
50	122.65	69.66	81.000	28.630	94.324	0.06114	0.19004	0.3421	0.2560	1.2816	1447	451.6	0.374	0.0276	0.0416	0.00810	6.17	50
55	132.92	68.92	81.000	30.346	94.840	0.06444	0.18976	0.3460	0.2616	1.2956	1403	448.7	0.360	0.0280	0.0410	0.00829	5.83	55
60	143.82	68.16	81.000	32.080	95.336	0.06773	0.18946	0.3503	0.2676	1.3113	1358	445.5	0.347	0.0283	0.0403	0.00849	5.50	60
65	155.38	67.39	81.000	33.834	95.808	0.07103	0.18916	0.3549	0.2742	1.3289	1313	442.0	0.334	0.0287	0.0397	0.00871	5.17	65
70	167.62	66.58	81.000	35.609	96.255	0.07434	0.18884	0.3599	0.2814	1.3488	1268	438.3	0.322	0.0291	0.0390	0.00893	4.84	70
75	180.56	65.76	81.000	37.406	96.675	0.07764	0.18850	0.3654	0.2894	1.3713	1222	434.3	0.310	0.0295	0.0384	0.00918	4.52	75
80	194.24	64.90	81.000	39.228	97.065	0.08096	0.18814	0.3715	0.2983	1.3970	1176	430.0	0.298	0.0300	0.0377	0.00943	4.19	80
85	208.68	64.02	81.000	41.076	97.421	0.08429	0.18775	0.3783	0.3083	1.4265	1130	425.3	0.286	0.0304	0.0371	0.00971	3.87	85
90	223.92	63.10	81.000	42.952	97.740	0.08764	0.18732	0.3858	0.3196	1.4606	1083	420.3	0.275	0.0309	0.0364	0.01002	3.55	90
95	239.97	62.14	81.000	44.860	98.019	0.09101	0.18686	0.3944	0.3325	1.5003	1035	414.9	0.264	0.0315	0.0358	0.01035	3.24	95
100	256.88	61.14	81.000	46.803	98.251	0.09441	0.18634	0.4043	0.3475	1.5471	987	409.2	0.253	0.0321	0.0351	0.01071	2.93	100
105	274.68	60.09	81.000	48.784	98.431	0.09784	0.18576	0.4157	0.3650	1.6029	938	403.1	0.242	0.0327	0.0344	0.01112	2.62	105
110	293.40	58.99	81.000	50.809	98.551	0.10130	0.18511	0.4291	0.3858	1.6706	888	396.5	0.231	0.0334	0.0338	0.01158	2.32	110
115	313.08	57.82	81.000	52.885	98.600	0.10482	0.18438	0.4453	0.4112	1.7541	838	389.5	0.220	0.0343	0.0331	0.01210	2.03	115
120	333.77	56.57	81.000	55.018	98.568	0.10840	0.18354	0.4652	0.4427	1.8597	786	382.0	0.209	0.0352	0.0325	0.01270	1.74	120
125	355.50	55.22	81.000	57.221	98.435	0.11206	0.18256	0.4904	0.4833	1.9972	732	373.9	0.198	0.0362	0.0318	0.01341	1.47	125
130	378.33	53.76	81.000	59.509	98.177	0.11583	0.18141	0.5237	0.5375	2.1831	677	365.3	0.187	0.0375	0.0311	0.01425	1.20	130
135	402.31																	

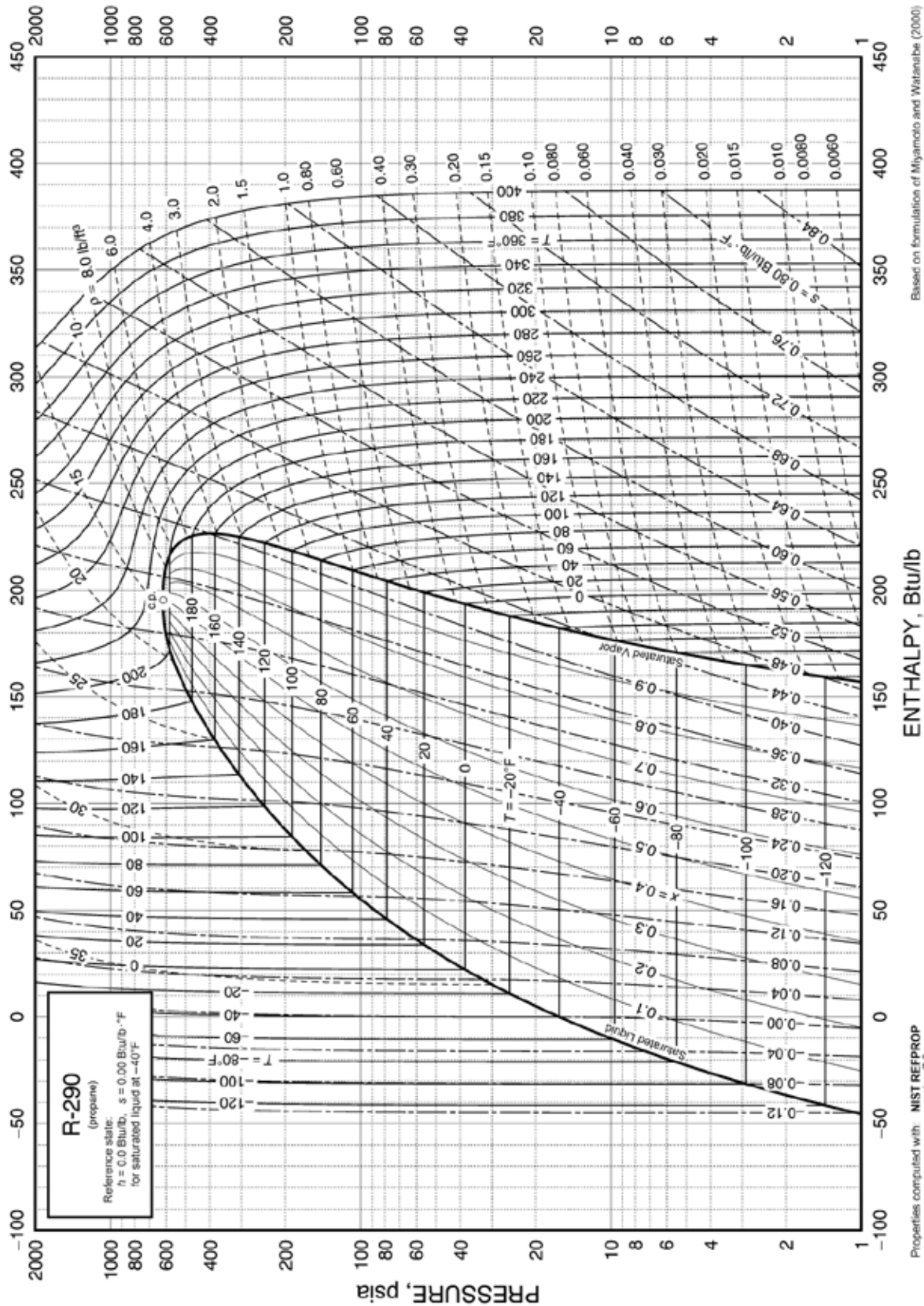


Fig. 24 Pressure-Enthalpy Diagram for Refrigerant 290 (Propane)

Thermophysical Properties of Refrigerants

Refrigerant 290 (Propane) Properties of Saturated Liquid and Saturated Vapor

Temp., °F	Pres. sure, psia	Density, lb/ft ³		Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat c _p , Btu/lb·°F		Vel. of Sound, ft/s		Viscosity, lb _m /ft·h		Thermal Cond., Btu/h·ft·°F		Surface Tension, dyne/cm		
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	
-200	0.020	42.03	3.1223	-80.510	137.326	-0.24019	0.59871	0.4770	0.2606	1.2094	5702	594.9	1.795	0.0099	0.1050	0.00287	28.59	-200
-190	0.040	41.68	1630.8	-75.728	139.945	-0.22212	0.57765	0.4794	0.2648	1.2055	5580	605.2	1.586	0.0102	0.1031	0.00308	27.75	-190
-180	0.076	41.33	898.92	-70.922	142.601	-0.20462	0.55886	0.4819	0.2691	1.2019	5459	615.2	1.415	0.0106	0.1012	0.00330	26.90	-180
-170	0.135	40.97	519.81	-66.090	145.294	-0.18764	0.54209	0.4845	0.2734	1.1985	5337	625.0	1.272	0.0109	0.0993	0.00351	26.06	-170
-160	0.232	40.62	313.69	-61.230	148.019	-0.17115	0.52711	0.4873	0.2777	1.1954	5215	634.5	1.152	0.0113	0.0974	0.00374	25.23	-160
-150	0.382	40.26	196.68	-56.342	150.774	-0.15511	0.51372	0.4903	0.2822	1.1925	5093	643.7	1.049	0.0116	0.0954	0.00397	24.39	-150
-145	0.484	40.08	157.78	-53.887	152.162	-0.14725	0.50756	0.4918	0.2845	1.1912	5032	648.2	1.003	0.0118	0.0944	0.00408	23.98	-145
-140	0.608	39.90	127.61	-51.423	153.557	-0.13948	0.50174	0.4934	0.2868	1.1899	4971	652.6	0.960	0.0119	0.0935	0.00420	23.57	-140
-135	0.757	39.72	104.00	-48.952	154.957	-0.13181	0.49624	0.4950	0.2892	1.1887	4910	656.9	0.919	0.0121	0.0925	0.00432	23.15	-135
-130	0.935	39.54	85.379	-46.472	156.364	-0.12423	0.49103	0.4967	0.2916	1.1876	4849	661.2	0.882	0.0123	0.0915	0.00444	22.74	-130
-125	1.147	39.35	70.580	-43.983	157.775	-0.11674	0.48611	0.4985	0.2940	1.1866	4788	665.3	0.846	0.0125	0.0905	0.00456	22.33	-125
-120	1.398	39.17	58.730	-41.485	159.191	-0.10934	0.48146	0.5003	0.2966	1.1856	4727	669.4	0.813	0.0126	0.0895	0.00468	21.92	-120
-115	1.693	38.99	49.176	-38.978	160.611	-0.10202	0.47706	0.5022	0.2992	1.1848	4666	673.3	0.782	0.0128	0.0885	0.00480	21.51	-115
-110	2.036	38.80	41.421	-36.461	162.036	-0.09477	0.47290	0.5041	0.3018	1.1840	4606	677.2	0.753	0.0130	0.0875	0.00493	21.10	-110
-105	2.435	38.62	35.086	-33.935	163.463	-0.08760	0.46897	0.5061	0.3045	1.1833	4545	680.9	0.725	0.0132	0.0865	0.00505	20.70	-105
-100	2.896	38.43	29.880	-31.398	164.894	-0.08050	0.46525	0.5082	0.3073	1.1827	4484	684.6	0.698	0.0133	0.0855	0.00518	20.29	-100
-95	3.425	38.24	25.577	-28.850	166.327	-0.07348	0.46174	0.5103	0.3102	1.1822	4423	688.1	0.673	0.0135	0.0846	0.00531	19.89	-95
-90	4.030	38.06	22.000	-26.291	167.762	-0.06652	0.45842	0.5125	0.3132	1.1818	4363	691.5	0.650	0.0137	0.0836	0.00544	19.49	-90
-85	4.718	37.87	19.010	-23.721	169.199	-0.05962	0.45529	0.5148	0.3162	1.1814	4303	694.8	0.627	0.0138	0.0826	0.00557	19.09	-85
-80	5.497	37.68	16.500	-21.138	170.638	-0.05278	0.45233	0.5172	0.3193	1.1812	4242	697.9	0.606	0.0140	0.0816	0.00570	18.69	-80
-75	6.376	37.49	14.381	-18.544	172.077	-0.04600	0.44954	0.5196	0.3225	1.1811	4182	700.9	0.585	0.0142	0.0806	0.00583	18.29	-75
-70	7.364	37.29	12.584	-15.936	173.516	-0.03928	0.44690	0.5222	0.3257	1.1812	4122	703.8	0.566	0.0144	0.0797	0.00596	17.89	-70
-65	8.470	37.10	11.054	-13.316	174.955	-0.03261	0.44442	0.5248	0.3291	1.1813	4062	706.5	0.547	0.0145	0.0787	0.00610	17.49	-65
-60	9.704	36.90	9.7455	-10.682	176.394	-0.02600	0.44208	0.5275	0.3325	1.1816	4002	709.1	0.529	0.0147	0.0778	0.00624	17.10	-60
-55	11.075	36.71	8.6215	-8.034	177.831	-0.01943	0.43987	0.5302	0.3360	1.1820	3942	711.6	0.513	0.0149	0.0768	0.00637	16.71	-55
-50	12.593	36.51	7.6522	-5.371	179.267	-0.01291	0.43779	0.5331	0.3397	1.1825	3882	713.9	0.496	0.0150	0.0759	0.00651	16.31	-50
-45	14.270	36.31	6.8133	-2.693	180.701	-0.00643	0.43583	0.5361	0.3434	1.1831	3823	716.0	0.481	0.0152	0.0749	0.00665	15.92	-45
-43.80 ^b	14.696	36.26	6.6298	-2.051	181.043	-0.00489	0.43538	0.5368	0.3443	1.1833	3809	716.5	0.477	0.0153	0.0747	0.00669	15.83	-43.80
-40	16.117	36.11	6.0846	0.000	182.132	0.00000	0.43399	0.5392	0.3472	1.1840	3763	718.0	0.466	0.0154	0.0740	0.00680	15.54	-40
-35	18.144	35.91	5.4494	2.709	183.560	0.00639	0.43225	0.5423	0.3511	1.1849	3704	719.8	0.451	0.0156	0.0730	0.00694	15.15	-35
-30	20.363	35.70	4.8938	5.435	184.984	0.01275	0.43062	0.5456	0.3551	1.1861	3644	721.5	0.438	0.0157	0.0721	0.00709	14.76	-30
-25	22.785	35.50	4.4064	8.177	186.404	0.01906	0.42909	0.5489	0.3592	1.1874	3585	723.0	0.425	0.0159	0.0712	0.00724	14.38	-25
-20	25.424	35.29	3.9773	10.937	187.819	0.02534	0.42765	0.5524	0.3634	1.1888	3525	724.3	0.412	0.0161	0.0703	0.00739	14.00	-20
-15	28.291	35.08	3.5985	13.715	189.229	0.03159	0.42630	0.5560	0.3677	1.1905	3466	725.4	0.400	0.0163	0.0694	0.00754	13.62	-15
-10	31.399	34.87	3.2632	16.512	190.632	0.03781	0.42503	0.5597	0.3722	1.1924	3406	726.3	0.388	0.0164	0.0685	0.00769	13.24	-10
-5	34.760	34.66	2.9655	19.327	192.029	0.04400	0.42384	0.5635	0.3768	1.1945	3347	727.0	0.377	0.0166	0.0676	0.00785	12.86	-5
0	38.389	34.44	2.7005	22.163	193.419	0.05016	0.42272	0.5674	0.3815	1.1968	3287	727.6	0.366	0.0168	0.0667	0.00801	12.49	0
5	42.296	34.22	2.4639	25.018	194.800	0.05629	0.42167	0.5715	0.3863	1.1993	3228	727.9	0.355	0.0170	0.0659	0.00817	12.11	5
10	46.497	34.00	2.2523	27.895	196.173	0.06240	0.42069	0.5757	0.3914	1.2021	3168	728.0	0.345	0.0172	0.0650	0.00834	11.74	10
15	51.005	33.78	2.0625	30.793	197.536	0.06848	0.41977	0.5800	0.3965	1.2052	3109	728.0	0.335	0.0174	0.0641	0.00850	11.37	15
20	55.834	33.55	1.8919	33.713	198.889	0.07455	0.41890	0.5845	0.4019	1.2086	3049	727.7	0.325	0.0175	0.0633	0.00868	11.00	20
25	60.997	33.32	1.7381	36.656	200.231	0.08059	0.41809	0.5891	0.4074	1.2123	2989	727.1	0.316	0.0177	0.0624	0.00885	10.64	25
30	66.509	33.09	1.5993	39.623	201.560	0.08662	0.41733	0.5939	0.4132	1.2164	2929	726.4	0.307	0.0179	0.0616	0.00903	10.28	30
35	72.383	32.86	1.4737	42.615	202.877	0.09263	0.41661	0.5989	0.4192	1.2208	2869	725.4	0.299	0.0181	0.0608	0.00921	9.92	35
40	78.636	32.62	1.3599	45.631	204.179	0.09863	0.41593	0.6041	0.4254	1.2256	2809	724.2	0.290	0.0183	0.0600	0.00940	9.56	40
45	85.280	32.38	1.2564	48.674	205.466	0.10461	0.41529	0.6094	0.4319	1.2309	2749	722.7	0.282	0.0185	0.0592	0.00959	9.20	45
50	92.331	32.13	1.1622	51.743	206.737	0.11058	0.41469	0.6150	0.4386	1.2367	2688	721.0	0.274	0.0188	0.0584	0.00979	8.85	50
55	99.804	31.88	1.0763	54.840	207.991	0.11655	0.41412	0.6209	0.4457	1.2429	2628	719.1	0.267	0.0190	0.0576	0.00999	8.50	55
60	107.71	31.63	0.9979	57.967	209.226	0.12250	0.41357	0.6269	0.4532	1.2498	2567	716.8	0.259	0.0192	0.0568	0.01020	8.15	60
65	116.08	31.37	0.9260	61.123	210.440	0.12845	0.41305	0.6333	0.4610	1.2573	2507	714.3	0.252	0.0194	0.0560	0.01042	7.80	65
70	124.91	31.11	0.8602	64.310	211.633	0.13440	0.41254	0.6399	0.4692	1.2656	2446	711.5	0.245	0.0197	0.0552	0.01064	7.46	70
75	134.22	30.85	0.7997	67.529	212.802	0.14034	0.41205	0.6469	0.4779	1.2746	2384	708.4	0.238	0.0199	0.0545	0.01087	7.12	75
80	144.04	30.57	0.7441	70.782	213.947	0.14629	0.41157	0.6543	0.4871	1.2846	2323	705.0	0.231	0.0202	0.0537	0.01111	6.78	80
85	154.37	30.30	0.6928	74.070	215.063	0.15224	0.41110	0.6620	0.4969	1.2955	2261	701.3	0.224	0.0204	0.0530	0.01135	6.45	85
90	165.23	30.01	0.6455	77.394	216.151	0.15819	0.41063	0.6703	0.5074	1.3076	2199	697.3	0.218	0.0207	0.0523	0.01161	6.12	90
95	176.64	29.72	0.6018	80.757	217.206	0.16415	0.41015	0.6790	0.5186	1.3209	2137	693.0	0.212	0.0210	0.0515	0.01188	5.79	95
100	188.62	29.43	0.5613	84.160	218.227	0.17013	0.40967	0.6883	0.5306	1.3358	2075	688.3	0.205	0.0213	0.0508	0.01216	5.47	100
110	214.34	28.81	0.4889	91.096	220.152	0.18212	0.40866	0.7089	0.5577	1.3707	1948	677.9	0.193	0.0219	0.0494	0.01276	4.83	110
120	242.54</																	

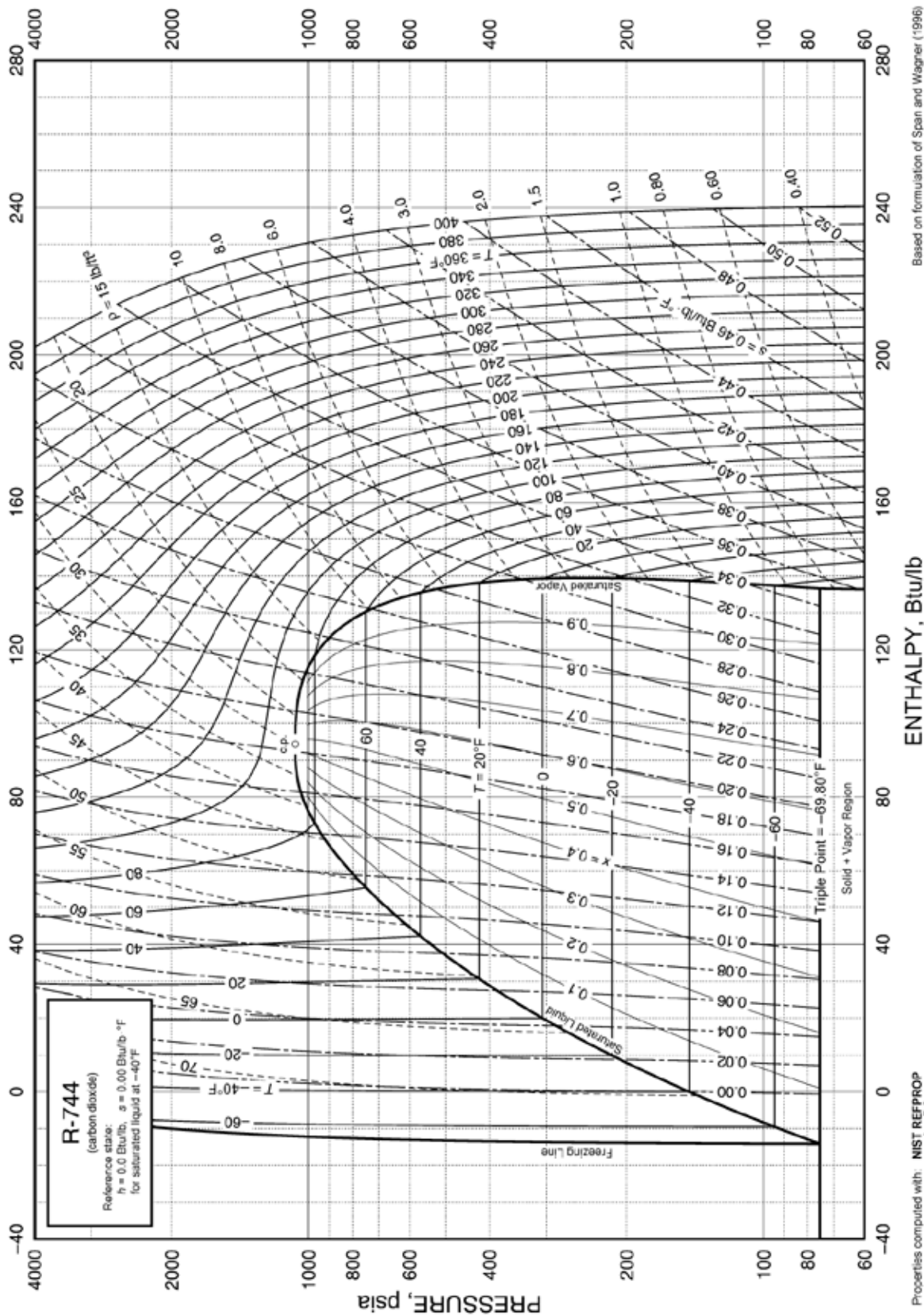


Fig. 21 Pressure-Enthalpy Diagram for Refrigerant 744 (Carbon Dioxide)

Thermophysical Properties of Refrigerants

30.45

Refrigerant 744 (Carbon Dioxide) Properties of Saturated Liquid and Saturated Vapor

Temp.,* °F	Pres- sure, psia	Density, lb/ft ³		Volume, ft ³ /lb		Enthalpy, Btu/lb		Entropy, Btu/lb·°F		Specific Heat c _p , Btu/lb·°F		c _p /c _v	Vel. of Sound, ft/s		Viscosity, lb _m /ft·h		Thermal Cond., Btu/h·ft·°F		Surface Tension, Temp.,* dync/cm °F
		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	Liquid	Vapor		Liquid	Vapor	Liquid	Vapor	Liquid	Vapor	
-69.80*	75.124	73.57	1.1641	-14.140	136.598	-0.03449	0.35215	0.4668	0.2172	1.4442	3202	730.9	0.621	0.0265	0.1044	0.00637	17.16	-69.80	
-65	84.234	72.97	1.0434	-11.886	137.013	-0.02881	0.34847	0.4684	0.2212	1.4534	3138	731.9	0.593	0.0268	0.1024	0.00650	16.49	-65	
-60	94.573	72.33	0.9336	-9.532	137.417	-0.02294	0.34473	0.4703	0.2257	1.4638	3073	732.7	0.565	0.0272	0.1003	0.00664	15.81	-60	
-55	105.84	71.69	0.8375	-7.167	137.790	-0.01714	0.34107	0.4724	0.2304	1.4754	3007	733.2	0.539	0.0276	0.0982	0.00678	15.12	-55	
-50	118.08	71.04	0.7532	-4.791	138.130	-0.01138	0.33749	0.4749	0.2355	1.4882	2941	733.5	0.514	0.0279	0.0962	0.00693	14.45	-50	
-48	123.26	70.77	0.7224	-3.837	138.257	-0.00909	0.33608	0.4760	0.2377	1.4937	2915	733.5	0.505	0.0281	0.0954	0.00699	14.18	-48	
-46	128.61	70.51	0.6930	-2.881	138.379	-0.00681	0.33467	0.4771	0.2399	1.4994	2889	733.5	0.496	0.0283	0.0945	0.00706	13.91	-46	
-44	134.13	70.24	0.6651	-1.923	138.494	-0.00453	0.33328	0.4783	0.2422	1.5054	2862	733.5	0.486	0.0284	0.0937	0.00712	13.65	-44	
-42	139.82	69.97	0.6386	-0.963	138.604	-0.00226	0.33189	0.4795	0.2445	1.5116	2836	733.4	0.477	0.0286	0.0929	0.00718	13.38	-42	
-40	145.69	69.70	0.6132	0.000	138.708	0.00000	0.33052	0.4808	0.2470	1.5180	2809	733.3	0.469	0.0287	0.0921	0.00725	13.12	-40	
-38	151.74	69.42	0.5891	0.965	138.806	0.00226	0.32915	0.4821	0.2495	1.5247	2783	733.1	0.460	0.0289	0.0913	0.00732	12.86	-38	
-36	157.98	69.15	0.5661	1.933	138.898	0.00451	0.32779	0.4836	0.2520	1.5317	2756	732.9	0.452	0.0290	0.0905	0.00739	12.60	-36	
-34	164.40	68.87	0.5442	2.904	138.983	0.00675	0.32643	0.4850	0.2547	1.5390	2730	732.6	0.443	0.0292	0.0897	0.00746	12.34	-34	
-32	171.02	68.59	0.5233	3.877	139.062	0.00899	0.32509	0.4866	0.2574	1.5466	2703	732.3	0.435	0.0293	0.0889	0.00753	12.08	-32	
-30	177.83	68.31	0.5033	4.854	139.134	0.01123	0.32375	0.4882	0.2603	1.5545	2677	732.0	0.427	0.0295	0.0881	0.00760	11.82	-30	
-28	184.83	68.02	0.4842	5.833	139.199	0.01346	0.32241	0.4899	0.2632	1.5628	2650	731.6	0.420	0.0297	0.0873	0.00768	11.56	-28	
-26	192.04	67.74	0.4659	6.816	139.258	0.01568	0.32108	0.4917	0.2662	1.5714	2623	731.1	0.412	0.0298	0.0865	0.00775	11.31	-26	
-24	199.46	67.45	0.4485	7.802	139.309	0.01790	0.31975	0.4935	0.2694	1.5804	2596	730.6	0.405	0.0300	0.0857	0.00783	11.06	-24	
-22	207.08	67.16	0.4318	8.791	139.353	0.02012	0.31843	0.4955	0.2726	1.5898	2569	730.1	0.397	0.0302	0.0849	0.00791	10.80	-22	
-20	214.91	66.86	0.4158	9.784	139.389	0.02234	0.31711	0.4975	0.2760	1.5996	2542	729.5	0.390	0.0303	0.0841	0.00799	10.55	-20	
-18	222.97	66.56	0.4005	10.781	139.418	0.02455	0.31580	0.4996	0.2795	1.6099	2515	728.9	0.383	0.0305	0.0833	0.00807	10.30	-18	
-16	231.24	66.27	0.3859	11.781	139.438	0.02675	0.31448	0.5018	0.2831	1.6206	2488	728.2	0.376	0.0307	0.0825	0.00816	10.05	-16	
-14	239.73	65.96	0.3718	12.786	139.451	0.02896	0.31317	0.5042	0.2869	1.6318	2461	727.5	0.369	0.0308	0.0818	0.00825	9.81	-14	
-12	248.45	65.66	0.3584	13.794	139.455	0.03116	0.31186	0.5066	0.2908	1.6435	2433	726.7	0.363	0.0310	0.0810	0.00834	9.56	-12	
-10	257.40	65.35	0.3455	14.807	139.450	0.03336	0.31055	0.5091	0.2949	1.6557	2405	725.9	0.356	0.0312	0.0802	0.00843	9.32	-10	
-8	266.58	65.04	0.3331	15.824	139.437	0.03556	0.30924	0.5118	0.2991	1.6685	2378	725.0	0.350	0.0314	0.0794	0.00853	9.07	-8	
-6	276.01	64.72	0.3212	16.846	139.415	0.03776	0.30793	0.5146	0.3035	1.6820	2350	724.1	0.343	0.0315	0.0786	0.00863	8.83	-6	
-4	285.67	64.40	0.3098	17.873	139.383	0.03996	0.30662	0.5175	0.3082	1.6960	2321	723.1	0.337	0.0317	0.0778	0.00873	8.59	-4	
-2	295.58	64.08	0.2989	18.905	139.342	0.04216	0.30531	0.5206	0.3130	1.7108	2293	722.1	0.331	0.0319	0.0771	0.00883	8.35	-2	
0	305.74	63.76	0.2884	19.942	139.291	0.04435	0.30399	0.5238	0.3180	1.7262	2264	721.0	0.325	0.0321	0.0763	0.00894	8.11	0	
2	316.15	63.43	0.2782	20.985	139.230	0.04655	0.30267	0.5272	0.3233	1.7425	2235	719.8	0.319	0.0323	0.0755	0.00905	7.88	2	
4	326.82	63.09	0.2685	22.033	139.158	0.04875	0.30135	0.5307	0.3288	1.7596	2206	718.6	0.313	0.0325	0.0747	0.00916	7.64	4	
6	337.75	62.76	0.2591	23.088	139.075	0.05095	0.30003	0.5345	0.3346	1.7776	2176	717.4	0.307	0.0327	0.0740	0.00928	7.41	6	
8	348.94	62.42	0.2501	24.148	138.981	0.05315	0.29869	0.5384	0.3406	1.7965	2146	716.1	0.302	0.0329	0.0732	0.00941	7.18	8	
10	360.41	62.07	0.2414	25.215	138.876	0.05535	0.29736	0.5425	0.3470	1.8166	2116	714.7	0.296	0.0331	0.0724	0.00953	6.95	10	
12	372.14	61.72	0.2331	26.289	138.758	0.05756	0.29601	0.5469	0.3537	1.8377	2085	713.2	0.291	0.0333	0.0716	0.00967	6.72	12	
14	384.16	61.36	0.2250	27.369	138.628	0.05977	0.29466	0.5514	0.3607	1.8601	2054	711.8	0.286	0.0335	0.0709	0.00981	6.50	14	
16	396.45	61.00	0.2173	28.457	138.485	0.06198	0.29329	0.5563	0.3681	1.8837	2023	710.2	0.280	0.0338	0.0701	0.00995	6.27	16	
18	409.03	60.63	0.2098	29.552	138.328	0.06420	0.29192	0.5614	0.3759	1.9089	1991	708.6	0.275	0.0340	0.0693	0.01010	6.05	18	
20	421.91	60.26	0.2025	30.656	138.158	0.06642	0.29054	0.5669	0.3841	1.9356	1959	706.9	0.270	0.0342	0.0685	0.01026	5.83	20	
22	435.07	59.89	0.1956	31.768	137.973	0.06865	0.28915	0.5726	0.3928	1.9640	1926	705.2	0.265	0.0345	0.0677	0.01042	5.61	22	
24	448.54	59.50	0.1888	32.889	137.772	0.07089	0.28774	0.5787	0.4021	1.9942	1894	703.4	0.260	0.0347	0.0670	0.01059	5.39	24	
26	462.30	59.11	0.1823	34.019	137.556	0.07313	0.28632	0.5853	0.4120	2.0266	1861	701.6	0.255	0.0350	0.0662	0.01077	5.17	26	
28	476.38	58.71	0.1760	35.159	137.323	0.07538	0.28488	0.5922	0.4225	2.0611	1827	699.7	0.250	0.0352	0.0654	0.01096	4.96	28	
30	490.77	58.31	0.1699	36.309	137.072	0.07764	0.28342	0.5997	0.4337	2.0982	1794	697.7	0.245	0.0355	0.0646	0.01116	4.75	30	
32	505.48	57.90	0.1640	37.470	136.803	0.07991	0.28195	0.6076	0.4457	2.1380	1760	695.7	0.240	0.0358	0.0638	0.01137	4.54	32	
34	520.51	57.48	0.1583	38.643	136.514	0.08220	0.28045	0.6162	0.4586	2.1808	1726	693.6	0.236	0.0361	0.0631	0.01160	4.33	34	
36	535.86	57.05	0.1528	39.828	136.206	0.08449	0.27893	0.6254	0.4725	2.2271	1692	691.4	0.231	0.0364	0.0623	0.01183	4.13	36	
38	551.55	56.61	0.1475	41.025	135.875	0.08680	0.27739	0.6353	0.4875	2.2771	1657	689.1	0.227	0.0367	0.0615	0.01208	3.92	38	
40	567.58	56.16	0.1423	42.237	135.522	0.08912	0.27582	0.6460	0.5038	2.3314	1623	686.8	0.222	0.0370	0.0607	0.01235	3.72	40	
42	583.95	55.71	0.1373	43.464	135.145	0.09147	0.27422	0.6577	0.5215	2.3905	1588	684.4	0.217	0.0373	0.0599	0.01263	3.53	42	
44	600.67	55.24	0.1324	44.706	134.741	0.09383	0.27259	0.6704	0.5408	2.4551	1553	681.9	0.213	0.0377	0.0591	0.01294	3.33	44	
46	617.75	54.76	0.1276	45.965	134.310	0.09621	0.27092	0.6843	0.5620	2.5260	1518	679.3	0.209	0.0381	0.0583	0.01326	3.14	46	
48	635.18	54.27	0.1230	47.242	133.850	0.09861	0.26921	0.6996	0.5854	2.6040	1482	676.7	0.204	0.0384	0.0575	0.01362	2.94	48	
50	652.99	53.76	0.1185	48.539	133.357	0.10104	0.26746	0.7164	0.6113	2.6903	1447	673.9	0.200	0.0388	0.0567	0.01400	2.76	50	
52	671.16	53.24	0.1141	49.858	132.830	0.10350	0.26566	0.7352	0.6402	2.7863	1411	671.0	0.195	0.0393	0.0559	0.01441	2.57	52	
54	689.72	52.70	0.1099	51.200	132.266	0.10599	0.26381	0.7562	0.6725	2.8937	1375	668.1	0.191	0.0397	0.0551	0.01485	2.39	54	
56	708.67	52.14	0.1057	52.568	131.661	0.10852	0.26190	0.7798	0.7091	3.0147	1338	665.0	0.187	0.0402	0.0543	0.01534	2.21	56	