Properties of <u>Saturated</u> Refrigerant R134a (Temperature Table)

Saturated refrigerant-134a–Temperature table

Temp. °C T	Press. MPa P_{sat}	Specific volume m³/kg		Internal energy kJ/kg		Enthalpy kJ/kg			Entropy kJ/(kg·K)	
		Sat. liquid v_f	Sat. vapor v_g	Sat. liquid u_f	Sat. vapor u_g	Sat. liquid h_f	Evap. h_{fg}	Sat. vapor h_g	Sat. liquid s_f	Sat. vapor s_g
−40	0.051 64	0.000 705 5	0.3569	−0.04	204.45	0.00	222.88	222.88	0.0000	0.9560
−36	0.063 32	0.000 711 3	0.2947	4.68	206.73	4.73	220.67	225.40	0.0201	0.9506
−32	0.077 04	0.000 717 2	0.2451	9.47	209.01	9.52	218.37	227.90	0.0401	0.9456
−28	0.093 05	0.000 723 3	0.2052	14.31	211.29	14.37	216.01	230.38	0.0600	0.9411
−26	0.101 99	0.000 726 5	0.1882	16.75	212.43	16.82	214.80	231.62	0.0699	0.9390
−24	0.111 60	0.000 729 6	0.1728	19.21	213.57	19.29	213.57	232.85	0.0798	0.9370
−22	0.121 92	0.000 732 8	0.1590	21.68	214.70	21.77	212.32	234.08	0.0897	0.9351
−20	0.132 99	0.000 736 1	0.1464	24.17	215.84	24.26	211.05	235.31	0.0996	0.9332
−18	0.144 83	0.000 739 5	0.1350	26.67	216.97	26.77	209.76	236.53	0.1094	0.9315
−16	0.157 48	0.000 742 8	0.1247	29.18	218.10	29.30	208.45	237.74	0.1192	0.9298
−12	0.185 40	0.000 749 8	0.1068	34.25	220.36	34.39	205.77	240.15	0.1388	0.9267
−8	0.217 04	0.000 756 9	0.0919	39.38	222.60	39.54	203.00	242.54	0.1583	0.9239
−4	0.252 74	0.000 764 4	0.0794	44.56	224.84	44.75	200.15	244.90	0.1777	0.9213
0	0.292 82	0.000 772 1	0.0689	49.79	227.06	50.02	197.21	247.23	0.1970	0.9190
4	0.337 65	0.000 780 1	0.0600	55.08	229.27	55.35	194.19	249.53	0.2162	0.9169
8	0.387 56	0.000 788 4	0.0525	60.43	231.46	60.73	191.07	251.80	0.2354	0.9150
12	0.442 94	0.000 797 1	0.0460	65.83	233.63	66.18	187.85	254.03	0.2545	0.9132
16	0.504 16	0.000 806 2	0.0405	71.29	235.78	71.69	184.52	256.22	0.2735	0.9116
20	0.571 60	0.000 815 7	0.0358	76.80	237.91	77.26	181.09	258.36	0.2924	0.9102
24	0.645 66	0.000 825 7	0.0317	82.37	240.01	82.90	177.55	260.45	0.3113	0.9089
26	0.685 30	0.000 830 9	0.0298	85.18	241.05	85.75	175.73	261.48	0.3208	0.9082
28	0.726 75	0.000 836 2	0.0281	88.00	242.08	88.61	173.89	262.50	0.3302	0.9076
30	0.770 06	0.000 841 7	0.0265	90.84	243.10	91.49	172.00	263.50	0.3396	0.9070
32	0.815 28	0.000 847 3	0.0250	93.70	244.12	94.39	170.09	264.48	0.3490	0.9064
34	0.862 47	0.000 853 0	0.0236	96.58	245.12	97.31	168.14	265.45	0.3584	0.9058
36	0.911 68	0.000 859 0	0.0223	99.47	246.11	100.25	166.15	266.40	0.3678	0.9053
38	0.962 98	0.000 865 1	0.0210	102.38	247.09	103.21	164.12	267.33	0.3772	0.9047
40	1.016 4	0.000 871 4	0.0199	105.30	248.06	106.19	162.05	268.24	0.3866	0.9041
42	1.072 0	0.000 878 0	0.0188	108.25	249.02	109.19	159.94	269.14	0.3960	0.9035
44	1.129 9	0.000 884 7	0.0177	111.22	249.96	112.22	157.79	270.01	0.4054	0.9030
48	1.252 6	0.000 898 9	0.0159	117.22	251.79	118.35	153.33	271.68	0.4243	0.9017
52	1.385 1	0.000 914 2	0.0142	123.31	253.55	124.58	148.66	273.24	0.4432	0.9004
56	1.527 8	0.000 930 8	0.0127	129.51	255.23	130.93	143.75	274.68	0.4622	0.8990
60	1.681 3	0.000 948 8	0.0114	135.82	256.81	137.42	138.57	275.99	0.4814	0.8973
70	2.116 2	0.001 002 7	0.0086	152.22	260.15	154.34	124.08	278.43	0.5302	0.8918
80	2.632 4	0.001 076 6	0.0064	169.88	262.14	172.71	106.41	279.12	0.5814	0.8827
90	3.243 5	0.001 194 9	0.0046	189.82	261.34	193.69	82.63	276.32	0.6380	0.8655
100	3.974 2	0.001 544 3	0.0027	218.60	248.49	224.74	34.40	259.13	0.7196	0.8117

Properties of <u>Saturated</u> Refrigerant R134a (Pressure Table)

Press. MPa P	Temp. °C T_{sat}	Specific volume m³/kg Sat. liquid v_f	Sat. vapor v_g	Internal energy kJ/kg Sat. liquid u_f	Sat. vapor u_g	Enthalpy kJ/kg Sat. liquid h_f	Evap. h_{fg}	Sat. vapor h_g	Entropy kJ/(kg·K) Sat. liquid s_f	Sat. vapor s_g
0.06	−37.07	0.000 709 7	0.3100	3.41	206.12	3.46	221.27	224.72	0.0147	0.9520
0.08	−31.21	0.000 718 4	0.2366	10.41	209.46	10.47	217.92	228.39	0.0440	0.9447
0.10	−26.43	0.000 725 8	0.1917	16.22	212.18	16.29	215.06	231.35	0.0678	0.9395
0.12	−22.36	0.000 732 3	0.1614	21.23	214.50	21.32	212.54	233.86	0.0879	0.9354
0.14	−18.80	0.000 738 1	0.1395	25.66	216.52	25.77	210.27	236.04	0.1055	0.9322
0.16	−15.62	0.000 743 5	0.1229	29.66	218.32	29.78	208.18	237.97	0.1211	0.9295
0.18	−12.73	0.000 748 5	0.1098	33.31	219.94	33.45	206.26	239.71	0.1352	0.9273
0.20	−10.09	0.000 753 2	0.0993	36.69	221.43	36.84	204.46	241.30	0.1481	0.9253
0.24	−5.37	0.000 761 8	0.0834	42.77	224.07	42.95	201.14	244.09	0.1710	0.9222
0.28	−1.23	0.000 769 7	0.0719	48.18	226.38	48.39	198.13	246.52	0.1911	0.9197
0.32	2.48	0.000 777 0	0.0632	53.06	228.43	53.31	195.35	248.66	0.2089	0.9177
0.36	5.84	0.000 783 9	0.0564	57.54	230.28	57.82	192.76	250.58	0.2251	0.9160
0.4	8.93	0.000 790 4	0.0509	61.69	231.97	62.00	190.32	252.32	0.2399	0.9145
0.5	15.74	0.000 805 6	0.0409	70.93	235.64	71.33	184.74	256.07	0.2723	0.9117
0.6	21.58	0.000 819 6	0.0341	78.99	238.74	79.48	179.71	259.19	0.2999	0.9097
0.7	26.72	0.000 832 8	0.0292	86.19	241.42	86.78	175.07	261.85	0.3242	0.9080
0.8	31.33	0.000 845 4	0.0255	92.75	243.78	93.42	170.73	264.15	0.3459	0.9066
0.9	35.53	0.000 857 6	0.0226	98.79	245.88	99.56	166.62	266.18	0.3656	0.9054
1.0	39.39	0.000 869 5	0.0202	104.42	247.77	105.29	162.68	267.97	0.3838	0.9043
1.2	46.32	0.000 892 8	0.0166	114.69	251.03	115.76	155.23	270.99	0.4164	0.9023
1.4	52.43	0.000 915 9	0.0140	123.98	253.74	125.26	148.14	273.40	0.4453	0.9003
1.6	57.92	0.000 939 2	0.0121	132.52	256.00	134.02	141.31	275.33	0.4714	0.8982
1.8	62.91	0.000 963 1	0.0105	140.49	257.88	142.22	134.60	276.83	0.4954	0.8959
2.0	67.49	0.000 987 8	0.0093	148.02	259.41	149.99	127.95	277.94	0.5178	0.8934
2.5	77.59	0.001 056 2	0.0069	165.48	261.84	168.12	111.06	279.17	0.5687	0.8854
3.0	86.22	0.001 141 6	0.0053	181.88	262.16	185.30	92.71	278.01	0.6156	0.8735

Properties of <u>Superheated</u> Refrigerant R134a

Superheated refrigerant 134a

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/(kg·K)	v m³/kg	u kJ/kg	h kJ/kg	s kJ/(kg·K)
	P = 0.06 MPa (T_{sat} = −37.07°C)				**P = 0.10 MPa** (T_{sat} = −26.43°C)			
Sat.	0.31003	206.12	224.72	0.9520	0.19170	212.18	231.35	0.9395
−20	0.33536	217.86	237.98	1.0062	0.19770	216.77	236.54	0.9602
−10	0.34992	224.97	245.96	1.0371	0.20686	224.01	244.70	0.9918
0	0.36433	232.24	254.10	1.0675	0.21587	231.41	252.99	1.0227
10	0.37861	239.69	262.41	1.0973	0.22473	238.96	261.43	1.0531
20	0.39279	247.32	270.89	1.1267	0.23349	246.67	270.02	1.0829
30	0.40688	255.12	279.53	1.1557	0.24216	254.54	278.76	1.1122
40	0.42091	263.10	288.35	1.1844	0.25076	262.58	287.66	1.1411
50	0.43487	271.25	297.34	1.2126	0.25930	270.79	296.72	1.1696
60	0.44879	279.58	306.51	1.2405	0.26779	279.16	305.94	1.1977
70	0.46266	288.08	315.84	1.2681	0.27623	287.70	315.32	1.2254
80	0.47650	296.75	325.34	1.2954	0.28464	296.40	324.87	1.2528
90	0.49031	305.58	335.00	1.3224	0.29302	305.27	334.57	1.2799
	P = 0.14 MPa (T_{sat} = −18.80°C)				**P = 0.18 MPa** (T_{sat} = −12.73°C)			
Sat.	0.13945	216.52	236.04	0.9322	0.10983	219.94	239.71	0.9273
−10	0.14549	223.03	243.40	0.9606	0.11135	222.02	242.06	0.9362
0	0.15219	230.55	251.86	0.9922	0.11678	229.67	250.69	0.9684
10	0.15875	238.21	260.43	1.0230	0.12207	237.44	259.41	0.9998
20	0.16520	246.01	269.13	1.0532	0.12723	245.33	268.23	1.0304
30	0.17155	253.96	277.97	1.0828	0.13230	253.36	277.17	1.0604
40	0.17783	262.06	286.96	1.1120	0.13730	261.53	286.24	1.0898
50	0.18404	270.32	296.09	1.1407	0.14222	269.85	295.45	1.1187
60	0.19020	278.74	305.37	1.1690	0.14710	278.31	304.79	1.1472
70	0.19633	287.32	314.80	1.1969	0.15193	286.93	314.28	1.1753
80	0.20241	296.06	324.39	1.2244	0.15672	295.71	323.92	1.2030
90	0.20846	304.95	334.14	1.2516	0.16148	304.63	333.70	1.2303
100	0.21449	314.01	344.04	1.2785	0.16622	313.72	343.63	1.2573
	P = 0.20 MPa (T_{sat} = −10.09°C)				**P = 0.24 MPa** (T_{sat} = −5.37°C)			
Sat.	0.09933	221.43	241.30	0.9253	0.08343	224.07	244.09	0.9222
−10	0.09938	221.50	241.38	0.9256				
0	0.10438	229.23	250.10	0.9582	0.08574	228.31	248.89	0.9399
10	0.10922	237.05	258.89	0.9898	0.08993	236.26	257.84	0.9721
20	0.11394	244.99	267.78	1.0206	0.09399	244.30	266.85	1.0034
30	0.11856	253.06	276.77	1.0508	0.09794	252.45	275.95	1.0339
40	0.12311	261.26	285.88	1.0804	0.10181	260.72	285.16	1.0637
50	0.12758	269.61	295.12	1.1094	0.10562	269.12	294.47	1.0930
60	0.13201	278.10	304.50	1.1380	0.10937	277.67	303.91	1.1218
70	0.13639	286.74	314.02	1.1661	0.11307	286.35	313.49	1.1501
80	0.14073	295.53	323.68	1.1939	0.11674	295.18	323.19	1.1780
90	0.14504	304.47	333.48	1.2212	0.12037	304.15	333.04	1.2055
100	0.14932	313.57	343.43	1.2483	0.12398	313.27	343.03	1.2326

Properties of Superheated Refrigerant R134a

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/(kg·K)	v m³/kg	u kJ/kg	h kJ/kg	s kJ/(kg·K)
	$P = 0.28$ MPa ($T_{sat} = -1.23$°C)				$P = 0.32$ MPa ($T_{sat} = 2.48$°C)			
Sat.	0.07193	226.38	246.52	0.9197	0.06322	228.43	248.66	0.9177
0	0.07240	227.37	247.64	0.9238				
10	0.07613	235.44	256.76	0.9566	0.06576	234.61	255.65	0.9427
20	0.07972	243.59	265.91	0.9883	0.06901	242.87	264.95	0.9749
30	0.08320	251.83	275.12	1.0192	0.07214	251.19	274.28	1.0062
40	0.08660	260.17	284.42	1.0494	0.07518	259.61	283.67	1.0367
50	0.08992	268.64	293.81	1.0789	0.07815	268.14	293.15	1.0665
60	0.09319	277.23	303.32	1.1079	0.08106	276.79	302.72	1.0957
70	0.09641	285.96	312.95	1.1364	0.08392	285.56	312.41	1.1243
80	0.09960	294.82	322.71	1.1644	0.08674	294.46	322.22	1.1525
90	0.10275	303.83	332.60	1.1920	0.08953	303.50	332.15	1.1802
100	0.10587	312.98	342.62	1.2193	0.09229	312.68	342.21	1.2076
110	0.10897	322.27	352.78	1.2461	0.09503	322.00	352.40	1.2345
120	0.11205	331.71	363.08	1.2727	0.09774	331.45	362.73	1.2611
	$P = 0.40$ MPa ($T_{sat} = 8.93$°C)				$P = 0.50$ MPa ($T_{sat} = 15.74$°C)			
Sat.	0.05089	231.97	252.32	0.9145	0.04086	235.64	256.07	0.9117
10	0.05119	232.87	253.35	0.9182				
20	0.05397	241.37	262.96	0.9515	0.04188	239.40	260.34	0.9264
30	0.05662	249.89	272.54	0.8937	0.04416	248.20	270.28	0.9597
40	0.05917	258.47	282.14	1.0148	0.04633	256.99	280.16	0.9918
50	0.06164	267.13	291.79	1.0452	0.04842	265.83	290.04	1.0229
60	0.06405	275.89	301.51	1.0748	0.05043	274.73	299.95	1.0531
70	0.06641	284.75	311.32	1.1038	0.05240	283.72	309.92	1.0825
80	0.06873	293.73	321.23	1.1322	0.05432	292.80	319.96	1.1114
90	0.07102	302.84	331.25	1.1602	0.05620	302.00	330.10	1.1397
100	0.07327	312.07	341.38	1.1878	0.05805	311.31	340.33	1.1675
110	0.07550	321.44	351.64	1.2149	0.05988	320.74	350.68	1.1949
120	0.07771	330.94	362.03	1.2417	0.06168	330.30	361.14	1.2218
130	0.07991	340.58	372.54	1.2681	0.06347	339.98	371.72	1.2484
140	0.08208	350.35	383.18	1.2941	0.06524	349.79	382.42	1.2746

Properties of <u>Superheated</u> Refrigerant R134a

(Continued)

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/(kg·K)	v m³/kg	u kJ/kg	h kJ/kg	s kJ/(kg·K)
	\multicolumn{4}{c}{$P = 0.60$ MPa ($T_{sat} = 21.58$°C)}	\multicolumn{4}{c}{$P = 0.70$ MPa ($T_{sat} = 26.72$°C)}
Sat.	0.03408	238.74	259.19	0.9097	0.02918	241.42	261.85	0.9080
30	0.03581	246.41	267.89	0.9388	0.02979	244.51	265.37	0.9197
40	0.03774	255.45	278.09	0.9719	0.03157	253.83	275.93	0.9539
50	0.03958	264.48	288.23	1.0037	0.03324	263.08	286.35	0.9867
60	0.04134	273.54	298.35	1.0346	0.03482	272.31	296.69	1.0182
70	0.04304	282.66	308.48	1.0645	0.03634	281.57	307.01	1.0487
80	0.04469	291.86	318.67	1.0938	0.03781	290.88	317.35	1.0784
90	0.04631	301.14	328.93	1.1225	0.03924	300.27	327.74	1.1074
100	0.04790	310.53	339.27	1.1505	0.04064	309.74	338.19	1.1358
110	0.04946	320.03	349.70	1.1781	0.04201	319.31	348.71	1.1637
120	0.05099	329.64	360.24	1.2053	0.04335	328.98	359.33	1.1910
130	0.05251	339.38	370.88	1.2320	0.04468	338.76	370.04	1.2179
140	0.05402	349.23	381.64	1.2584	0.04599	348.66	380.86	1.2444
150	0.05550	359.21	392.52	1.2844	0.04729	358.68	391.79	1.2706
160	0.05698	369.32	403.51	1.3100	0.04857	368.82	402.82	1.2963
	\multicolumn{4}{c}{$P = 0.80$ MPa ($T_{sat} = 31.33$°C)}	\multicolumn{4}{c}{$P = 0.90$ MPa ($T_{sat} = 35.53$°C)}
Sat.	0.02547	243.78	264.15	0.9066	0.02255	245.88	266.18	0.9054
40	0.02691	252.13	273.66	0.9374	0.02325	250.32	271.25	0.9217
50	0.02846	261.62	284.39	0.9711	0.02472	260.09	282.34	0.9566
60	0.02992	271.04	294.98	1.0034	0.02609	269.72	293.21	0.9897
70	0.03131	280.45	305.50	1.0345	0.02738	279.30	303.94	1.0214
80	0.03264	289.89	316.00	1.0647	0.02861	288.87	314.62	1.0521
90	0.03393	299.37	326.52	1.0940	0.02980	298.46	325.28	1.0819
100	0.03519	308.93	337.08	1.1227	0.03095	308.11	335.96	1.1109
110	0.03642	318.57	347.71	1.1508	0.03207	317.82	346.68	1.1392
120	0.03762	328.31	358.40	1.1784	0.03316	327.62	357.47	1.1670
130	0.03881	338.14	369.19	1.2055	0.03423	337.52	368.33	1.1943
140	0.03997	348.09	380.07	1.2321	0.03529	347.51	379.27	1.2211
150	0.04113	358.15	391.05	1.2584	0.03633	357.61	390.31	1.2475
160	0.04227	368.32	402.14	1.2843	0.03736	367.82	401.44	1.2735
170	0.04340	378.61	413.33	1.3098	0.03838	378.14	412.68	1.2992
180	0.04452	389.02	424.63	1.3351	0.03939	388.57	424.02	1.3245

Properties of Underlined **Superheated** Refrigerant R134a

T °C	v m³/kg	u kJ/kg	h kJ/kg	s kJ/(kg·K)	v m³/kg	u kJ/kg	h kJ/kg	s kJ/(kg·K)
	P = **1.00 MPa** (T_{sat} = **39.39°C**)				P = **1.20 MPa** (T_{sat} = **46.32°C**)			
Sat.	0.02020	247.77	267.97	0.9043	0.01663	251.03	270.99	0.9023
40	0.02029	248.39	268.68	0.9066				
50	0.02171	258.48	280.19	0.9428	0.01712	254.98	275.52	0.9164
60	0.02301	268.35	291.36	0.9768	0.01835	265.42	287.44	0.9527
70	0.02423	278.11	302.34	1.0093	0.01947	275.59	298.96	0.9868
80	0.02538	287.82	313.20	1.0405	0.02051	285.62	310.24	1.0192
90	0.02649	297.53	324.01	1.0707	0.02150	295.59	321.39	1.0503
100	0.02755	307.27	334.82	1.1000	0.02244	305.54	332.47	1.0804
110	0.02858	317.06	345.65	1.1286	0.02335	315.50	343.52	1.1096
120	0.02959	326.93	356.52	1.1567	0.02423	325.51	354.58	1.1381
130	0.03058	336.88	367.46	1.1841	0.02508	335.58	365.68	1.1660
140	0.03154	346.92	378.46	1.2111	0.02592	345.73	376.83	1.1933
150	0.03250	357.06	389.56	1.2376	0.02674	355.95	388.04	1.2201
160	0.03344	367.31	400.74	1.2638	0.02754	366.27	399.33	1.2465
170	0.03436	377.66	412.02	1.2895	0.02834	376.69	410.70	1.2724
180	0.03528	388.12	423.40	1.3149	0.02912	387.21	422.16	1.2980
	P = **1.40 MPa** (T_{sat} = **52.43°C**)				P = **1.60 MPa** (T_{sat} = **57.92°C**)			
Sat.	0.01405	253.74	273.40	0.9003	0.01208	256.00	275.33	0.8982
60	0.01495	262.17	283.10	0.9297	0.01233	258.48	278.20	0.9069
70	0.01603	272.87	295.31	0.9658	0.01340	269.89	291.33	0.9457
80	0.01701	283.29	307.10	0.9997	0.01435	280.78	303.74	0.9813
90	0.01792	293.55	318.63	1.0319	0.01521	291.39	315.72	1.0148
100	0.01878	303.73	330.02	1.0628	0.01601	301.84	327.46	1.0467
110	0.01960	313.88	341.32	1.0927	0.01677	312.20	339.04	1.0773
120	0.02039	324.05	352.59	1.1218	0.01750	322.53	350.53	1.1069
130	0.02115	334.25	363.86	1.1501	0.01820	332.87	361.99	1.1357
140	0.02189	344.50	375.15	1.1777	0.01887	343.24	373.44	1.1638
150	0.02262	354.82	386.49	1.2048	0.01953	353.66	384.91	1.1912
160	0.02333	365.22	397.89	1.2315	0.02017	364.15	396.43	1.2181
170	0.02403	375.71	409.36	1.2576	0.02080	374.71	407.99	1.2445
180	0.02472	386.29	420.90	1.2834	0.02142	385.35	419.62	1.2704
190	0.02541	396.96	432.53	1.3088	0.02203	396.08	431.33	1.2960
200	0.02608	407.73	444.24	1.3338	0.02263	406.90	443.11	1.3212