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Standard Specification for Propane Thermophysical Property Tables¹

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1. Scope

1.1 The thermophysical property tables for propane are used in calculating the pressure-volume-temperature (PVT), thermodynamic, and transport properties of propane for process design and operations. Two tables provide properties at the conditions of liquid-vapor equilibrium (saturation properties), one for liquid and one for vapor, at temperatures between 90 K and the critical point, 380 K. A third table provides properties at selected T, p points for the equilibrium phase at temperatures between 90 K and 600 K at pressures to 20 MPa. The tables were developed by the National Institute of Standards and Technology from a Standard Reference Database product REFPROP, version 10.0.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Applicability

2.1 These tables apply only to pure gaseous propane. They may also be used in mathematical models and tables for the thermophysical properties of mixtures containing propane.

3. Tables

3.1 These tables were produced by equations from a computer package, “NIST Standard Reference Database 23; Reference Fluid Thermodynamic and Transport Properties Database (REFPROP): Version 10.0.”² A wide selection of units (SI

¹ This specification is under the jurisdiction of ASTM Committee D03 on Gaseous Fuels and is the direct responsibility of Subcommittee D03.08 on Thermophysical Properties.

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² Available from Standard Reference Data, National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, <http://www.nist.gov>.

units, engineering units, chemical units) and additional properties are available with this program.

3.2 These thermophysical property tables are:

3.2.1 *Thermophysical Properties of Propane Liquid at Vapor-Liquid Equilibrium*, in SI units. See **Table 1**.

3.2.2 *Thermophysical Properties of Propane Vapor at Vapor-Liquid Equilibrium*, in SI units. See **Table 2**.

3.2.3 *Thermophysical Properties of Propane Along Isobars*, in SI units. See **Table 3**.

3.3 The symbols are:

T , temperature (K)

ρ , molar density ($\text{mol}\cdot\text{L}^{-1}$)

H , molar enthalpy ($\text{J}\cdot\text{mol}^{-1}$)

S , molar entropy ($\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$)

C_v , constant volume molar heat capacity ($\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$)

C_p , constant pressure molar heat capacity ($\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$)

c , speed of sound ($\text{m}\cdot\text{s}^{-1}$)

η , viscosity ($\mu\text{Pa}\cdot\text{s}$)

λ , thermal conductivity ($\text{mW}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$)

3.4 The tabulated thermophysical properties are:

ρ , molar density ($\text{mol}\cdot\text{L}^{-1}$)

H , molar enthalpy ($\text{J}\cdot\text{mol}^{-1}$)

S , molar entropy ($\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$)

C_v , constant volume molar heat capacity ($\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$)

C_p , constant pressure molar heat capacity ($\text{J}\cdot\text{K}^{-1}\cdot\text{mol}^{-1}$)

c , speed of sound ($\text{m}\cdot\text{s}^{-1}$)

η , viscosity ($\mu\text{Pa}\cdot\text{s}$)

λ , thermal conductivity ($\text{mW}\cdot\text{m}^{-1}\cdot\text{K}^{-1}$)

4. Additional Information

4.1 Reference state properties are required to calculate the thermodynamic properties enthalpy and entropy from an equation of state formulation. The reference state properties used are those specified by the International Institute of Refrigeration (IIR): enthalpy, $H=200\text{ J/g}$, and entropy, $S=1\text{ J/(g}\cdot\text{K)}$, for the saturated liquid at 273.15 K (0 °C).

4.2 The molar mass of propane is 44.096 g/mol.

5. Keywords

5.1 natural gas; propane gas tables; thermodynamic properties of propane; transport properties of propane

TABLE 1 Thermophysical Properties of Propane Liquid at Vapor-Liquid Equilibrium

<i>T</i> K	<i>p</i> MPa	ρ mol·L ⁻¹	<i>H</i> J·mol ⁻¹	<i>S</i> J·mol ⁻¹ ·K ⁻¹	<i>C_v</i> J·mol ⁻¹ ·K ⁻¹	<i>C_p</i> J·mol ⁻¹ ·K ⁻¹	<i>c</i> m·s ⁻¹	η μPa·s	λ mW·m ⁻¹ ·K ⁻¹
90	9.6910E-10	16.520	-8292.7	-57.241	59.512	84.645	2106.1	7624.3	206.64
92	1.9788E-09	16.473	-8123.3	-55.380	59.421	84.730	2092.4	6560.6	206.01
94	3.9100E-09	16.426	-7953.8	-53.557	59.340	84.820	2078.8	5686.1	205.35
96	7.4917E-09	16.379	-7784.1	-51.770	59.269	84.916	2065.1	4962.8	204.66
98	1.3947E-08	16.333	-7614.1	-50.018	59.206	85.016	2051.5	4361.1	203.94
100	2.5272E-08	16.286	-7444.0	-48.299	59.150	85.119	2037.8	3857.6	203.20
102	4.4646E-08	16.240	-7273.7	-46.613	59.100	85.226	2024.1	3433.7	202.42
104	7.7011E-08	16.193	-7103.1	-44.957	59.057	85.336	2010.4	3074.9	201.63
106	1.2989E-07	16.147	-6932.3	-43.330	59.018	85.448	1996.7	2769.2	200.80
108	2.1448E-07	16.101	-6761.3	-41.732	58.984	85.563	1983.0	2507.3	199.96
110	3.4717E-07	16.055	-6590.1	-40.161	58.955	85.680	1969.4	2281.7	199.09
112	5.5143E-07	16.008	-6418.6	-38.616	58.929	85.799	1955.7	2086.2	198.20
114	8.6039E-07	15.962	-6246.9	-37.096	58.907	85.920	1942.1	1915.8	197.29
116	1.3200E-06	15.916	-6074.9	-35.601	58.888	86.042	1928.5	1766.6	196.36
118	1.9930E-06	15.870	-5902.7	-34.129	58.873	86.167	1914.9	1635.2	195.41
120	2.9638E-06	15.825	-5730.2	-32.680	58.860	86.294	1901.3	1518.9	194.45
122	4.3445E-06	15.779	-5557.5	-31.252	58.850	86.422	1887.8	1415.4	193.46
124	6.2822E-06	15.733	-5384.5	-29.846	58.843	86.553	1874.2	1323.0	192.46
126	8.9669E-06	15.687	-5211.3	-28.460	58.838	86.685	1860.7	1240.0	191.44
128	1.2642E-05	15.641	-5037.8	-27.094	58.836	86.820	1847.2	1165.2	190.41
130	1.7614E-05	15.595	-4864.0	-25.747	58.836	86.957	1833.7	1097.5	189.37
132	2.4270E-05	15.550	-4690.0	-24.418	58.839	87.096	1820.3	1036.0	188.31
134	3.3085E-05	15.504	-4515.6	-23.107	58.844	87.237	1806.8	979.87	187.23
136	4.4645E-05	15.458	-4341.0	-21.814	58.852	87.381	1793.4	928.56	186.15
138	5.9662E-05	15.412	-4166.1	-20.537	58.863	87.527	1780.0	881.47	185.05
140	7.8993E-05	15.366	-3990.9	-19.277	58.875	87.675	1766.6	838.13	183.94
142	0.00010366	15.320	-3815.4	-18.032	58.891	87.826	1753.2	798.12	182.82
144	0.00013489	15.275	-3639.6	-16.802	58.909	87.980	1739.8	761.09	181.69
146	0.00017410	15.229	-3463.5	-15.588	58.929	88.136	1726.4	726.74	180.55
148	0.00022297	15.183	-3287.0	-14.388	58.953	88.295	1713.0	694.81	179.41
150	0.00028345	15.137	-3110.3	-13.201	58.979	88.457	1699.7	665.05	178.25
152	0.00035776	15.091	-2933.2	-12.029	59.008	88.621	1686.3	637.27	177.08
154	0.00044848	15.044	-2755.8	-10.869	59.041	88.789	1672.9	611.28	175.91
156	0.00055852	14.998	-2578.0	-9.7223	59.076	88.959	1659.6	586.93	174.73
158	0.00069119	14.952	-2399.9	-8.5880	59.115	89.133	1646.2	564.08	173.55
160	0.00085022	14.906	-2221.5	-7.4657	59.158	89.310	1632.9	542.61	172.35
162	0.0010398	14.859	-2042.7	-6.3552	59.204	89.490	1619.5	522.39	171.16
164	0.0012645	14.813	-1863.5	-5.2560	59.255	89.674	1606.1	503.33	169.95
166	0.0015296	14.766	-1684.0	-4.1679	59.309	89.862	1592.7	485.34	168.74
168	0.0018407	14.719	-1504.0	-3.0906	59.367	90.053	1579.4	468.35	167.53
170	0.0022041	14.673	-1323.7	-2.0238	59.430	90.249	1566.0	452.26	166.32
172	0.0026267	14.626	-1143.0	-0.96706	59.497	90.448	1552.6	437.03	165.10
174	0.0031159	14.579	-961.86	0.079712	59.569	90.652	1539.2	422.58	163.87
176	0.0036799	14.532	-780.32	1.1168	59.646	90.861	1525.9	408.87	162.65
178	0.0043274	14.485	-598.36	2.1446	59.727	91.074	1512.5	395.85	161.42
180	0.0050678	14.437	-415.96	3.1633	59.814	91.292	1499.1	383.46	160.19
182	0.0059115	14.390	-233.11	4.1732	59.905	91.515	1485.7	371.66	158.96
184	0.0068692	14.342	-49.80	5.1745	60.002	91.743	1472.3	360.43	157.73
186	0.0079526	14.295	133.97	6.1675	60.104	91.977	1459.0	349.71	156.49
188	0.0091741	14.247	318.22	7.1523	60.211	92.216	1445.6	339.48	155.26
190	0.010547	14.199	502.96	8.1293	60.324	92.462	1432.2	329.71	154.03
192	0.012085	14.151	688.21	9.0986	60.441	92.713	1418.9	320.37	152.79
194	0.013802	14.102	873.97	10.061	60.565	92.970	1405.5	311.43	151.56
196	0.015715	14.054	1060.3	11.015	60.693	93.234	1392.2	302.88	150.33
198	0.017839	14.005	1247.1	11.963	60.827	93.504	1378.8	294.68	149.10
200	0.020192	13.957	1434.5	12.904	60.966	93.780	1365.5	286.82	147.87
202	0.022791	13.908	1622.5	13.838	61.111	94.064	1352.2	279.27	146.65
204	0.025655	13.858	1811.0	14.766	61.261	94.354	1338.9	272.02	145.42
206	0.028803	13.809	2000.2	15.687	61.416	94.652	1325.7	265.06	144.20
208	0.032255	13.760	2189.9	16.603	61.576	94.957	1312.4	258.36	142.98
210	0.036032	13.710	2380.3	17.512	61.741	95.269	1299.2	251.92	141.76
212	0.040156	13.660	2571.4	18.416	61.912	95.589	1285.9	245.71	140.55
214	0.044649	13.610	2763.1	19.315	62.087	95.917	1272.7	239.72	139.34
216	0.049534	13.560	2955.4	20.208	62.268	96.252	1259.5	233.96	138.13
218	0.054834	13.509	3148.5	21.096	62.453	96.596	1246.4	228.39	136.93
220	0.060574	13.458	3342.3	21.979	62.643	96.948	1233.2	223.01	135.73
222	0.066780	13.407	3536.8	22.857	62.838	97.308	1220.1	217.82	134.53
224	0.073476	13.356	3732.1	23.730	63.037	97.676	1206.9	212.80	133.34
226	0.080689	13.304	3928.1	24.599	63.241	98.053	1193.8	207.94	132.16
228	0.088447	13.252	4125.0	25.464	63.449	98.438	1180.7	203.24	130.98
230	0.096776	13.200	4322.6	26.324	63.662	98.833	1167.6	198.68	129.80
232	0.10570	13.148	4521.0	27.180	63.879	99.236	1154.5	194.27	128.63
234	0.11526	13.095	4720.3	28.032	64.101	99.649	1141.5	189.99	127.46
236	0.12548	13.042	4920.4	28.880	64.327	100.07	1128.4	185.83	126.30

TABLE 1 *Continued*

<i>T</i> K	<i>p</i> MPa	ρ mol·L ⁻¹	<i>H</i> J·mol ⁻¹	<i>S</i> J·mol ⁻¹ ·K ⁻¹	<i>C_v</i> J·mol ⁻¹ ·K ⁻¹	<i>C_p</i> J·mol ⁻¹ ·K ⁻¹	<i>c</i> m·s ⁻¹	η μPa·s	λ mW·m ⁻¹ ·K ⁻¹
238	0.13638	12.989	5121.4	29.725	64.557	100.50	1115.3	181.80	125.15
240	0.14800	12.935	5323.3	30.566	64.792	100.94	1102.3	177.88	124.00
242	0.16037	12.881	5526.1	31.404	65.031	101.39	1089.2	174.07	122.86
244	0.17352	12.827	5729.8	32.238	65.274	101.86	1076.2	170.37	121.73
246	0.18748	12.772	5934.5	33.069	65.522	102.33	1063.1	166.77	120.60
248	0.20228	12.717	6140.2	33.897	65.774	102.81	1050.1	163.26	119.48
250	0.21796	12.662	6346.9	34.722	66.030	103.30	1037.1	159.85	118.37
252	0.23455	12.606	6554.6	35.544	66.290	103.81	1024.0	156.52	117.26
254	0.25209	12.550	6763.3	36.364	66.555	104.32	1010.9	153.28	116.16
256	0.27060	12.493	6973.1	37.180	66.824	104.85	997.87	150.11	115.06
258	0.29012	12.436	7183.9	37.995	67.098	105.39	984.80	147.02	113.97
260	0.31068	12.379	7395.9	38.807	67.375	105.94	971.73	144.01	112.89
262	0.33233	12.320	7609.0	39.617	67.658	106.51	958.64	141.06	111.82
264	0.35509	12.262	7823.3	40.424	67.944	107.09	945.54	138.18	110.75
266	0.37901	12.203	8038.8	41.230	68.235	107.69	932.43	135.37	109.70
268	0.40411	12.143	8255.4	42.034	68.530	108.30	919.32	132.62	108.64
270	0.43043	12.083	8473.3	42.836	68.830	108.92	906.18	129.93	107.60
272	0.45801	12.023	8692.5	43.636	69.134	109.56	893.04	127.29	106.56
274	0.48689	11.961	8913.0	44.435	69.442	110.22	879.88	124.71	105.54
276	0.51711	11.899	9134.8	45.232	69.755	110.89	866.70	122.18	104.51
278	0.54869	11.837	9357.9	46.028	70.072	111.59	853.50	119.71	103.50
280	0.58169	11.774	9582.5	46.823	70.393	112.30	840.29	117.28	102.50
282	0.61613	11.710	9808.4	47.617	70.719	113.04	827.06	114.90	101.50
284	0.65205	11.645	10036	48.410	71.049	113.79	813.81	112.56	100.51
286	0.68951	11.580	10265	49.201	71.384	114.57	800.53	110.26	99.524
288	0.72852	11.514	10495	49.993	71.723	115.38	787.23	108.01	98.548
290	0.76914	11.447	10727	50.783	72.066	116.21	773.90	105.80	97.581
292	0.81140	11.380	10961	51.573	72.414	117.06	760.55	103.62	96.621
294	0.85535	11.311	11196	52.363	72.766	117.95	747.16	101.48	95.669
296	0.90101	11.242	11433	53.153	73.122	118.87	733.75	99.380	94.725
298	0.94844	11.171	11672	53.943	73.484	119.82	720.30	97.311	93.788
300	0.99768	11.100	11913	54.733	73.850	120.80	706.81	95.274	92.858
302	1.0488	11.027	12155	55.523	74.221	121.83	693.28	93.269	91.936
304	1.1017	10.954	12399	56.313	74.596	122.90	679.71	91.293	91.021
306	1.1567	10.879	12646	57.105	74.977	124.01	666.09	89.346	90.113
308	1.2135	10.803	12894	57.897	75.363	125.18	652.42	87.426	89.213
310	1.2724	10.726	13145	58.690	75.754	126.40	638.70	85.533	88.319
312	1.3334	10.647	13398	59.484	76.151	127.68	624.91	83.664	87.432
314	1.3965	10.567	13653	60.280	76.554	129.02	611.07	81.818	86.552
316	1.4617	10.485	13910	61.078	76.964	130.44	597.16	79.995	85.678
318	1.5292	10.402	14170	61.877	77.379	131.93	583.18	78.193	84.810
320	1.5989	10.317	14432	62.679	77.802	133.52	569.12	76.410	83.948
322	1.6708	10.230	14698	63.483	78.232	135.20	554.97	74.646	83.092
324	1.7452	10.141	14966	64.291	78.670	137.00	540.74	72.899	82.241
326	1.8219	10.051	15237	65.102	79.116	138.93	526.40	71.167	81.395
328	1.9011	9.9574	15511	65.916	79.572	141.00	511.96	69.450	80.554
330	1.9828	9.8617	15789	66.735	80.038	143.24	497.40	67.744	79.717
332	2.0671	9.7634	16070	67.558	80.515	145.67	482.72	66.050	78.884
334	2.1540	9.6622	16355	68.387	81.004	148.33	467.90	64.364	78.055
336	2.2436	9.5578	16644	69.222	81.506	151.24	452.93	62.684	77.229
338	2.3359	9.4499	16937	70.064	82.024	154.47	437.79	61.009	76.405
340	2.4311	9.3382	17235	70.913	82.558	158.07	422.46	59.336	75.584
342	2.5291	9.2222	17539	71.772	83.112	162.12	406.93	57.661	74.764
344	2.6300	9.1014	17848	72.640	83.689	166.73	391.16	55.982	73.947
346	2.7340	8.9751	18163	73.521	84.294	172.03	375.11	54.294	73.131
348	2.8411	8.8427	18485	74.415	84.934	178.21	358.76	52.592	72.317
350	2.9514	8.7030	18815	75.325	85.617	185.54	342.06	50.870	71.507
352	3.0650	8.5550	19155	76.255	86.357	194.39	324.94	49.121	70.704
354	3.1820	8.3970	19505	77.208	87.170	205.36	307.36	47.336	69.912
356	3.3025	8.2269	19868	78.189	88.082	219.35	289.24	45.501	69.144
358	3.4266	8.0418	20246	79.206	89.127	237.92	270.49	43.601	68.420
360	3.5545	7.8371	20645	80.271	90.358	263.88	250.99	41.609	67.783
362	3.6864	7.6062	21069	81.400	91.863	303.00	230.58	39.487	67.330
364	3.8224	7.3371	21532	82.624	93.801	369.18	209.01	37.168	67.296
366	3.9629	7.0055	22056	84.005	96.517	506.34	185.86	34.528	68.355
368	4.1084	6.5428	22708	85.725	101.03	960.63	160.18	31.328	73.051

TABLE 2 Thermophysical Properties of Propane Vapor at Vapor-Liquid Equilibrium

<i>T</i> K	<i>p</i> MPa	ρ mol·L ⁻¹	<i>H</i> J·mol ⁻¹	<i>S</i> J·mol ⁻¹ ·K ⁻¹	<i>C_v</i> J·mol ⁻¹ ·K ⁻¹	<i>C_p</i> J·mol ⁻¹ ·K ⁻¹	<i>c</i> m·s ⁻¹	η μPa·s	λ mW·m ⁻¹ ·K ⁻¹
90	9.6910E-10	1.2951E-09	16326	216.30	31.236	39.550	146.59	2.4488	1.9194
92	1.9788E-09	2.5869E-09	16405	211.23	31.584	39.898	148.03	2.5037	2.0166
94	3.9100E-09	5.0028E-09	16485	206.43	31.931	40.246	149.46	2.5586	2.1150
96	7.4917E-09	9.3859E-09	16566	201.88	32.277	40.591	150.88	2.6136	2.2145
98	1.3947E-08	1.7117E-08	16648	197.55	32.621	40.935	152.28	2.6685	2.3152
100	2.5272E-08	3.0395E-08	16730	193.44	32.962	41.277	153.66	2.7235	2.4171
102	4.4646E-08	5.2643E-08	16813	189.53	33.301	41.615	155.03	2.7785	2.5201
104	7.7011E-08	8.9061E-08	16896	185.81	33.636	41.951	156.39	2.8335	2.6243
106	1.2989E-07	1.4738E-07	16980	182.26	33.969	42.284	157.73	2.8885	2.7296
108	2.1448E-07	2.3886E-07	17065	178.89	34.298	42.613	159.06	2.9435	2.8362
110	3.4717E-07	3.7959E-07	17151	175.67	34.624	42.939	160.38	2.9985	2.9439
112	5.5143E-07	5.9216E-07	17237	172.60	34.947	43.261	161.69	3.0535	3.0527
114	8.6039E-07	9.0773E-07	17324	169.66	35.266	43.580	162.98	3.1085	3.1627
116	1.3200E-06	1.3686E-06	17411	166.87	35.582	43.896	164.27	3.1636	3.2739
118	1.9930E-06	2.0313E-06	17499	164.19	35.894	44.209	165.54	3.2186	3.3863
120	2.9638E-06	2.9705E-06	17588	161.64	36.203	44.518	166.80	3.2736	3.4998
122	4.3445E-06	4.2831E-06	17678	159.20	36.509	44.824	168.05	3.3287	3.6145
124	6.2822E-06	6.0934E-06	17767	156.86	36.812	45.127	169.30	3.3837	3.7303
126	8.9669E-06	8.5594E-06	17858	154.63	37.112	45.427	170.53	3.4388	3.8474
128	1.2642E-05	1.1879E-05	17949	152.49	37.409	45.725	171.75	3.4938	3.9655
130	1.7614E-05	1.6297E-05	18041	150.44	37.704	46.020	172.96	3.5488	4.0849
132	2.4270E-05	2.2115E-05	18133	148.48	37.996	46.313	174.17	3.6039	4.2054
134	3.3085E-05	2.9698E-05	18226	146.61	38.286	46.603	175.36	3.6589	4.3270
136	4.4645E-05	3.9486E-05	18319	144.81	38.575	46.892	176.54	3.7140	4.4498
138	5.9662E-05	5.2003E-05	18413	143.08	38.861	47.179	177.72	3.7690	4.5738
140	7.8993E-05	6.7871E-05	18508	141.43	39.146	47.465	178.88	3.8240	4.6989
142	0.00010366	8.7817E-05	18603	139.84	39.429	47.750	180.04	3.8790	4.8252
144	0.00013489	0.00011269	18699	138.32	39.712	48.034	181.18	3.9340	4.9527
146	0.00017410	0.00014346	18795	136.87	39.993	48.317	182.32	3.9890	5.0812
148	0.00022297	0.00018126	18891	135.47	40.274	48.600	183.45	4.0440	5.2110
150	0.00028345	0.00022736	18988	134.12	40.554	48.882	184.57	4.0990	5.3418
152	0.00035776	0.00028322	19086	132.84	40.833	49.165	185.67	4.1539	5.4738
154	0.00044848	0.00035046	19184	131.60	41.112	49.448	186.77	4.2088	5.6070
156	0.00055852	0.00043091	19283	130.41	41.392	49.731	187.86	4.2637	5.7412
158	0.00069119	0.00052658	19382	129.27	41.671	50.016	188.94	4.3186	5.8766
160	0.00085022	0.00063974	19481	128.18	41.952	50.301	190.01	4.3735	6.0131
162	0.0010398	0.00077285	19581	127.13	42.232	50.589	191.06	4.4283	6.1508
164	0.0012645	0.00092862	19682	126.12	42.514	50.877	192.11	4.4831	6.2895
166	0.0015296	0.0011100	19783	125.15	42.796	51.168	193.14	4.5378	6.4293
168	0.0018407	0.0013202	19884	124.22	43.080	51.462	194.17	4.5925	6.5703
170	0.0022041	0.0015627	19986	123.32	43.366	51.758	195.18	4.6472	6.7123
172	0.0026267	0.0018412	20088	122.47	43.653	52.057	196.18	4.7018	6.8554
174	0.0031159	0.0021598	20190	121.64	43.942	52.359	197.17	4.7563	6.9996
176	0.0036799	0.0025227	20293	120.85	44.234	52.665	198.15	4.8108	7.1449
178	0.0043274	0.0029345	20396	120.09	44.527	52.975	199.11	4.8653	7.2913
180	0.0050678	0.0034000	20499	119.36	44.824	53.290	200.06	4.9197	7.4387
182	0.0059115	0.0039244	20603	118.66	45.123	53.609	200.99	4.9740	7.5872
184	0.0068692	0.0045132	20707	117.98	45.426	53.933	201.92	5.0283	7.7367
186	0.0079526	0.0051720	20811	117.33	45.731	54.263	202.82	5.0825	7.8873
188	0.0091741	0.0059068	20915	116.71	46.040	54.597	203.71	5.1366	8.0390
190	0.010547	0.0067240	21020	116.11	46.353	54.938	204.59	5.1906	8.1917
192	0.012085	0.0076301	21125	115.54	46.670	55.285	205.45	5.2446	8.3454
194	0.013802	0.0086319	21230	114.99	46.990	55.638	206.30	5.2985	8.5002
196	0.015715	0.0097366	21335	114.46	47.314	55.998	207.12	5.3523	8.6561
198	0.017839	0.010952	21441	113.95	47.643	56.364	207.93	5.4060	8.8130
200	0.020192	0.012285	21546	113.46	47.975	56.737	208.73	5.4597	8.9710
202	0.022791	0.013744	21652	112.99	48.312	57.118	209.50	5.5132	9.1300
204	0.025655	0.015337	21758	112.55	48.653	57.505	210.26	5.5667	9.2902
206	0.028803	0.017073	21864	112.11	48.998	57.900	210.99	5.6201	9.4514
208	0.032255	0.018961	21970	111.70	49.348	58.303	211.71	5.6734	9.6137
210	0.036032	0.021009	22076	111.30	49.702	58.713	212.41	5.7267	9.7771
212	0.040156	0.023227	22182	110.92	50.060	59.130	213.08	5.7798	9.9416
214	0.044649	0.025625	22289	110.56	50.442	59.556	213.74	5.8329	10.107
216	0.049534	0.028212	22395	110.21	50.789	59.990	214.37	5.8859	10.274
218	0.054834	0.030998	22501	109.87	51.160	60.431	214.98	5.9389	10.442
220	0.060574	0.033994	22607	109.55	51.535	60.881	215.57	5.9917	10.611
222	0.066780	0.037210	22713	109.24	51.914	61.339	216.14	6.0445	10.782
224	0.073476	0.040658	22819	108.94	52.297	61.805	216.68	6.0973	10.953
226	0.080689	0.044349	22926	108.66	52.684	62.281	217.20	6.1500	11.126
228	0.088447	0.048293	23031	108.39	53.075	62.764	217.69	6.2027	11.301
230	0.096776	0.052503	23137	108.13	53.470	63.257	218.16	6.2554	11.477
232	0.10570	0.056991	23243	107.88	53.868	63.759	218.61	6.3080	11.654
234	0.11526	0.061770	23348	107.64	54.271	64.270	219.03	6.3606	11.832
236	0.12548	0.066851	23454	107.41	54.677	64.790	219.42	6.4132	12.013

TABLE 2 *Continued*

<i>T</i> K	<i>p</i> MPa	ρ mol·L ⁻¹	<i>H</i> J·mol ⁻¹	<i>S</i> J·mol ⁻¹ ·K ⁻¹	<i>C_v</i> J·mol ⁻¹ ·K ⁻¹	<i>C_p</i> J·mol ⁻¹ ·K ⁻¹	<i>c</i> m·s ⁻¹	η μPa·s	λ mW·m ⁻¹ ·K ⁻¹
238	0.13638	0.072248	23559	107.19	55.087	65.320	219.79	6.4658	12.195
240	0.14800	0.077974	23664	106.98	55.501	65.860	220.12	6.5185	12.378
242	0.16037	0.084043	23768	106.79	55.919	66.411	220.43	6.5712	12.563
244	0.17352	0.090469	23873	106.59	56.341	66.972	220.72	6.6239	12.750
246	0.18748	0.097266	23977	106.41	56.766	67.544	221.02	6.6768	12.939
248	0.20228	0.10445	24081	106.24	57.195	68.127	221.20	6.7297	13.130
250	0.21796	0.11203	24184	106.07	57.628	68.722	221.39	6.7827	13.323
252	0.23455	0.12004	24287	105.91	58.065	69.330	221.56	6.8359	13.518
254	0.25209	0.12847	24390	105.76	58.506	69.950	221.69	6.8892	13.715
256	0.27060	0.13736	24493	105.62	58.950	70.583	221.79	6.9427	13.915
258	0.29012	0.14671	24594	105.48	59.399	71.231	221.86	6.9964	14.117
260	0.31068	0.15655	24696	105.35	59.852	71.893	221.90	7.0503	14.322
262	0.33233	0.16690	24797	105.22	60.310	72.571	221.90	7.1046	14.529
264	0.35509	0.17776	24897	105.10	60.771	73.264	221.88	7.1591	14.739
266	0.37901	0.18917	24997	104.98	61.237	73.975	221.81	7.2139	14.953
268	0.40411	0.20115	25096	104.87	61.708	74.704	221.71	7.2691	15.169
270	0.43043	0.21371	25195	104.77	62.184	75.451	221.58	7.3247	15.389
272	0.45801	0.22687	25293	104.67	62.664	76.219	221.41	7.3808	15.612
274	0.48689	0.24067	25390	104.57	63.150	77.008	221.20	7.4373	15.839
276	0.51711	0.25513	25487	104.48	63.641	77.819	220.96	7.4945	16.070
278	0.54869	0.27026	25583	104.39	64.137	78.655	220.68	7.5522	16.305
280	0.58169	0.28611	25678	104.31	64.639	79.516	220.36	7.6105	16.544
282	0.61613	0.30269	25772	104.22	65.147	80.404	220.00	7.6696	16.788
284	0.65205	0.32003	25865	104.15	65.660	81.322	219.59	7.7294	17.037
286	0.68951	0.33817	25957	104.07	66.181	82.270	219.15	7.7901	17.291
288	0.72852	0.35715	26049	104.00	66.707	83.252	218.67	7.8516	17.550
290	0.76914	0.37698	26139	103.93	67.240	84.269	218.14	7.9142	17.815
292	0.81140	0.39772	26228	103.86	67.781	85.324	217.57	7.9779	18.086
294	0.85535	0.41940	26316	103.79	68.328	86.420	216.95	8.0427	18.364
296	0.90101	0.44206	26403	103.73	68.883	87.561	216.29	8.1087	18.648
298	0.94844	0.46575	26488	103.66	69.446	88.749	215.58	8.1762	18.940
300	0.99768	0.49051	26572	103.60	70.016	89.989	214.82	8.2451	19.239
302	1.0488	0.51640	26655	103.53	70.595	91.285	214.02	8.3156	19.546
304	1.1017	0.54347	26736	103.47	71.183	92.642	213.16	8.3879	19.862
306	1.1567	0.57177	26815	103.41	71.779	94.065	212.26	8.4620	20.188
308	1.2135	0.60137	26893	103.35	72.385	95.560	211.30	8.5382	20.523
310	1.2724	0.63234	26969	103.28	73.000	97.136	210.28	8.6166	20.869
312	1.3334	0.66475	27043	103.22	73.625	98.799	209.21	8.6974	21.227
314	1.3965	0.69869	27114	103.15	74.261	100.56	208.09	8.7808	21.597
316	1.4617	0.73423	27184	103.08	74.908	102.43	206.91	8.8671	21.981
318	1.5292	0.77149	27251	103.01	75.566	104.41	205.66	8.9565	22.378
320	1.5989	0.81055	27316	102.94	76.237	106.53	204.35	9.0492	22.792
322	1.6708	0.85155	27378	102.86	76.920	108.80	202.98	9.1457	23.223
324	1.7452	0.89461	27437	102.78	77.616	111.24	201.55	9.2462	23.672
326	1.8219	0.93987	27493	102.70	78.324	113.87	200.04	9.3511	24.143
328	1.9011	0.98750	27546	102.61	79.044	116.71	198.47	9.4610	24.636
330	1.9828	1.0377	27595	102.51	79.776	119.81	196.82	9.5763	25.154
332	2.0671	1.0906	27640	102.41	80.521	123.20	195.10	9.6976	25.700
334	2.1540	1.1466	27681	102.30	81.280	126.93	193.30	9.8255	26.279
336	2.2436	1.2058	27716	102.18	82.057	131.07	191.43	9.9610	26.893
338	2.3359	1.2685	27747	102.04	82.857	135.72	189.47	10.105	27.549
340	2.4311	1.3353	27771	101.90	83.689	140.98	187.44	10.258	28.252
342	2.5291	1.4064	27790	101.75	84.562	147.00	185.31	10.422	29.011
344	2.6300	1.4824	27800	101.57	85.487	153.96	183.10	10.599	29.835
346	2.7340	1.5640	27803	101.38	86.476	162.11	180.78	10.789	30.738
348	2.8411	1.6518	27796	101.17	87.541	171.79	178.36	10.996	31.734
350	2.9514	1.7468	27778	100.93	88.693	183.45	175.83	11.223	32.846
352	3.0650	1.8503	27748	100.67	89.942	197.76	173.18	11.474	34.102
354	3.1820	1.9637	27703	100.37	91.301	215.70	170.39	11.753	35.542
356	3.3025	2.0892	27641	100.02	92.786	238.85	167.47	12.068	37.221
358	3.4266	2.2297	27556	99.625	94.421	269.86	164.38	12.428	39.224
360	3.5545	2.3896	27444	99.157	96.243	313.56	161.12	12.849	41.687
362	3.6864	2.5756	27293	98.593	98.318	379.78	157.65	13.356	44.845
364	3.8224	2.7995	27089	97.890	100.77	491.96	153.89	13.991	49.164
366	3.9629	3.0857	26796	96.958	103.87	722.87	149.70	14.853	55.772
368	4.1084	3.5029	26323	95.546	108.36	1463.7	144.54	16.295	68.804

TABLE 3 Thermophysical Properties of Propane Along Isobars

<i>T</i> K	ρ mol·L ⁻¹	<i>H</i> J·mol ⁻¹	<i>S</i> J·mol ⁻¹ ·K ⁻¹	<i>C_V</i> J·mol ⁻¹ ·K ⁻¹	<i>C_P</i> J·mol ⁻¹ ·K ⁻¹	<i>c</i> m·s ⁻¹	η μPa·s	λ mW·m ⁻¹ ·K ⁻¹
Pressure = 0.1 MPa								
90	16.521	-8287.4	-57.250	59.516	84.644	2106.4	7632.2	206.66
100	16.287	-7438.7	-48.308	59.154	85.118	2038.1	3861.4	203.22
110	16.055	-6584.8	-40.170	58.959	85.678	1969.7	2283.8	199.12
120	15.825	-5725.0	-32.689	58.864	86.291	1901.7	1520.2	194.47
130	15.596	-4858.8	-25.756	58.840	86.953	1834.1	1098.4	189.40
140	15.367	-3985.8	-19.286	58.880	87.671	1767.0	838.80	183.97
150	15.138	-3105.2	-13.211	58.983	88.451	1700.1	665.58	178.28
160	14.907	-2216.5	-7.4761	59.163	89.304	1633.4	543.04	172.38
170	14.674	-1318.8	-2.0344	59.435	90.241	1566.5	452.62	166.34
180	14.439	-411.32	3.1526	59.818	91.283	1499.7	383.76	160.22
190	14.200	507.24	8.1186	60.328	92.452	1432.8	329.97	154.05
200	13.958	1438.2	12.894	60.970	93.770	1366.1	287.02	147.88
210	13.711	2383.2	17.504	61.744	95.259	1299.7	252.07	141.76
220	13.459	3344.0	21.973	62.645	96.940	1233.5	223.10	135.73
230	13.200	4322.7	26.323	63.662	98.832	1167.7	198.69	129.79
230.74	13.181	4395.7	26.640	63.742	98.981	1162.8	197.04	129.36
230.74	0.054127	23176	108.03	53.616	63.441	218.33	6.275	11.542
240	0.051792	23769	110.55	55.062	64.673	222.95	6.533	12.396
250	0.049510	24423	113.22	56.692	66.117	227.74	6.809	13.345
260	0.047439	25092	115.85	58.390	67.665	232.35	7.085	14.322
270	0.045547	25777	118.43	60.149	69.302	236.81	7.359	15.327
280	0.043811	26478	120.98	61.964	71.015	241.13	7.631	16.361
290	0.042210	27197	123.50	63.823	72.790	245.33	7.903	17.423
300	0.040729	27934	126.00	65.720	74.616	249.43	8.173	18.513
310	0.039353	28690	128.48	67.647	76.482	253.42	8.441	19.632
320	0.038070	29464	130.94	69.596	78.380	257.34	8.708	20.780
330	0.036872	30258	133.38	71.563	80.301	261.17	8.974	21.956
340	0.035750	31070	135.80	73.540	82.240	264.93	9.239	23.161
350	0.034696	31902	138.22	75.524	84.190	268.62	9.502	24.394
360	0.033704	32754	140.62	77.510	86.146	272.26	9.763	25.657
370	0.032769	33625	143.00	79.493	88.104	275.83	10.024	26.948
380	0.031886	34516	145.38	81.471	90.058	279.35	10.282	28.268
390	0.031049	35426	147.74	83.439	92.006	282.82	10.540	29.617
400	0.030257	36356	150.10	85.395	93.944	286.25	10.795	30.995
410	0.029505	37305	152.44	87.336	95.869	289.63	11.050	32.401
420	0.028789	38274	154.77	89.261	97.779	292.97	11.302	33.837
430	0.028109	39261	157.10	91.167	99.672	296.26	11.553	35.301
440	0.027460	40267	159.41	93.053	101.55	299.52	11.803	36.794
450	0.026841	41292	161.71	94.917	103.40	302.74	12.051	38.317
460	0.026249	42335	164.01	96.759	105.23	305.93	12.297	39.868
470	0.025683	43396	166.29	98.578	107.04	309.08	12.541	41.448
480	0.025142	44476	168.56	100.37	108.83	312.20	12.784	43.057
490	0.024623	45573	170.82	102.14	110.59	315.29	13.025	44.696
500	0.024125	46687	173.07	103.89	112.33	318.35	13.264	46.363
510	0.023647	47819	175.32	105.61	114.05	321.37	13.501	48.059
520	0.023188	48968	177.55	107.31	115.74	324.37	13.737	49.784
530	0.022746	50134	179.77	108.98	117.41	327.34	13.971	51.539
540	0.022322	51316	181.98	110.63	119.05	330.29	14.203	53.322
550	0.021912	52515	184.18	112.25	120.67	333.21	14.433	55.134
560	0.021518	53730	186.36	113.85	122.27	336.10	14.661	56.976
570	0.021138	54960	188.54	115.43	123.84	338.97	14.888	58.846
580	0.020771	56206	190.71	116.98	125.39	341.81	15.112	60.746
590	0.020416	57468	192.87	118.51	126.91	344.63	15.335	62.674
600	0.020074	58745	195.01	120.02	128.42	347.43	15.556	64.632
Pressure = 1 MPa								
90	16.527	-8240.0	-57.327	59.550	84.633	2109.1	7703.4	206.86
100	16.294	-7391.4	-48.387	59.189	85.104	2041.1	3896.0	203.45
110	16.063	-6537.6	-40.250	58.995	85.659	1972.9	2302.9	199.38
120	15.834	-5678.0	-32.771	58.901	86.266	1905.1	1532.1	194.77
130	15.605	-4812.1	-25.841	58.878	86.922	1837.8	1106.6	189.72
140	15.377	-3939.4	-19.373	58.918	87.632	1771.0	844.90	184.33
150	15.148	-3059.3	-13.302	59.023	88.403	1704.4	670.37	178.66
160	14.918	-2171.1	-7.5697	59.204	89.245	1637.9	546.97	172.80
170	14.687	-1274.1	-2.1318	59.477	90.171	1571.5	455.95	166.80
180	14.452	-367.35	3.0507	59.862	91.199	1505.0	386.64	160.70
190	14.215	550.29	8.0119	60.371	92.352	1438.6	332.52	154.57
200	13.975	1480.2	12.781	61.013	93.651	1372.4	289.32	148.45
210	13.730	2423.9	17.385	61.786	95.116	1306.5	254.18	142.36
220	13.480	3383.1	21.847	62.685	96.767	1241.0	225.07	136.35
230	13.223	4359.9	26.189	63.700	98.620	1175.8	200.55	130.43
240	12.960	5356.3	30.429	64.825	100.70	1110.8	179.57	124.63
250	12.687	6374.6	34.586	66.057	103.02	1045.6	161.35	118.98
260	12.404	7417.6	38.676	67.395	105.63	980.08	145.31	113.47