International Journal of Thermophysics, Vol. 10, No. 5, 1989

The Thermal Conductivity of Propane[1]

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This paper presents thermal conductivity measurements of propane over the temperature range of 192–320 K, at pressures to 70 MPa, and densities to 15 $\mathrm{mol \cdot L^{-1}}$, using a transient line-source instrument. The precision and reproducibility of the instrument are within ±0.5%. The measurements are estimated to be accurate to ±1.5%. A correlation of the present data, together with other available data in the range 110–580 K up to 70 MPa, including the anomalous critical region, is presented. This correlation of the over 800 data points is estimated to be accurate within ±7.5%.

KEY WORDS: high pressure; propane; thermal conductivity.

1. INTRODUCTION

In this paper, absolute measurements of the thermal conductivity of propane are reported in the range of 193–300 K at pressures to 70 MPa. These data, together with those from other sources [1–5] in the range 120–580 K at pressures to 70 MPa, including the anomalous critical region, are correlated within ±7.5%.

Previous work on the measurement and correlation of the thermal conductivity of propane include that reported in the temperature range 111–300 K [1, 2] and that reported by Tufeu and Le Neindre [3] in the range of 300–480 K. The maximum pressure in the above cases was limited to about 70 MPa.

Holland et al. [6] present a correlation in the range of 140–500 K from 1 to 50 MPa. This correlation, however, has a large uncertainty, due

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[1] Paper presented at the Tenth Symposium on Thermophysical Properties, June 20–23, 1988, Gaithersburg, Maryland, U.S.A.

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primarily to the lack of reliable data available at the time it was made. The present work, therefore, permits comparison of the latest experimental measurements and provides a correlation of the data over a wider range of temperature than earlier studies.

The precision and reproducibility of the instrument used for the thermal conductivity measurement are estimated to be ±0.5% and the measurements are estimated to be accurate within ±1.5% [7].

2. EXPERIMENTAL

The investigation was carried out with a transient hot-wire instrument of the compensating type [7]. The calibration coefficients and length and diameter of the wires used are given in Table I. The principle of the measurement, as well as various components of the apparatus (e.g., the conductivity cell, the thermostat, the pressurizing system, the measurement

Table I. Calibration Coefficients and Specifications of the Wire and Test Fluid

(a) Calibration equation

$$R = a_0 + a_1 T + a_2 T^2 + bP$$

T (°C), P (MPa)

(b) Wire specification and calibration coefficients

	Long wire	Short wire
Purity (%)	99.999	99.999
Length (m)	8.661$E-02$	4.6816$E-02$
Diameter μm)	12.7	12.7
a_0	68.39340	36.67749
a_1	0.265132	0.142398
a_2	−3.95057$E-05$	−2.021200$E-05$
b	−1.22823$E-03$	−6.62392$E-04$

(c) Specification of the test fluid

Test fluid	Propane
Purity	99.99% pure
T_{TP}	85.47 K
T_{cr}	369.80 K
P_{cr}	4.24204 MPa
ρ_{cr}	4.96 mol · L^{-1} (0.2187 g · cm^{-3})
M	44.097

system, and the uncertainty in the results) are described in detail elsewhere [7, 8].

A hot wire immersed vertically in the fluid, initially in thermal equilibrium, is subjected to a step voltage at $t = 0$. The transient temperature rise (ΔT_w) of the wire is obtained by the solution of Fourier's equation [9]:

$$\Delta T = \frac{Q_1}{4\pi\lambda(\rho, T)} \ln\left[\frac{4\alpha t}{a^2 C}\right] \tag{1}$$

$$T_{re} = T_0 + \tfrac{1}{2}[\Delta T(t_1) + \Delta T(t_2)] \tag{2}$$

$$\Delta T = \Delta T_w + \sum \delta T_i \tag{3}$$

where ΔT_w is the experimentally measured temperature rise of the hot wire.[4] The corrections, δT_i, are described in detail elsewhere [9, 10].

A straight line is fitted to the $\Delta T \sim \ln(t)$ data by linear regression over selected ranges of time. The thermal conductivity is calculated from the slope of this line and the applied power, using Eq. (1). The applied power, which decreases by up to 2% for a 5 K temperature rise of the hot wire, is determined from simultaneous measurements of the current and the out-of-balance voltage across the wires. These measurements are also used to evaluate the temperature rise of each wire.

Experimental runs obtained with low-pressure propane vapor show the expected linear $\Delta T \sim \ln(t)$ behavior at large times; at shorter times, the effect of thermal accommodation can be seen [11]. Results obtained with liquid propane are linear over the period 200–1000 ms.

3. RESULTS

The thermal conductivity of propane was measured along six isotherms at nominal temperatures of 193, 209, 220, 229, 252, and 261 K at pressures up to 70 MPa. In all, 129 measurements are reported covering the density range $0.01 < \rho < 15\ \text{mol} \cdot \text{L}^{-1}$.

In addition to the temperature (T_0; K), pressure (P; kPa), and thermal conductivity (λ; $\text{mW} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$), the fluid density ($\rho$; $\text{mol} \cdot \text{L}^{-1}$) is also tabulated in Table II. The density of propane was obtained from Ref. 12.

The accuracy of the present measurement can, in part, be inferred

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[4] Definitions of terms are given under Nomenclature, below.

Table II. Experimental Data for the Thermal Conductivity of Propane and Comparison with the NBS Correlation [1]

ID No.	T (K)	P (kPa)	ρ $(\mathrm{mol \cdot L^{-3}})$	ρ $(\mathrm{g \cdot cm^{-3}})$	λ_{corr} $(\mathrm{mW \cdot m^{-1} \cdot K^{-1}})$	λ_{exp} $(\mathrm{mW \cdot m \cdot K^{-1}})$	Dev. (%)
			For liquid				
088	192.93	581.2	14.14	0.623	154.928	157.541	1.659
085	193.43	582.6	14.13	0.623	154.597	153.727	−0.566
098	193.35	581.2	14.13	0.623	154.652	154.429	−0.144
067	193.63	928.7	14.13	0.623	154.687	153.259	−0.932
068	193.86	928.0	14.12	0.623	154.520	154.528	0.005
001	193.54	953.7	14.13	0.623	154.760	153.388	−0.894
008	193.88	969.5	14.12	0.623	154.543	153.285	−0.820
009	193.80	974.8	14.12	0.623	154.605	153.468	−0.740
075	194.81	6838.9	14.20	0.626	157.389	157.169	−0.140
007	194.35	8201.4	14.24	0.628	158.442	157.085	−0.864
006	193.99	41932.9	14.72	0.649	175.490	173.982	−0.867
005	193.87	55474.6	14.88	0.656	181.393	180.147	−0.692
004	193.76	68955.8	15.02	0.662	186.891	185.495	−0.753
003	193.77	69583.8	15.03	0.663	187.144	185.842	−0.701
083	195.27	576.4	14.08	0.621	153.425	152.954	−0.308
087	195.43	579.9	14.08	0.621	153.323	152.590	−0.480
073	197.64	578.5	14.02	0.618	151.912	150.737	−0.779
084	197.07	580.5	14.04	0.619	152.274	151.318	−0.632
086	197.78	582.6	14.02	0.618	151.816	150.735	−0.717
066	195.99	928.7	14.07	0.620	153.185	152.458	−0.477
072	196.04	929.4	14.07	0.620	153.147	152.376	−0.506
002	195.83	963.1	14.07	0.621	153.280	151.665	−1.065
082	196.69	1356.2	14.06	0.620	152.994	152.724	−0.177
081	197.37	1366.5	14.04	0.619	152.562	151.851	−0.469
078	195.56	3444.0	14.13	0.623	154.950	154.465	−0.314
077	195.70	3486.0	14.12	0.623	154.865	154.244	−0.403
076	195.85	3539.1	14.12	0.623	154.822	154.081	−0.481
074	195.97	6972.7	14.18	0.625	156.744	155.932	−0.520
079	195.64	37915.9	14.64	0.646	172.771	172.035	−0.428
080	195.61	68683.2	14.99	0.661	185.876	185.181	−0.375

090	198.14	579.9	14.01	0.618	151.577	150.419	−0.770
069	200.50	928.0	13.96	0.616	150.299	148.821	−0.993
070	198.25	928.7	14.02	0.618	151.734	150.805	−0.616
071	204.05	928.0	13.87	0.612	148.049	146.570	−1.009
012	209.48	1004.0	13.74	0.606	144.644	143.440	−0.839
019	209.30	1013.1	13.75	0.606	144.787	143.560	−0.854
010	209.33	1015.8	13.74	0.606	144.770	143.759	−0.703
011	209.89	1016.9	13.73	0.606	144.417	143.328	−0.760
018	209.27	6252.0	13.85	0.611	148.134	146.965	−0.795
017	208.83	15161.9	14.03	0.619	153.711	152.660	−0.688
016	208.69	28870.6	14.26	0.629	161.223	159.911	−0.821
015	208.57	47917.0	14.52	0.640	170.530	169.185	−0.795
013	209.17	69547.5	14.76	0.651	179.634	178.583	−0.589
014	207.99	70795.5	14.79	0.652	180.714	179.838	−0.487
091	215.37	646.7	13.59	0.599	140.735	140.591	−0.102
093	217.79	650.9	13.52	0.596	139.228	139.074	−0.111
095	220.67	937.7	13.46	0.594	137.628	137.709	0.059
096	220.56	937.0	13.46	0.594	137.702	137.673	−0.021
097	220.05	937.0	13.47	0.594	138.005	137.929	−0.055
094	220.28	948.7	13.47	0.594	137.875	137.803	−0.052
092	219.86	70992.9	14.59	0.644	175.128	174.888	−0.137
021	229.15	1100.0	13.24	0.584	132.542	131.797	−0.566
020	229.38	1116.7	13.24	0.584	132.400	131.579	−0.624
029	229.51	27518.5	13.80	0.609	149.198	148.229	−0.654
027	229.31	40956.1	14.03	0.619	156.528	155.527	−0.643
028	229.34	42224.2	14.05	0.620	157.158	156.202	−0.612
026	229.39	53303.7	14.21	0.627	162.608	161.593	−0.628
024	229.29	54302.5	14.22	0.627	163.117	161.726	−0.860
025	229.31	54520.6	14.22	0.627	163.211	162.248	−0.593
022	228.67	67436.7	14.40	0.635	169.438	168.642	−0.472
023	228.68	69311.6	14.42	0.636	170.250	169.293	−0.565

Table II. *(Continued)*

ID No.	T (K)	P (kPa)	ρ $(\mathrm{mol \cdot L^{-3}})$	ρ $(\mathrm{g \cdot cm^{-3}})$	λ_{corr} $(\mathrm{mW \cdot m^{-1} \cdot K^{-1}})$	λ_{exp} $(\mathrm{mW \cdot m \cdot K^{-1}})$	Dev. (%)
036	251.39	882.3	12.64	0.557	119.065	118.610	−0.384
037	252.23	884.6	12.62	0.556	118.571	118.296	−0.232
031	251.01	952.9	12.65	0.558	119.345	118.647	−0.589
032	252.59	955.3	12.61	0.556	118.421	118.472	0.043
030	253.70	957.3	12.58	0.555	117.786	117.502	−0.242
042	250.96	993.7	12.66	0.558	119.414	118.723	−0.582
041	253.61	3538.9	12.67	0.559	119.979	119.551	−0.358
039	253.72	3547.8	12.67	0.559	119.927	120.173	0.205
040	253.73	3548.1	12.67	0.559	119.920	120.026	0.088
038	253.71	3549.0	12.67	0.559	119.939	120.018	0.066
035	251.36	66555.9	14.00	0.617	158.676	158.965	0.182
034	252.74	67985.4	14.00	0.617	158.728	158.686	−0.027
033	252.72	70534.5	14.03	0.619	159.933	159.886	−0.029
110	264.91	1004.0	12.26	0.541	111.328	112.580	1.112
106	262.24	1027.7	12.34	0.544	112.891	114.245	1.185
107	263.43	1027.4	12.30	0.542	112.208	113.332	0.992
108	265.22	1027.9	12.25	0.540	111.174	112.397	1.088
109	265.23	1027.0	12.25	0.540	111.160	112.428	1.128
105	261.91	1028.9	12.35	0.544	113.060	113.812	0.661
103	265.41	1031.6	12.24	0.540	111.069	112.299	1.096
104	268.59	1030.4	12.15	0.536	109.240	110.466	1.110
099	264.30	1039.6	12.28	0.541	111.709	112.886	1.042
100	263.85	1038.6	12.29	0.542	111.969	113.089	0.990
101	264.08	1039.8	12.28	0.542	111.849	112.967	0.990
102	265.11	1038.3	12.25	0.540	111.232	112.427	1.063
098	266.15	1097.9	12.22	0.539	110.709	111.953	1.111
111	264.87	1105.6	12.26	0.541	111.441	112.698	1.115
112	264.48	1110.7	12.27	0.541	111.672	112.703	0.915
113	264.47	1114.3	12.27	0.541	111.664	112.778	0.988
043	262.30	1138.1	12.34	0.544	112.945	112.926	−0.017
053	261.53	3502.8	12.45	0.549	115.457	115.235	−0.193
052	261.52	7382.3	12.58	0.555	118.694	118.690	−0.004
051	261.72	14456.6	12.80	0.564	124.010	123.917	−0.076

050	261.55	27503.0	13.13	0.579	132.917	132.875	−0.032
049	261.50	41811.0	13.43	0.592	141.455	141.397	−0.041
048	261.26	56009.7	13.67	0.603	149.143	148.989	−0.104
047	262.12	56754.9	13.67	0.603	149.141	149.124	−0.011
046	261.97	68930.1	13.86	0.611	155.180	155.210	0.019
045	262.33	69482.4	13.86	0.611	155.275	155.175	−0.064
044	261.60	69489.2	13.87	0.612	155.593	155.629	0.023
				For Vapor			
056	295.63	246.1	0.10	0.005	18.759	18.627	−0.713
057	295.01	247.6	0.11	0.005	18.700	18.411	−1.571
058	294.71	248.2	0.11	0.005	18.655	18.635	−0.111
059	299.59	249.9	0.10	0.005	19.186	19.020	−0.870
060	298.93	248.6	0.10	0.005	19.125	18.833	−1.553
061	299.71	250.8	0.11	0.005	19.215	18.653	−3.015
062	299.62	249.7	0.10	0.005	19.203	18.756	−2.378
063	299.75	247.6	0.10	0.005	19.211	19.050	0.844
064	299.74	247.6	0.10	0.005	19.212	18.836	−1.997
122	299.19	488.8	0.21	0.009	19.747	18.693	−5.635
126	298.08	490.9	0.22	0.010	19.644	18.575	−5.756
127	298.05	490.9	0.22	0.010	19.646	18.436	−6.559
114	298.00	492.3	0.22	0.010	19.641	18.719	−4.923
123	300.35	490.2	0.21	0.009	19.873	18.826	−5.566
124	300.99	489.5	0.21	0.009	19.940	18.906	−5.473
119	301.91	485.4	0.21	0.009	20.023	19.062	−5.042
125	302.05	490.9	0.21	0.009	20.061	19.029	−5.432
117	303.14	333.0	0.14	0.006	19.785	18.976	−4.263
116	304.16	484.7	0.21	0.009	20.257	19.289	−5.018
120	309.66	490.2	0.21	0.009	20.860	19.952	−4.548
128	310.43	488.2	0.20	0.009	20.932	19.950	−4.922
129	310.26	491.6	0.21	0.009	20.910	19.931	−4.913
130	310.35	491.6	0.21	0.009	20.924	20.062	−4.296
131	310.51	490.9	0.21	0.009	20.930	20.075	−4.258
115	316.69	490.2	0.20	0.009	21.624	20.901	−3.458
118	316.67	490.2	0.20	0.009	21.633	20.908	−3.471
121	322.05	491.6	0.20	0.009	22.205	21.438	−3.581

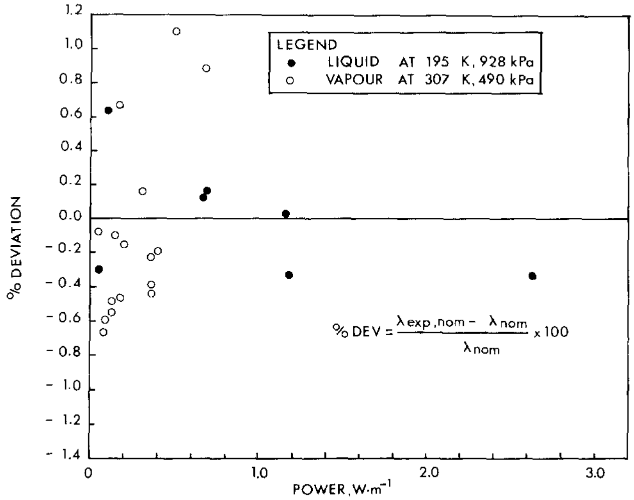

Fig. 1. Deviation in measurements of the thermal conductivity of propane obtained with various power levels.

from measurements made over a range of power levels as shown in Fig. 1. These measurements can be adjusted to a mean reference value within a maximum variation of ±0.7% and ±1.2% for the liquid and vapor states, respectively. There appears to be no systematic variation with power for both states. As shown later, the present measurements for liquid propane are found to be within ±1.2% of the available reliable overlapping data [1, 2]. The accuracy of the present measurement is, therefore, estimated to be better than ±1.5%.

The propane sample purity was certified to be 99.99%. The ciritcal properties of propane were obtained from Ref. 12 and are listed in Table I.

4. COMPARISON OF THE PRESENT DATA

The measurements reported (Table II) for the liquid fall within the experimental range covered by Refs. 1 and 2. The measurements were, therefore, compared with the correlation used by them [6]. It is seen that the measurements on liquid propane are generally lower, but within 1% of the correlation (Fig. 2). At low densities, in the vapor state, the present measurements are about 4 to 6% lower. The dilute-gas correlation employed in Refs. 1 and 2, however, was that recommended by Holland et al. [6] and had an estimated uncertainty of about ±8%. Figure 3 shows the deviation of the thermal conductivity at low densities ($\rho < 1.13$ mol · L^{-1}) reported here (Table II) as well as that for data reported by others [4, 5,

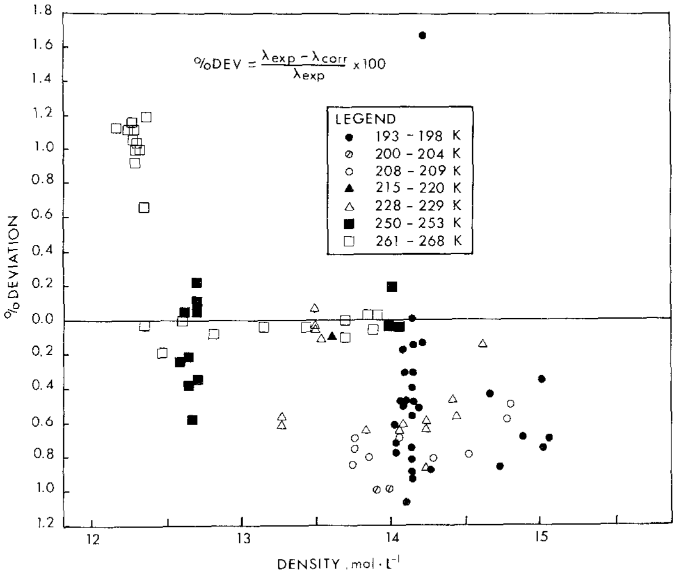

Fig. 2. Deviation plot of present data from the correlation of Refs. 1 and 2 for the thermal conductivity of liquid propane.

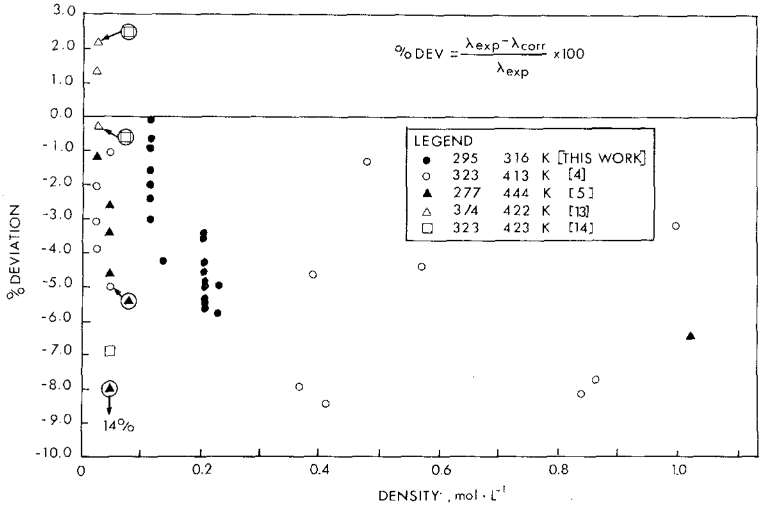

Fig. 3. Deviation plot of present data from the correlation of Refs. 1, 2, and 6 for the thermal conductivity of low-density propane vapor.

13, 14] at similar densities. It is seen that all these measurements are consistently lower, by up to 8%, than those obtained with the correlation of Eq. (6), indicating the need for increased data and improved correlation in this region.

5. CORRELATION

5.1. General Correlation

A correlation of the present data together with those of others [1–5] was attempted using the model suggested by Sengers et al. [15].

$$\lambda(\rho, T) = \lambda_{\mathrm{bg}}(\rho, T) + \Delta\lambda_{\mathrm{cr}}(\rho, T) \tag{4}$$

$$\lambda_{\mathrm{bg}}(\rho, T) = \lambda_0(T) + \Delta\lambda_{\mathrm{e}}(\rho, T) \tag{5}$$

5.2. Thermal Conductivity for the Dilute Vapor

The available thermal conductivity data for propane in the low-density region are inconsistent as shown in Ref. 6 as well as Fig. 3. A new correlation for λ_0 based on our measurements was, therefore, not attempted and the expression recommended by Holland et al. [6] and employed by Roder and his co-worker [1, 2] was used:

$$\begin{aligned}\lambda_0(T) = {} & a_1 T^{-1} + a_2 T^{-2/3} + a_3 T^{-1/3} + a_4 + a_5 T^{1/3} + a_6 T^{2/3} \\ & + a_7 T + a_8 T^{4/3} + a_9 T^{5/3}\end{aligned} \tag{6}$$

The empirical coefficients a_n ($n = 1$ to 9) are given in Ref. 6 and Table III. Below 150 K the correlation is unreliable since both correlations severely diverge from the low temperature behavior expected of a low-density vapor theoretically and empirically.

5.3. The Excess Thermal Conductivity, $\Delta\lambda_e$

Measurements in the high-density region indicate an increase in the excess thermal conductivity, $\Delta\lambda_e$, with an increase in density along any isotherm. The data of Tufeu and Le Neindre [3] show the critical-point thermal conductivity enhancement along isotherms in the range 357–388 K. On the basis of preliminary analyses, measurements showing the anomalous critical-region increase and near the liquid–vapor saturation line were excluded for the correlation of the excess thermal conductivity, $\Delta\lambda_e$. In this low-density region ($\rho < 1\ \mathrm{mol \cdot L^{-1}}$), five data points from

Ref. 4, two from Ref. 5, and one from Ref. 14, showing deviations greater than 10%, were also excluded.

The excess thermal conductivity, $\Delta\lambda_e$, was first correlated with density alone using the model:

$$\Delta\lambda_e(\rho) = \sum_{n=0}^{m} b_n(\Delta\rho^*)^n \tag{7}$$

Regression analysis of the data was performed with $m = 3$ to 7. Based on the maximum deviation and the nature of the plot from the resulting correlation, a correlation model, given by Eq. (7), with $m = 6$ was determined to represent the data best. Least-squares estimates of the correlation coefficients b_n ($n = 0$ to 6) are listed in Table III. Correlation of the data was to within ±7.5% (Fig. 4).

Table III. Empirical Coefficients for Correlation of the Thermal Conductivity of Propane

(a) Correlation coefficient for λ_0 [1, 6]

$a_1 = -0.1089381103E+04$
$a_2 = 0.8343297829E+03$
$a_3 = -0.2270902736E+03$
$a_4 = 0.1667866368E+02$
$a_5 = 0.4347320565E+01$
$a_6 = -0.1177734671E+01$
$a_7 = 0.1215425833E+00$
$a_8 = -0.6040596921E-02$
$a_9 = 0.1207373681E-03$

(b) Correlation coefficient for $\Delta\lambda_e$

$b_0 = 0.01888627$
$b_1 = 0.02582971$
$b_2 = 0.00462271$
$b_3 = -0.00229670$
$b_4 = 0.00663134$
$b_5 = 0.00467437$
$b_6 = -0.00236672$

(c) Correlation coefficient for $\Delta\lambda_{cr}$

$c_1 = 0.00004432$
$c_2 = 0.00142564$
$c_3 = -0.01972275$
$c_4 = 2.75975351$
$n = 0$

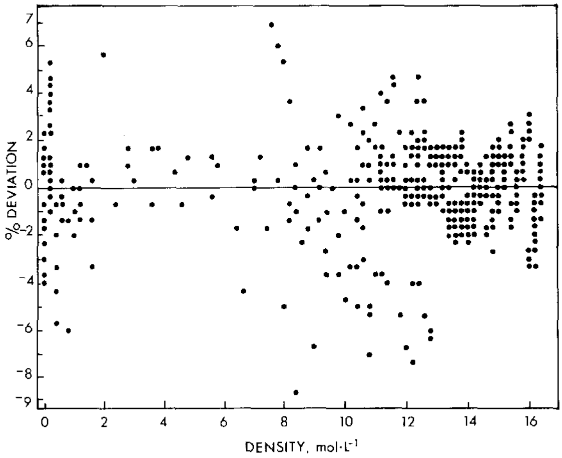

Fig. 4. Deviation plot: correlation of the excess thermal conductivity ($\Delta\lambda_e$) for propane.

A correlation of the excess thermal conductivity in terms of density and temperature was next attempted with

$$\Delta\lambda_e(\rho, T) = \sum_{i=0}^{m} \sum_{j=0}^{n} b_{ij} T_r^i \rho_r^j \tag{8}$$

using $m = 5$ and $n = 4$. This correlation, as well as others with lower values of m and n, did not result in a lower maximum deviation; Eq. (7) was, therefore, preferred over Eq. (8).

5.4. The Anomalous Thermal Conductivity, $\Delta\lambda_{cr}$

The anomalous thermal conductivity, $\Delta\lambda_{cr}$, was estimated by subtracting the background conductivity, λ_{bg} [Eqs. (5)–(7)], from the experimental data in the anomalous region. A correlation of $\Delta\lambda_{cr}$ in terms of density and temperature was attempted with the model [16, 17].

$$\Delta\lambda_{cr}(\rho, T) = Ae^{-x^2} \tag{9}$$

with

$$A = C_1/[(\Delta T^*)^2 + C_2] \tag{10}$$

$$X = C_4[\Delta\rho^* - C_3(\Delta T^*)^n] \tag{11}$$

This model is similar to the one recommended by Roder [16]; however, the expression for the amplitude term A [Eqs. (9) and (10)] has been

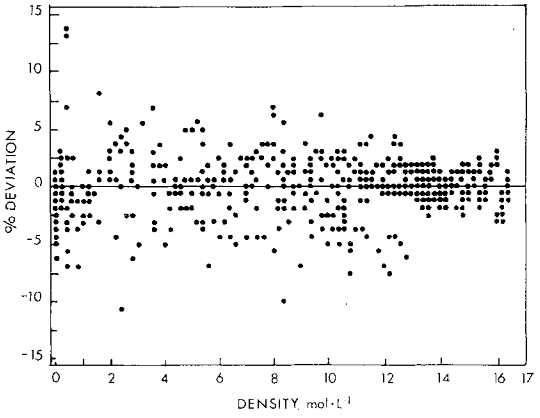

Fig. 5. Deviation plot: correlation of the anomalous thermal conductivity ($\Delta\lambda_{cr}$) for propane.

modified [17] to ensure maximum enhancement along the critical isotherm. Correlation to within about ±8% (Fig. 5) was obtained with $n = 0$ in Eq. (11). The estimates of the empirical coefficients C_n ($n = 1$ to 4) are listed in Table III.

6. DISCUSSION AND CONCLUSIONS

In summary, the thermal conductivity of propane in the range 192–320 K and up to 70 MPa was measured experimentally with a transient hot-wire instrument. These measurements are in excellent agreement (±1.2%) with other reliable measurement [1, 2] and are estimated to be accurate within ±1.5%.

The present measurements and data from other sources [1–5] were employed to present a correlation in the range 110–480 K and up to 70 MPa including the critical region.

The present correlation expressed by Eqs. (9)–(11) for the anomalous thermal conductivity is based on the data of Tufeu and Le Neindre [3] in the critical region, including some data at $\Delta T^* = 0.01$ [15]. It is recommended that the method suggested by Sengers et al. [15] be employed for $\Delta T^* < 0.01$ for this region.

The uncertainty in the correlation presented is estimated to be about ±8%.

ACKNOWLEDGMENT

This work was performed under a program of studies funded by the Natural Sciences and Engineering Research Council of Canada, under Grants A8859 and A5477.

NOMENCLATURE

a_n, b_{ij}, b_n, c_n	Parameters of regression model
C	Euler's constant $(=1.781)$
P	Pressure, MPa (kPa)
P_{cr}	Critical pressure, MPa
Q_1	Heat flux per unit length, $\mathrm{W \cdot m^{-1}}$
t	time, s
T	Temperature, K
T_{cr}	Critical temperature, K
T_0	Equilibrium temperature, K
T_{re}	Reference temperature, K
T_{r}	Reduced temperature $= T/T_{\mathrm{cr}}$
T_{TP}	Triple-point temperature, K

Greek symbols

α	Thermal diffusivity, $\mathrm{m^2 \cdot s^{-1}}$
δT_i	Temperature corrections, K
ΔT	Temperature difference, K
ΔT_{w}	Temperature rise of wire between time t_1 and time t_2, K
ΔT^*	Reduced temperature difference $(T - T_{\mathrm{cr}})/T_{\mathrm{cr}}$
λ_{corr}	Thermal conductivity value from correlation, $\mathrm{W \cdot m^{-1} \cdot K^{-1}}$
$\Delta\lambda_{\mathrm{cr}}$	Thermal conductivity anomaly, $\mathrm{W \cdot m^{-1} \cdot K^{-1}}$
$\Delta\lambda_{\mathrm{e}}$	Excess thermal conductivity, $\mathrm{W \cdot m^{-1} \cdot K^{-1}}$
$\Delta\rho^*$	Reduced density difference
λ	Thermal conductivity, $\mathrm{W^{-1} \cdot m^{-1} \cdot K^{-1}}$, $\mathrm{mW \cdot m^{-1} \cdot K^{-1}}$
λ_{bg}	Background thermal conductivity, $\mathrm{W \cdot m^{-1} \cdot K^{-1}}$
λ_0	Zero-density thermal conductivity, $\mathrm{W \cdot m^{-1} \cdot K^{-1}}$
ρ	Density, $\mathrm{mol \cdot L^{-1}}$
ρ_{cr}	Critical density, $\mathrm{mol \cdot L^{-1}}$
ρ_{re}	Reference density, $\mathrm{mol \cdot L^{-1}}$
ρ_{r}	Reduced density

REFERENCES

1. H. M. Roder and C. A. N. de Castro, *J. Chem. Eng. Data* **22**:12 (1982).
2. H. M. Roder, *Experimental Thermal Conductivity Values for Hydrogen, Methane, Ethane and Propane*, Report No. NBS TN 684 (1984).
3. R. Tufeu and B. Le Neindre, *Proceedings, First Asian Thermophysical Properties Conference*, Beijing, People's Replubic of China (1986), pp. 438–443.
4. D. E. Leng and E. W. Comings, *Ind. Eng. Chem.* **49**:2042 (1957).
5. L. J. Carmichael, J. Jacobs, and B. H. Sage, *J. Chem. Eng. Data* **13**:40 (1968).
6. P. M. Holland, H. J. M. Hanley, K. E. Gubbins, and J. M. Haile, *J. Phys. Chem. Ref. Data* **8**:559 (1979).
7. E. F. Buyukbicer, J. E. S. Venart, and R. C. Prasad, *High Temp. High Press.* **18**:55 (1986).
8. E. F. Buyukbicer, *Precise Measurement of Thermal Conductivity of Fluids*, M.Sc.E. thesis (University of New Brunswick, Frederiction, Canada, 1984).
9. J. J. Healy, J. J. de Groot, and J. Kestin, *Physica* **82c**:393 (1976).
10. C. A. N. de Castro, S. F. Y. Li, G. C. Maitland, and W. E. Wakeham, *Int. J. Thermophys.* **4**:311 (1983).
11. J. E. S. Venart, R. C. Prasad, and G. Wang, *Int. J. Thermophys.* **8**:39 (1987).
12. R. D. Goodwin, *Provisional Thermodynamic Functions of Propane from 85–700 K* at *Pressures to 700 bar*, Report No. NBSIR 77-860 (1977).
13. R. G. Vines and L. A. Bennett, *J. Chem. Phys.* **22**:360 (1954).
14. W. J. S. Smith, L. D. Durbin, and R. Kobayashi, *J. Chem. Eng. Data* **5**:316 (1960).
15. J. V. Sengers, R. S. Basu, and J. M. H. Levelt Sengers, *Representative Equations for the Thermodynamic and Transport Properties of Fluids Near the Gas-Liquid Critical Point*, NASA Contractor Report 3424 (1981).
16. H. M. Roder, *J. Res. NBS* **87**:279 (1982).
17. R. C. Prasad and J. E. S. Venart, *Int. J. Thermophys.* **5**:367 (1984).