TABLE II.[a] Atmospheric pressure viscosity and relative viscosity[b] at elevated pressures[c] of seven pure hydrocarbons.

Boiling point at 1 mm °C	PSU No.	Temp.[d] (°C)	Atmos vis. (cp)	Pressure (bars)									
				345	689	1030	1380	1720	2070	2410	2760	3100	3450
197.0	18	37.8	11.47	1.64	3.67	4.30	6.93	10.9	16.9	26.2	40.4	61.1	93.3
		60	5.78	1.59	2.42	3.64	5.40	7.95	11.5	16.5	23.8	33.9	47.9
		98.9	2.50	1.55	2.16	2.93	3.91	5.28	7.05	9.35	12.4	16.1	20.9
194.5	19	37.8	28.66	2.20	4.47	8.62	16.3	30.6	55.0	95.3	167	...	...
		60	11.72	1.97	3.70	6.59	11.5	19.5	32.4	53.3	87.0	137	...
		98.9	4.06	1.80	2.89	4.58	7.19	11.0	16.6	24.9	36.4	53.4	77.3
184.0	25	37.8	7.06	1.64	2.66	3.91	5.72	8.16	11.46	15.7	21.3	28.6	37.8
		60	3.91	1.58	2.38	3.40	4.81	6.65	9.05	12.1	15.9	20.8	26.8
		98.9	1.87	1.52	2.16	2.96	3.97	5.10	6.63	8.44	10.7	13.4	16.6
188.0	110	37.8	9.43	1.62	2.61	4.08	6.19	9.16	13.4	19.0	26.5	36.6	49.8
		60	4.99	1.54	2.84	3.75	5.00	7.15	10.0	13.8	18.8	25.0	33.1
		98.9	2.26	1.51	2.23	3.45	4.08	5.40	7.12	9.33	12.1	15.6	19.8
		135	1.47	1.48	2.00	2.61	3.37	4.30	5.46	6.87	8.50	10.41	12.52
193.0	111	37.8	13.59	1.76	3.04	4.99	7.95	12.4	18.7	28.1	41.4	59.7	86.0
		60	6.79	1.67	2.68	4.21	6.38	9.40	13.7	19.5	27.3	38.1	52.4
		98.9	2.88	1.58	2.38	3.38	4.75	6.64	9.10	12.3	16.2	21.4	28.0
198.0	113	37.8	22.53	1.93	3.54	6.21	10.6	17.8	39.3	48.0	...	...	...
		60	10.16	1.78	3.04	5.04	8.07	12.6	19.7	29.8	44.8	66.3	96.7
		98.9	3.88	1.67	2.51	3.79	5.59	8.14	11.7	16.5	22.9	31.7	43.0
		135	2.13	1.61	2.35	3.32	4.54	6.20	8.45	11.3	15.0	19.7	...
245.0	179[a]	37.8	911.7	3.91	...	...	...	...	...	...	...	...	...
		60	135.3	2.78	7.92	22.4	...	...	...	...	...	...	...
		98.9	17.58	2.08	4.18	8.30	16.6	33.6	71.0	152	...	...	...
		135	5.93	1.74	2.94	5.02	8.40	14.2	23.8	40.6	69.5	120	208

a The viscosity values listed in Table II for PSU 179 were obtained on a sample that proved to have been slightly oxidized and therefore not as pure as were the others. The atmospheric values of the viscosities of the nonoxidized material were 839.7 at 37.8°C 134.1 at 60°C, 18.34 at 98.9°C. Scarcity of sample prevented obtaining a new high pressure run but the results of the mixture work reported herein suggest that the correct high pressure values can be obtained by multiplying the values entered by the ratio of the atmospheric values of the viscosities of the nonoxidized to the oxidized sample.

b Based on atmospheric pressure viscosity of water at 20°C being 1.0052.

c The pressure values correspond to 5000 psi intervals.

d The centigrade temperatures 37.8°C, 60°C, 98.9°C, and 135°C correspond to 100°F, 140°F, 210°F, and 275°F.

binary mixtures of them. The structures of the pure liquids and some pertinent physical properties of these compounds are shown in Table I. The first six hydrocarbons are closely related structurally while PSU 179 was included in order to obtain an indication of the effect of a radical difference in structure at the same molecular weight level. Viscosity measurements were made at 37.78°, 60°, and 98.9°C on PSU 18, PSU 19, PSU 25, and PSU 111. The other hydrocarbons and the mixtures were studied at 135°C,‡ in addition to the above temperatures. It will be recalled from the viscometer calibration equation that the liquid density at the pressure in question is a prerequisite to calculation of the viscosity. For PSU 18 at 37.78°, 60°, and 98.9°C, and PSU 19, PSU 25, and PSU 111 at 37.78° and 98.9°C the density had been experimentally determined over the pressure range used in the viscosity measurements.[10]

‡ The temperatures listed correspond to 100°, 140°, 210°, and 275°F, respectively.

[10] Cutler, McMickle, Webb, and Schiessler, J. Chem. Phys. 29, 727 (1958).

The Tait equation[11]

$$v_0 - v = C \log(B+P)/(B+P_0), \qquad (2)$$

where v_0 and v are are the specific volumes at the pressures P_0 and P, respectively, and C and B are constants characteristic of the liquid, was used to estimate the density of the remaining compounds to within 2%. The density of each mixture was assumed to be the same as that of the corresponding pure compound over the entire pressure range. This assumption has since been verified experimentally for the mixtures studied. A report of this $p-v-T$ work is given in reference 10.

The precision of the calculated viscosities is estimated to be ±1%. Below 5 cp the uncertainty of the rolling-ball viscosity values is estimated at ±4%, decreasing to ±2% at 10 cp and above. Another measure of the uncertainty is afforded by comparison of data on PSU 19, PSU 25, PSU 111, and a petroleum oil on which measurements were also made at 37.78°,

[11] P. G. Tait, Physics and Chemistry of the Voyage of H. M. S. Challenger (Stationery Office, London), Vol. II, Part IV, S. P., LXI (1888).

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