

APPENDIX I

KEY TO FOOTNOTES

- * Calculated values; Appendix II, below.
^a For the air-saturated hydrocarbon at 1 atmos.
^b Apparent values from weights in air.
^c Absolute values from weights in vacuum.
^d At saturation pressure.
^e At saturation pressure (triple point).
^f For solid-vapor equilibrium.
^g At boiling point.
^h Critical solution temperature instead of aniline point.
ⁱ Apparent values for methane at 60 F (15.56 C).

- ^k The + sign and the number following signify that the octane number of the compound corresponds to that of 2,2,4-trimethylpentane with the indicated number of milliliters of tetraethyl lead added.
^l Average value from octane numbers of more than one sample.
^m Extrapolated to room temperature from higher temperatures.
ⁿ Too volatile to run as a liquid in the CFR engine.
^o For heats of combustion of gaseous hydrocarbons, C₁ to C₅, see Table VIII.

- ^p At sublimation point.
^q Specific gravity -119 F/60 F (sublimation point).
^r For the under cooled liquid below the normal freezing point.
^s At 185 F (85 C).
^t Determined at 212 F.
^u Determined at 302 F.
^v Value for the ideal gas.
^w Formerly labeled "trans".
^x Formerly labeled "cis".
^y At 15.56 C.
^z Approximate value.

APPENDIX II

CALCULATED VALUES*

Indicated by asterisks in the tables

Molecular weights: Based on atomic weight oxygen = 16.0000; atomic weight carbon = 12.01; atomic weight hydrogen = 1.008.

$$\text{deg A.P.I.} = \frac{141.5}{\text{sp gr } 60/60} - 131.5$$

Density (liquid):

- (1) at 60 F (apparent, from weights in air):

$$d_{\text{app}} = (d_{\text{vac}} - d_a) \left(\frac{d_b}{d_b - d_a} \right);$$

$d_a = 0.0762$ lb per cu ft air at 1 atmos with 50 per cent humidity at 60 F, and $d_b = 524$ lb per cu ft brass at 1 atmos and 60 F. Density on the vacuum basis can be obtained by adding 0.07 lb per cu ft (or 0.009 lb per gal) to the apparent density without changing the precision of the values given in the range of densities in these tables, provided the results are rounded to the same number of significant figures as appear in the tables.

- (2) at 15 C: from values at other temperatures, using the coefficient of expansion of the liquid at 60 F (15.56 C),

$$d_t = \frac{d_{60}}{1 + \left[\frac{1}{V} \left(\frac{dV}{dt} \right) \right] (t - 60)}$$

Coefficient of expansion (60 F):

$$\left(\frac{1}{V} \frac{dV}{dT} \right) = \frac{1}{V_{60}} \left(\frac{V_{t_2} - V_{t_1}}{t_2 - t_1} \right)$$

Heat of combustion (liquid, 60 F and constant pressure): Calculated from values at 77 F, reference (3)¹ in Btu per lb and then converted to Btu per gal using the density of the liquid on the vacuum basis.

Specific volume (real gas, 60 F, 1 atm):

$$\begin{aligned} \text{cu ft per lb} &= \frac{Z_{HC} RT}{MP} \\ &= \frac{Z_{HC}(0.7302)(459.7 + t \text{ deg Fahr})}{(\text{molecular wt HC})(1 \text{ atmos})}; \end{aligned}$$

cu ft gas per gal liquid

$$= \left(\frac{\text{cu ft gas}}{\text{lb}} \right) \left(\frac{\text{lb liquid}}{\text{gal}} \right).$$

Density on the vacuum basis was used in the latter equation.

Specific gravity (real gas; 60 F, 1 atmos; air = 1):

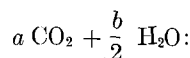
$$\begin{aligned} \text{Sp gr.} &= \frac{\text{lb per cu ft gas}}{\text{lb per cu ft air (dry)}} \\ &= \frac{\text{lb per cu ft gas}}{0.076323} = \frac{13.102}{\text{ft per cu lb gas}} \end{aligned}$$

Heat of combustion (gas; 60 F, constant

¹ The boldface numbers in parentheses refer to the list of references appended to this paper.

pressure): Calculated from values at 77 C (3). Values in Btu per lb were converted to Btu per cu ft using the density of the real gas $\left(d = \frac{M_{HC}}{Z_{HC} RT} \right)$.

Air required for combustion according to the reaction $C_a H_b + \left(a + \frac{b}{4} \right) O_2 \rightarrow$



- (1) of the real gas (60 F, 1 atmos):

$$\frac{\text{cu ft air}}{\text{cu ft gas}} = \frac{\left(a + \frac{b}{4} \right) (13.102) (32.00)}{(0.2315) (\text{molecular vol of HC})}$$

$$\frac{\text{lb air}}{\text{lb gas}} = \frac{\text{cu ft air}}{\text{cu ft gas}} \times \frac{1}{\text{sp gr gas}}$$

13.102 cu ft per lb = specific volume dry air at 60 F and 1 atmos

32.00 lb per mole = mole weight of oxygen

0.2315 = weight fraction of oxygen in air
 $Z_{HC} RT$ cu ft per lb mole = molal volume of hydrocarbon at 1 atmos.

- (2) of the ideal gas (60 F, 1 atmos):

$$\frac{\text{cu ft air}}{\text{cu ft gas}} = \frac{\left(a + \frac{b}{4} \right)}{0.2095};$$

$$\frac{\text{lb air}}{\text{lb gas}} = \frac{\left(a + \frac{b}{4} \right) (28.966)}{(0.2095) (\text{molecular wt of HC})}.$$

28,966 lb per mole = molecular wt of dry air at 60 F, 1 atmos
 0.2095 lb per mole = volume fraction of oxygen in air.

All calculated values were obtained through the use of data and conversion

factors from the tables of the API Research Project 44 (3) and from data appearing in this compilation. Values for the refractive index are for the sodium *D* line for which the wavelength is taken to be 5892.6 Å, the

intensity weighted mean of the *D*₁ and *D*₂ lines. For the specific dispersion, *n_F* and *n_C* are for the wavelengths of the hydrogen F (4861.3 Å) and the hydrogen C (4562.8 Å) lines, respectively.

ESTIMATED VALUES (IN PARENTHESES)

Vapor pressure (100 F) by method described in reference (36).

Critical constants: see reference (6).

Specific gravity (liquid, 60 F/60 F): converted from values at other temperatures (see Appendix I) by method described in reference (32).

Heat capacity at constant pressure:

(1) of ideal gas (Btu per lb deg Fahr; 60 F, 1 atmos): by method described in reference (59).

(2) of liquid (Btu per lb; 60 F, 1 atmos): by formula, $C_p(\text{liquid}) = C_v(\text{gas}) / (0.400 + 0.0125 n)$ in which *n* equals the total number of carbon atoms in the molecule and $C_v(\text{gas}) =$

$$C_p(\text{gas}) - \frac{1.98719}{\text{molecular wt of HC}}$$

Values in Btu per lb deg Fahr (60 F, 1 atmos) were converted to cal per g deg Cent (60 F, 1 atmos) and the change in heat capacity with temperature esti-

mated by comparison with other hydrocarbons of the same type, for which measured values were available, to give cal per g deg Cent (25 C, 1 atmos).

Heat of vaporization (at normal boiling point, 1 atmos): by method described in reference (36):

Heat of combustion (liquid; 60 F, constant pressure): Vapor heats of combustion from reference (3) or (60) (or estimated as described in reference (60)) were converted to 60 F. The liquid values (Btu per lb) were obtained by subtracting the corresponding heats of vaporization (at 60 F), estimated as in reference (36) and then converted to Btu per gal using the density of the liquid (lb per gal) on the vacuum basis. These values are the same as those given in the earlier edition (1950) of this bulletin except that they are based on weights in vacuum to conform with the values for other hydro-

carbons obtained from the tables of the API Research Project 44 (3). Values at 25 C (77 F) were calculated from those at 60 F and then converted to kcal per mol and cal per g.

Flammability limits: estimated by comparison with values for other hydrocarbons and checked with a master plot. These values were supplied by M. G. Zabetakis, Chief, Branch of Gas Explosions, Explosives Research Laboratory, U. S. Bureau of Mines, Pittsburgh, Pa.

Compressibility factors:

(1) at 60 F, 1 atmos: by method described in reference (56).

(2) at boiling point: from a generalized plot of compressibility factors versus reduced temperature and reduced pressure. These values were supplied by the Phillips Petroleum Co., Bartlesville, Okla.

APPENDIX III

KEY TO REFERENCES

NOTE: For sources of data on compounds and properties not listed here, see the sections on calculated and estimated quantities (pp. 61 and 62) or references as follows:

(1) Octane numbers: reference (5).

(2) All others: reference (3).

No.	Compound	Boiling Point	Vapor Pressure	Freezing Point	Critical Constants			Specific Gravity, Liquid, 60F/60F	Density, Liquid	Refractive Index, Liquid	Heat Capacity, Ideal Gas	Heat of Vaporization at Normal Boiling Point	Heat of Combustion, Liquid	Flammability Limits (Measured)	Aniline Point or Critical Solution Temperature	Compressibility Factor
					Pressure	Temperature	Volume									
1.	Paraffins:															
1	Methane	...	...	...	...	...	...	52	52	...	...	...	...	22	...	...
2	Ethane	...	...	...	...	...	...	9	9	...	...	...	...	22, 73	...	...
3	Propane	...	39	...	...	...	...	...	...	...	...	...	...	22, 73	...	...
4	<i>n</i> -Butane	...	38	...	...	...	...	...	...	...	...	...	...	22, 73	44	...
5	2-Methylpropane (isobutane)	...	38	...	...	...	...	...	...	...	...	...	...	22	44	...
6	<i>n</i> -Pentane	...	...	...	...	1	...	...	...	...	...	...	...	22, 71	8, 27, 33, 58, 69	47
7	2-Methylbutane (isopentane)	...	...	...	...	1	...	...	...	...	...	...	...	22	8, 27, 33, 69, 64	47
8	2,2-Dimethylpropane (neopentane)	...	55	...	...	...	...	...	...	...	...	...	...	22	31	56
9	<i>n</i> -Hexane	...	...	...	...	1	...	...	...	...	...	...	...	22, 71	8, 27, 58, 69, 25	...
10	2-Methylpentane	...	...	...	...	1	...	...	...	...	...	...	...	22	33, 69, 25	...
11	3-Methylpentane	...	...	...	...	...	...	...	...	...	...	...	...	...	69, 25	...
12	2,2-Dimethylbutane	...	...	...	...	1	...	...	...	...	...	...	...	22	69, 25	...
13	2,3-Dimethylbutane	...	...	...	...	1	...	...	...	...	...	...	...	...	69, 25	...
14	<i>n</i> -Heptane	...	...	...	...	...	...	...	...	...	...	...	...	71, 73	78, 25, 27, 33, 41, 44, 58, 69	...
15	2-Methylhexane	...	...	...	...	1	...	...	...	...	59	...	...	...	25, 27, 33, 69	...
16	3-Methylhexane	...	...	...	...	...	...	...	...	...	59	...	...	...	25, 27, 33, 35	...
17	3-Ethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	...	25, 27	...
18	2,2-Dimethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	...	25, 27, 69	...
19	2,3-Dimethylpentane	...	...	...	...	...	...	...	...	...	...	...	...	...	25, 27, 33, 69	...
20	2,4-Dimethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	...	25, 27, 69	...
21	3,3-Dimethylpentane	...	...	...	...	...	6	...	...	...	59	...	...	...	25, 27, 69	...
22	2,2,3-Trimethylbutane	...	...	...	...	...	...	...	...	...	...	...	...	...	25, 27, 69	...
23	<i>n</i> -Octane	...	...	...	...	1	...	...	...	...	...	...	...	73	7, 8, 25, 27, 30, 46, 58, 69	...
24	2-Methylheptane	...	...	...	...	1	...	...	...	...	59	...	...	73	25, 46	...
25	3-Methylheptane	...	...	...	...	...	...	...	...	...	59	...	...	...	46, 69	...
26	4-Methylheptane	...	...	...	...	...	...	...	...	...	59	...	...	...	46	...
27	3-Ethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	46	...
28	2,2-Dimethylhexane	...	...	...	...	...	...	...	...	...	59	...	...	...	31	...
29	2,3-Dimethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	46, 69	...
30	2,4-Dimethylhexane	...	...	...	...	...	...	...	...	...	59	...	...	...	46	...
31	2,5-Dimethylhexane	...	...	...	...	...	...	...	...	...	59	...	...	...	46, 69	...
32	3,3-Dimethylhexane	...	...	...	...	...	...	...	...	...	59	...	...	...	31	...
33	3,4-Dimethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	46, 69	...
34	2-Methyl-3-ethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	...	46	...
35	3-Methyl-3-ethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	...	69	...
36	2,2,3-Trimethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	...	69	...
37	2,2,4-Trimethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	73	27, 41, 69	...
38	2,3,3-Trimethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	...	31	...
39	2,3,4-Trimethylpentane	...	...	...	...	...	...	...	...	...	59	...	...	...	31	...
40	2,2,3,3-Tetramethylbutane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
41	<i>n</i> -Nonane	...	...	...	...	1	...	...	...	...	...	...	...	51, 73	27, 33, 58, 69	...
42	2-Methyloctane	...	...	...	6	6	6	...	...	...	59	...	...	...	66	...
43	3-Methyloctane	...	...	...	6	6	6	...	...	...	59	...	...	...	66	...
44	4-Methyloctane	...	...	...	6	6	6	...	...	...	59	...	...	...	66	...
45	3-Ethylheptane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
46	4-Ethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
47	2,2-Dimethylheptane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
48	2,3-Dimethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
49	2,4-Dimethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
50	2,5-Dimethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...

KEY TO REFERENCES—Continued

No.	Compound	Boiling Point	Vapor Pressure	Freezing Point	Critical Constants			Specific Gravity, Liquid, 60F/60F	Density, Liquid	Refractive Index, Liquid	Heat Capacity, Ideal Gas	Heat of Vaporization at Normal Boiling Point	Heat of Combustion, Liquid	Flammability Limits (Measured)	Aniline Point or Critical Solution Temperature	Compressibility Factor
					Pressure	Temperature	Volume									
I.	Paraffins—Continued:															
51	2,6-Dimethylheptane	...	...	...	6	6	6	...	...	...	59	...	...	...	68	...
52	3,3-Dimethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
53	3,4-Dimethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
60	2,2,3-Trimethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
61	2,2,4-Trimethylhexane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
62	2,2,5-Trimethylhexane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
63	2,3,3-Trimethylhexane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
65	2,3,5-Trimethylhexane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
66	2,4,4-Trimethylhexane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
67	3,3,4-Trimethylhexane	...	...	...	6	6	6	...	...	...	59	...	...	...	...	...
68	3,3-Diethylpentane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
69	2,2-Dimethyl-3-ethylpentane	...	...	...	6	6	6	...	...	...	59	...	...	...	...	...
70	2,3-Dimethyl-3-ethylpentane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
71	2,4-Dimethyl-3-ethylpentane	...	...	...	6	6	6	...	...	...	59	...	...	...	...	...
72	2,2,3,3-Tetramethylpentane	...	...	...	6	6	6	...	...	...	59	...	...	73	31	...
73	2,2,3,4-Tetramethylpentane	...	...	...	6	6	6	...	...	...	59	...	...	...	...	...
74	2,2,4,4-Tetramethylpentane	...	...	...	6	6	6	...	...	...	59	...	...	...	31	...
75	2,3,3,4-Tetramethylpentane	...	...	...	6	6	6	...	...	...	59	...	...	...	...	...
76	<i>n</i> -Decane	...	63	...	...	1	...	...	...	...	...	...	...	73	11, 27, 30, 33, 58	...
77	2-Methylnonane	...	...	...	6	6	6	...	...	...	59	...	...	51	11	...
78	3-Methylnonane	...	...	...	6	6	6	...	...	...	59	...	...	...	11	...
79	4-Methylnonane	...	...	...	6	6	6	...	...	...	59	...	...	...	11	...
80	5-Methylnonane	...	...	...	6	6	6	...	...	...	59	...	...	...	11	...
81	3-Ethyldecane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
83	2,2-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
84	2,3-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
85	2,4-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
86	2,5-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
87	2,6-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
88	2,7-Dimethyloctane	...	63	...	6	6	6	...	...	...	59	...	...	...	31, 33	...
89	3,3-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
90	3,4-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
92	3,6-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
94	4,5-Dimethyloctane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
95	4- <i>n</i> -Propylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
100	3-Methyl-3-ethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
105	2,2,3-Trimethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
108	2,2,6-Trimethylheptane	...	...	24	6	6	6	...	...	...	59	...	...	...	31	...
115	2,4,6-Trimethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
118	3,3,5-Trimethylheptane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
122	3,3-Diethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
124	2,2-Dimethyl-3-ethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
134	2,2,3,4-Tetramethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
138	2,2,5,5-Tetramethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
143	3,3,4,4-Tetramethylhexane	...	...	...	...	...	...	...	...	...	...	...	...	...	31	...
II.	Cycloparaffins:															
1	Cyclopropane	...	...	...	9	9	...	...	9	...	...	...	...	22	...	...
17	Ethylcyclobutane	...	...	...	...	...	...	...	...	...	...	...	...	22	69	...
23	Cyclopentane	...	...	...	...	...	...	...	...	...	...	...	...	...	7, 14, 27, 28, 33, 34, 58	...
24	Methylcyclopentane	...	...	...	...	...	...	...	...	...	...	...	...	42	7, 14, 17, 27, 28, 33, 34, 58	...
25	Ethylcyclopentane	...	...	...	...	...	...	...	...	...	...	...	...	22	14, 27, 28, 33, 34	...
26	1,1-Dimethylcyclopentane	...	...	...	...	...	...	...	...	...	...	...	...	...	24	...
27	1, <i>cis</i> -2-Dimethylcyclopentane	...	...	...	...	...	...	...	...	...	...	...	...	...	13	...
28	1, <i>trans</i> -2-Dimethylcyclopentane	...	...	...	...	...	...	...	...	...	...	...	...	...	13, 35	...
29	1, <i>cis</i> -3-Dimethylcyclopentane	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30	1, <i>trans</i> -3-Dimethylcyclopentane	...	...	...	...	...	...	...	...	...	...	...	...	...	14, 16, 27, 28, 33, 34, 35	...
31	<i>n</i> -Propylcyclopentane	...	...	...	57	57	57	...	...	...	...	...	...	...	14, 27, 28, 33, 34	...
32	Isopropylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...

KEY TO REFERENCES—Continued

No.	Compound	Boiling Point	Vapor Pressure	Freezing Point	Critical Constants			Specific Gravity, Liquid, 60F/60F	Density, Liquid	Refractive Index, Liquid	Heat Capacity, Ideal Gas	Heat of Vaporization at Normal Boiling Point	Heat of Combustion, Liquid	Flammability Limits (Measured)	Aniline Point or Critical Solution Temperature	Compressibility Factor
					Pressure	Temperature	Volume									
II.	Cycloparaffins—Continued:															
33	1-Methyl-1-ethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
34	1-Methyl- <i>cis</i> -2-ethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	18	...
35	1-Methyl- <i>trans</i> -2-ethylcyclopentane	...	...	21	57	57	57	...	...	...	59	36	36, 60	...	18	...
36	1-Methyl- <i>cis</i> -3-ethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
37	1-Methyl- <i>trans</i> -3-ethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
38	1,1,2-Trimethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
39	1,1,3-Trimethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
40	1, <i>cis</i> -2, <i>cis</i> -3-Trimethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
41	1, <i>cis</i> -2, <i>trans</i> -3-Trimethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	33	...
42	1, <i>trans</i> -2, <i>cis</i> -3-Trimethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	33	...
43	1, <i>cis</i> -2, <i>cis</i> -4-Trimethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
44	1, <i>cis</i> -2, <i>trans</i> -4-Trimethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
45	1, <i>trans</i> -2, <i>cis</i> -4-Trimethylcyclopentane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
46	<i>n</i> -Butylcyclopentane	...	36	...	57	57	57	...	...	...	...	...	...	...	14, 27, 28, 33, 34	...
47	Isobutylcyclopentane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
48	<i>sec</i> -Butylcyclopentane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
49	<i>tert</i> -Butylcyclopentane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
51	1-Methyl- <i>cis</i> -2- <i>n</i> -propylcyclopentane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	20	...
52	1-Methyl- <i>trans</i> -2- <i>n</i> -propylcyclopentane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	20	...
58	1-Methyl- <i>cis</i> -3-isopropylcyclopentane	...	36	24	57	57	57	...	...	...	59	36	36, 60	...	...	...
59	1-Methyl- <i>trans</i> -3-isopropylcyclopentane	...	36	24	57	57	57	...	...	...	59	36	36, 60	...	...	...
61	1- <i>cis</i> -2-Diethylcyclopentane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	19	...
62	1- <i>trans</i> -2-Diethylcyclopentane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	19	...
102	Cyclohexane	...	...	...	57	1	57	...	...	...	...	...	...	22	7, 10, 14, 17, 27, 28, 30, 33, 34, 41, 64, 69	...
103	Methylcyclohexane	...	...	...	57	1	57	...	...	...	...	...	...	22	7, 14, 17, 27, 33, 33, 41, 64, 69	...
104	Ethylcyclohexane	...	...	...	57	57	57	...	...	...	...	...	...	...	27, 34	...
105	1,1-Dimethylcyclohexane	...	...	...	57	57	57	...	...	...	...	...	...	...	50	...
106	1, <i>cis</i> -2-Dimethylcyclohexane	...	...	...	57	57	57	...	...	...	...	...	...	...	33, 49, 50	...
107	1, <i>trans</i> -2-Dimethylcyclohexane	...	...	...	57	57	57	...	...	...	...	...	...	...	50	...
108	1, <i>cis</i> -3-Dimethylcyclohexane	...	...	...	57	57	57	...	...	...	...	...	...	...	50	...
109	1, <i>trans</i> -3-Dimethylcyclohexane	...	...	...	57	57	57	...	...	...	...	...	...	...	50	...
110	1, <i>cis</i> -4-Dimethylcyclohexane	...	...	...	57	57	57	...	...	...	...	...	...	...	33, 50	...
111	1, <i>trans</i> -4-Dimethylcyclohexane	...	...	...	57	57	57	...	...	...	...	...	...	...	50	...
112	<i>n</i> -Propylcyclohexane	...	2	...	57	57	57	...	...	...	...	...	...	...	27, 34	...
113	Isopropylcyclohexane	...	2	...	57	57	57	...	...	...	59	36	36, 60	...	63	...
121	1,1,2-Trimethylcyclohexane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
122	1,1,3-Trimethylcyclohexane	...	...	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
130	1, <i>trans</i> -2, <i>trans</i> -4-Trimethylcyclohexane	...	36	...	57	57	57	...	...	...	...	...	36, 60	...	67	...
131	1, <i>cis</i> -3, <i>cis</i> -5-Trimethylcyclohexane	...	...	62	...	...	...	...	...	...	...	...	...	...	...	...
132	1, <i>cis</i> -3, <i>trans</i> -5-Trimethylcyclohexane	...	...	62	...	...	...	...	...	...	...	...	...	...	...	...
133	<i>n</i> -Butylcyclohexane	...	2	...	57	57	57	...	...	...	...	...	...	...	27, 34	...
134	Isobutylcyclohexane	4	2	61	57	57	57	4	4	...	59	36	36, 60	...	24	...
135	<i>sec</i> -Butylcyclohexane	4	2	4	57	57	57	4	4	4	59	36	36, 60	...	...	...
136	<i>tert</i> -Butylcyclohexane	4	2	4	57	57	57	4	4	4	59	36	36, 60	...	24	...
137	1-Methyl-4-isopropylcyclohexane	4	36	4	57	57	57	4	4	4	59	36	36, 60	...	24	...
138	Cycloheptane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
139	Ethylcycloheptane	24	36	61	57	57	57	24	24	...	59	36	36, 60	...	...	...
140	Cyclooctane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
141	Methylcyclooctane	24	36	24	57	57	57	24	24	...	59	36	36, 60	...	...	...
142	Cyclononane	...	36	...	57	57	57	...	...	...	59	36	36, 60	...	...	...
143	Cyclodecane	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
144	<i>cis</i> -Decahydronaphthalene	...	...	...	...	...	...	...	...	...	...	...	...	...	27	...
145	<i>trans</i> -Decahydronaphthalene	...	...	...	...	...	...	...	...	...	...	...	...	...	27	...
III.	Monoolefins:															
1	Ethene (ethylene)	...	...	...	...	...	...	...	...	...	...	...	...	22	...	...
2	Propene (propylene)	...	37	...	...	...	...	...	...	...	...	...	...	22	...	...

KEY TO REFERENCES - *Continued*

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					Pressure	Temperature	Volume									
III.	Monocyclics—Continued:															
3	1-Butene	...	53	...	...	...	...	...	...	...	...	...	...	22	...	...
4	cis-2-Butene	...	37	...	...	1	...	...	...	...	...	...	...	...	...	56
5	trans-2-Butene	...	37	...	...	1	...	...	...	...	...	...	...	...	...	56
6	2-Methylpropene (isobutene)	...	37	...	...	...	...	...	...	...	...	...	...	...	44	56
7	1-Pentene	...	...	...	...	1	6	...	...	...	...	...	...	22	27	56
8	cis-2-Pentene	...	...	...	6	6	6	...	...	...	...	...	...	...	24, 27, 54	45, 56
9	trans-2-Pentene	...	...	...	6	6	6	...	...	...	...	...	...	...	24, 27, 54	45, 56
10	2-Methyl-1-butene	...	...	...	6	6	6	...	...	...	...	...	...	...	...	45, 56
11	3-Methyl-1-butene	...	...	...	6	6	6	...	...	...	...	...	...	...	...	45, 56
12	2-Methyl-2-butene	...	...	...	6	6	6	...	...	...	...	...	...	...	8, 27, 33, 41	45, 56
13	1-Hexene	...	...	...	6	1	6	...	...	...	...	...	...	...	27	...
14	cis-2-Hexene	...	...	...	6	6	6	...	...	...	...	...	...	...	27	...
15	trans-2-Hexene	...	...	...	6	6	6	...	...	...	...	...	...	...	27	...
16	cis-3-Hexene	...	...	...	6	6	6	...	...	...	...	...	...	...	24	...
17	trans-3-Hexene	...	...	...	6	6	6	...	...	...	...	...	...	...	24	...
21	2-Methyl-2-pentene	...	...	...	6	6	6	...	...	...	...	...	...	...	...	...
22	3-Methyl-cis-2-pentene	...	...	...	6	6	6	...	...	...	...	...	...	...	...	...
23	3-Methyl-trans-2-pentene	...	...	...	6	6	6	...	...	...	...	...	...	...	...	...
27	2,3-Dimethyl-1-butene	...	...	...	6	6	6	...	...	...	...	...	...	...	...	...
28	3,3-Dimethyl-1-butene	...	...	...	6	6	6	...	...	...	...	...	...	...	...	...
29	2,3-Dimethyl-2-butene	...	...	...	6	6	6	...	...	...	...	...	...	...	...	...
30	1-Heptene	...	...	...	6	1	6	...	...	...	...	...	...	...	27	...
31	cis-2-Heptene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
32	trans-2-Heptene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
33	cis-3-Heptene	...	...	...	...	...	...	...	...	...	...	...	...	...	24	...
34	trans-3-Heptene	...	...	...	...	...	...	...	...	...	...	...	...	...	24	...
56	4,4-Dimethyl-1-pentene	...	...	...	6	6	6	...	...	...	59	...	36, 60	...	...	...
58	2,3-Dimethyl-2-pentene	...	...	...	6	6	6	...	...	...	59	...	36, 60	...	...	...
65	2,3,3-Trimethyl-1-butene	...	...	...	6	6	6	...	...	...	59	...	36, 60	...	15	...
66	1-Octene	...	...	...	6	1	6	...	...	...	...	...	...	...	27	...
67	cis-2-Octene	...	...	...	6	6	6	...	...	...	59	36	36, 60	...	24	...
68	trans-2-Octene	...	...	...	6	6	6	...	...	...	59	36	36, 60	...	24	...
70	trans-3-Octene	...	...	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
71	cis-4-Octene	...	...	...	6	6	6	...	...	...	59	24	36, 60	...	...	...
72	trans-4-Octene	...	...	...	6	6	6	...	...	...	59	24	36, 60	...	...	...
73	2-Methyl-1-heptene	...	...	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
113	2,3-Dimethyl-2-hexene	...	...	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
144	2,3,3-Trimethyl-1-pentene	...	...	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
146	2,4,4-Trimethyl-1-pentene	...	...	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
153	2,4,4-Trimethyl-2-pentene	...	...	...	6	6	6	...	...	...	59	36	36, 60	...	41	...
158	1-Nonene	...	...	...	6	6	6	...	...	...	...	...	...	...	27	...
160	2,3-Dimethyl-2-heptene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
161	1-Decene	...	...	...	...	...	...	...	...	...	...	...	...	...	24	...
163	Propadiene (allene)	...	36	...	6	6	6	24	24	...	...	36	3, 36	...	...	56
164	1,2-Butadiene	...	36	...	6	6	6	...	...	...	...	36	3, 36	...	...	45, 56
165	1,3-Butadiene	...	36	...	...	...	...	...	...	...	...	36	...	22	...	...
166	1,2-Pentadiene	...	...	...	6	6	6	...	...	...	...	36	3, 36	...	...	45, 56
167	1,cis-3-Pentadiene	...	...	...	6	6	6	...	...	...	...	36	3, 36	...	...	45, 56
168	1,trans-3-Pentadiene	...	...	...	6	6	6	...	...	...	...	36	3, 36	...	...	45, 56
169	1,4-Pentadiene	...	...	...	6	6	6	...	...	...	...	36	3, 36	...	...	45, 56
170	2,3-Pentadiene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45, 56
171	3-Methyl-1,2-butadiene	...	...	...	6	6	6	...	...	...	...	36	3, 36	...	...	45, 56
172	2-Methyl-1,3-butadiene (isoprene)	...	...	...	6	6	6	...	...	...	...	36	...	...	...	45, 56
178	1,5-Hexadiene	...	36	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
189	4-Methyl-1,3-pentadiene	...	36	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
194	2,3-Dimethyl-1,3-butadiene	...	36	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
195	2-Methyl-1,5-hexadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
196	2-Methyl-2,4-hexadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
197	2,4-Dimethyl-1,3-pentadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
198	2,6-Octadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
199	3-Methyl-1,5-heptadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
200	2,5-Dimethyl-1,5-hexadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
201	2,5-Dimethyl-2,4-hexadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...

KEY TO REFERENCES—Continued

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					Pressure	Temperature	Volume									
III.	Monoolefins—Continued:															
202	2,6-Dimethyl-1,5-heptadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
203	2-Methyl-3-ethyl-1,5-hexadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
204	3,7-Dimethyl-1,6-hexadiene	24	36	24	6	6	6	24, 32	24, 32	...	59	36	36, 60	...	...	...
IV.	Cycloolefins:															
1	Cyclopentene	...	...	...	...	1	...	...	...	...	...	...	...	...	27, 34	...
2	1-Methylcyclopentene	...	...	...	...	...	...	...	...	...	...	...	...	...	27, 34	...
5	1-Ethylcyclopentene	...	...	...	...	...	...	...	...	...	...	...	...	...	27, 34	...
18	1- <i>n</i> -Propylcyclopentene	...	...	...	...	...	...	...	...	...	...	...	...	...	27, 34	...
19	1- <i>n</i> -Butylcyclopentene	...	...	...	...	...	...	...	...	...	...	...	...	...	27, 34	...
21	Cyclohexene	...	...	...	...	1	...	...	...	...	...	...	...	...	27, 33, 41	...
37	4-Vinylcyclohexene	55	55	55	...	...	...	55	55	55	...	...	...	...	...	...
38	1,5-Cyclooctadiene	55	55	55	...	...	...	55	55	55	...	...	...	...	...	...
V.	Acetylenes:															
1	Ethyne (acetylene)	...	...	...	...	...	...	24, 32	24	...	...	...	...	22	...	...
2	Propyne (methylacetylene)	...	...	...	6	...	6	24, 32	24	...	...	36	3, 36	...	...	56
3	1-Butyne (ethylacetylene)	...	36	...	6	...	6	...	...	...	...	36	3, 36	...	...	56
4	2-Butyne (dimethylacetylene)	...	...	...	6	...	6	...	...	...	...	36	3, 36	...	...	56
5	1-Pentyne	...	...	...	6	...	6	...	...	...	...	36	3, 36	...	...	45, 56
6	2-Pentyne	...	...	...	6	6	6	...	...	...	...	36	3, 36	...	...	45, 56
7	3-Methyl-1-butyne	...	...	...	...	...	...	...	...	...	...	...	...	...	...	45, 56
8	1-Hexyne	...	36	...	6	6	6	...	...	...	...	36	3, 36	...	...	...
10	3-Hexyne	...	36	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
15	1-Heptyne	...	36	...	6	6	6	...	...	...	...	36	3, 36	...	...	...
20	5-Methyl-1-hexyne	...	36	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
29	1-Octyne	...	36	...	6	6	6	...	...	...	...	36	36, 60	...	...	...
30	2-Octyne	...	36	40	6	6	6	...	...	...	59	36	36, 60	...	...	...
31	3-Octyne	...	36	...	6	6	6	...	...	...	59	36	36, 60	...	...	...
32	4-Octyne	24	36	40	6	6	6	24	24	26, 40	59	36	3, 36	...	...	...
33	1-Nonyne	...	36	...	6	6	6	...	...	...	...	...	3, 36	...	...	...
VI.	Alkylbenzenes, Naphthalene, Indans, and Tetrahydronaphthalene:															
1	Benzene	...	...	...	...	1	...	...	...	...	...	...	...	72	8, 34	...
2	Methylbenzene (toluene)	...	...	...	...	1	...	...	...	...	...	...	...	72	34	...
3	Ethylbenzene	...	...	...	...	1	...	...	...	...	...	...	...	72	34	...
4	1,2-Dimethylbenzene (<i>o</i> -xylene)	...	...	...	...	1	...	...	...	...	...	...	...	72	8	...
5	1,3-Dimethylbenzene (<i>m</i> -xylene)	...	...	...	...	1	...	...	...	...	...	...	...	72	24	...
6	1,4-Dimethylbenzene (<i>p</i> -xylene)	...	...	...	...	1	...	...	...	...	...	...	...	72	24	...
7	<i>n</i> -Propylbenzene	...	...	...	...	1	...	...	...	...	...	...	...	...	29, 34	...
8	Isopropylbenzene (cumene)	...	...	...	...	1	...	...	...	...	...	...	...	72	8	...
9	1-Methyl-2-ethylbenzene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
10	1-Methyl-3-ethylbenzene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
11	1-Methyl-4-ethylbenzene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
12	1,2,3-Trimethylbenzene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
13	1,2,4-Trimethylbenzene	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
14	1,3,5-Trimethylbenzene	...	...	...	...	...	...	...	...	...	...	...	...	...	34	...
15	<i>n</i> -Butylbenzene (1-phenylbutane)	...	...	...	57	1	57	...	...	...	...	...	...	22	29, 34	...
16	Isobutylbenzene (1-phenyl-2-methylpropane)	...	...	...	24	1	57	...	...	...	59	...	36, 60	...	...	...
17	<i>sec</i> -Butylbenzene (2-phenylbutane)	...	...	...	57	57	57	...	...	...	59	...	36, 60	...	...	...
18	<i>tert</i> -Butylbenzene (2-phenyl-2-methylpropane)	...	...	...	57	57	57	...	...	...	59	...	36, 60	...	...	...
22	1-Methyl-2-isopropylbenzene (<i>o</i> -cymene)	...	36	...	24	57	57	...	...	...	59	...	36, 60	...	...	...
23	1-Methyl-3-isopropylbenzene (<i>m</i> -cymene)	...	36	...	57	57	57	...	...	...	59	...	36, 60	...	...	...
24	1-Methyl-4-isopropylbenzene (<i>p</i> -cymene)	...	36	...	24	57	57	...	...	...	59	...	36, 60	72	...	...
36	1,2,4,5-Tetramethylbenzene (durene)	...	...	...	43	43	...	...	...	...	...	...	...	22	...	...
37	Naphthalene	...	...	...	45	1	...	...	...	...	...	...	...	70	...	...
43	1,2,3,4-Tetrahydronaphthalene	...	...	...	...	...	...	...	...	...	...	...	...	...	33	...

KEY TO REFERENCES—Continued

No.	Compound	Boiling Point	Vapor Pressure	Freezing Point	Critical Constants			Specific Gravity, Liquid, 60F/60F	Density, Liquid	Refractive Index, Liquid	Heat Capacity, Ideal Gas	Heat of Vaporization at Normal Boiling Point	Heat of Combustion, Liquid	Flammability Limits (Measured)	Aniline Point or Critical Solution Temperature	Compressibility Factor
					Pressure	Temperature	Volume									
VII.	Styrenes and Indenes:															
1	Ethenylbenzene (styrene; vinylbenzene; phenylethylene)	...	36	...	57	57	57	...	...	...	...	36	...	22	...	...
2	Isopropenylbenzene (α -methylstyrene; 2-Phenyl-1-propene)	...	36	...	57	57	57	...	...	...	...	36	3, 36	...	...	...
3	<i>cis</i> -1-Propenylbenzene (<i>cis</i> - β -methylstyrene; <i>cis</i> -1-Phenyl-1-propene)	...	36	...	57	57	57	...	...	...	...	36	3, 36	...	...	...
4	<i>trans</i> -1-Propenylbenzene (<i>trans</i> - β -methylstyrene; <i>trans</i> -1-Phenyl-1-propene)	...	36	...	57	...	...	...	...	...	...	36	3, 36	...	...	...
5	1-Methyl-2-ethenylbenzene (<i>o</i> -methylstyrene)	...	36	...	57	57	57	...	...	...	...	36	3, 36	...	...	...
6	1-Methyl-3-ethenylbenzene (<i>m</i> -methylstyrene)	...	36	...	57	57	57	...	...	...	...	36	3, 36	...	...	...
7	1-Methenyl-4-ethenylbenzene (<i>p</i> -methylstyrene)	...	36	...	57	57	57	...	...	...	...	36	3, 36	...	...	...
32	Phenylacetylene	24	36	24	57	57	57	24	24	24	59	36	36, 60	...	...	...

APPENDIX IV

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