

Table B.1 Selected properties of hydrocarbon fuels: enthalpy of formation,^a Gibbs function of formation,^a entropy,^a and higher and lower heating values all at 298.15 K and 1 atm; boiling points^b and latent heat of vaporization^c at 1 atm; constant-pressure adiabatic flame temperature at 1 atm,^d liquid density^e

Formula	Fuel	MW (kg/kmol)	\bar{h}_f° (kJ/kmol)	\bar{g}_f° (kJ/kmol)	\bar{s}° (kJ/kmol-K)	HHV [†] (kJ/kg)	LHV [†] (kJ/kg)	Boiling pt. (°C)	h_{fg} (kJ/kg)	T_{ad}^\ddagger (K)	ρ_{liq}^* (kg/m ³)
CH ₄	Methane	16.043	-74,831	-50,794	186.188	55,528	50,016	-164	509	2,226	300
C ₂ H ₂	Acetylene	26.038	226,748	209,200	200.819	49,923	48,225	-84	—	2,539	—
C ₂ H ₄	Ethene	28.054	52,283	68,124	219.827	50,313	47,161	-103.7	—	2,369	—
C ₂ H ₆	Ethane	30.069	-84,667	-32,886	229.492	51,901	47,489	-88.6	488	2,259	370
C ₃ H ₆	Propene	42.080	20,414	62,718	266.939	48,936	45,784	-47.4	437	2,334	514
C ₃ H ₈	Propane	44.096	-103,847	-23,489	269.910	50,368	46,357	-42.1	425	2,267	500
C ₄ H ₈	1-Butene	56.107	1,172	72,036	307.440	48,471	45,319	-63	391	2,322	595
C ₄ H ₁₀	<i>n</i> -Butane	58.123	-124,733	-15,707	310.034	49,546	45,742	-0.5	386	2,270	579
C ₅ H ₁₀	1-Pentene	70.134	-20,920	78,605	347.607	48,152	45,000	30	358	2,314	641
C ₅ H ₁₂	<i>n</i> -Pentane	72.150	-146,440	-8,201	348.402	49,032	45,355	36.1	358	2,272	626
C ₆ H ₆	Benzene	78.113	82,927	129,658	269.199	42,277	40,579	80.1	393	2,342	879
C ₆ H ₁₂	1-Hexene	84.161	-41,673	87,027	385.974	47,955	44,803	63.4	335	2,308	673
C ₆ H ₁₄	<i>n</i> -Hexane	86.177	-167,193	209	386.811	48,696	45,105	69	335	2,273	659
C ₇ H ₁₄	1-Heptene	98.188	-62,132	95,563	424.383	47,817	44,665	93.6	—	2,305	—
C ₇ H ₁₆	<i>n</i> -Heptane	100.203	-187,820	8,745	425.262	48,456	44,926	98.4	316	2,274	684
C ₈ H ₁₆	1-Octene	112.214	-82,927	104,140	462.792	47,712	44,560	121.3	—	2,302	—
C ₈ H ₁₈	<i>n</i> -Octane	114.230	-208,447	17,322	463.671	48,275	44,791	125.7	300	2,275	703
C ₉ H ₁₈	1-Nonene	126.241	-103,512	112,717	501.243	47,631	44,478	—	—	2,300	—
C ₉ H ₂₀	<i>n</i> -Nonane	128.257	-229,032	25,857	502.080	48,134	44,686	150.8	295	2,276	718
C ₁₀ H ₂₀	1-Decene	140.268	-124,139	121,294	539.652	47,565	44,413	170.6	—	2,298	—
C ₁₀ H ₂₂	<i>n</i> -Decane	142.284	-249,659	34,434	540.531	48,020	44,602	174.1	277	2,277	730
C ₁₁ H ₂₂	1-Undecene	154.295	-144,766	129,830	578.061	47,512	44,360	—	—	2,296	—
C ₁₁ H ₂₄	<i>n</i> -Undecane	156.311	-270,286	43,012	578.940	47,926	44,532	195.9	265	2,277	740

Table B.1 (continued)

Formula	Fuel	<i>MW</i> (kg/kmol)	\bar{h}_f° (kJ/kmol)	\bar{g}_f° (kJ/kmol)	\bar{s}° (kJ/kmol-K)	HHV [†] (kJ/kg)	LHV [†] (kJ/kg)	Boiling pt. (°C)	h_{fg} (kJ/kg)	T_{ad}^\ddagger (K)	ρ_{liq}^* (kg/m ³)
C ₁₂ H ₂₄	1-Dodecene	168.322	-165,352	138,407	616.471	47,468	44,316	213.4	—	2,295	—
C ₁₂ H ₂₆	<i>n</i> -Dodecane	170.337	-292,162	—	—	47,841	44,467	216.3	256	2,277	749

[†] Based on gaseous fuel.

[‡] For stoichiometric combustion with air (79 percent N₂, 21 percent O₂).

* For liquids at 20°C or for gases at the boiling point of the liquefied gas.

SOURCES:

^aRossini, F. D., et al., *Selected Values of Physical and Thermodynamic Properties of Hydrocarbons and Related Compounds*, Carnegie Press, Pittsburgh, PA, 1953.

^bWeast, R. C. (ed.), *Handbook of Chemistry and Physics*, 56th Ed., CRC Press, Cleveland, OH, 1976.

^cObert, E. F., *Internal Combustion Engines and Air Pollution*, Harper & Row, New York, 1973.

^dCalculated using HPFLAME (Appendix F).