RELATIVE MOLAR ENTHALPY (SENSIBLE HEAT + ENTHALPY OF FORMATION) OF CARBON AND OF GASES

kJ/mol or MJ/kmol at the standard pressure of 101.325 kPa and relative to the chemical constituents in their standard state at 25ºC.
Based on Technical Data on Fuel, 7th ed'n, Ed's J.W. Rose and J.R.Cooper, Scottish Academic Press, 1977. Tables 4.53 and 4.55

T/K	O(g)	H(g)	N(g)	C(g)	C(graphite)	OH(g)	O2(g)	H2(g)	H2O(g)	N2(g)	NO(g)	CO(g)	CO2(g)
298.15	**249.170**	**217.997**	**472.680**	**716.670**	**0**	**39.460**	**0**	**0**	**-241.814**	**0**	**90.200**	**-110.530**	**-393.510**
300	249.2113	218.0339	472.7170	716.7085	0.0170	39.5152	0.0543	0.0531	-241.7517	0.0550	90.2552	-110.4765	-393.4414
400	251.3777	220.1133	474.7970	718.7908	1.0460	42.4875	3.0258	2.9589	-238.3635	2.9710	93.2418	-107.5540	-389.5067
500	253.5137	222.1923	476.8760	720.8711	2.3810	45.4404	6.0847	5.8814	-234.8920	5.9120	96.2655	-104.5992	-385.2039
600	255.6324	224.2705	478.9560	722.9514	3.9620	48.3903	9.2474	8.8102	-231.3176	8.8950	99.3575	-101.5884	-380.6027
700	257.7399	226.3475	481.0350	725.0317	5.7400	51.3471	12.4992	11.7478	-227.6299	11.9370	102.5294	-98.5082	-375.7552
800	259.8411	228.4261	483.1100	727.1111	7.6650	54.3240	15.8363	14.7000	-223.8228	15.0460	105.7783	-95.3538	-370.7026
900	261.9369	230.5055	485.1900	729.1897	9.6940	57.3311	19.2421	17.6749	-219.8920	18.2220	109.0970	-92.1296	-365.4784
1000	264.0306	232.5850	487.2690	731.2692	11.8070	60.3766	22.7048	20.6794	-215.8343	21.4640	112.4764	-88.8410	-360.1112
1100	266.1209	234.6644	489.3490	733.3486	14.0000	63.4657	26.2143	23.7182	-211.6503	24.7610	115.9077	-85.4959	-354.6235
1200	268.2091	236.7426	491.4280	735.4273	16.2460	66.6007	29.7645	26.7956	-207.3412	28.1080	119.3830	-82.1010	-349.0345
1300	270.2961	238.8187	493.5030	737.5067	18.5390	69.7814	33.3481	29.9156	-202.9125	31.5060	122.8969	-78.6634	-343.3597
1400	272.3814	240.8982	495.5830	739.5866	20.8700	73.0077	36.9630	33.0795	-198.3707	34.9370	126.4409	-75.1890	-337.6121
1500	274.4667	242.9776	497.6620	741.6669	23.2300	76.2779	40.6060	36.2886	-193.7219	38.4050	130.0099	-71.6824	-331.8022
1750	279.6762	248.1737	502.8590	746.8759	29.2210	84.6279	49.8246	44.4939	-181.6803	47.2040	139.0349	-62.8011	-317.0570
2000	284.8828	253.3703	508.0550	752.1022	35.3170	93.1976	59.1951	52.9489	-169.1279	56.1410	148.1639	-53.7937	-302.0707
2250	290.0889	258.5664	513.2520	757.3556	41.4840	101.9488	68.7112	61.6257	-156.1596	65.1790	157.3729	-44.6927	-286.9067
2500	295.2997	263.7629	518.4570	762.6450	47.7060	110.8503	78.3700	70.4953	-142.8532	74.3040	166.6369	-35.5148	-271.6045
2750	300.5163	268.9632	523.7120	767.9784	53.9780	119.8764	88.1664	79.5361	-129.2690	83.4880	175.9549	-26.2915	-256.1949
3000	305.7434	274.1555	528.9000	773.3586	60.2960	129.0101	98.0934	88.7296	-115.4564	92.7220	185.3099	-17.0172	-240.6965
3500	316.2486	284.5477	539.4480	784.2671	73.0480	147.5381	118.3017	107.5451	-87.2822	111.3200	204.1209	1.6392	-209.4851
4000	326.8454	294.9404	550.2090	795.3635	85.9640	166.3406	138.9108	126.8605	-58.5406	130.0430	223.0369	20.4091	-178.0461
4500	337.5556	305.3330	561.2840	806.6193	99.0390	185.3682	159.8352	146.6253	-29.3727	148.8710	242.0409	39.2685	-146.4218
5000	348.3917	315.7257	572.7730	818.0048	112.2900	204.5823	180.9852	166.8173	0.1337	167.7870	261.1239	58.2023	-114.6388

N.B. Values for 298.15 K are the molar enthalpy of formation for the substance at standard conditions, 298.15 K and 1 atm

RELATIVE MOLAR ENTHALPY (SENSIBLE HEAT) OF CARBON AND OF GASES

kJ/mol or MJ/kmol at the standard pressure of 101.325 kPa and relative to the same substance at 25ºC.

Based on Technical Data on Fuel, 7th ed'n, Ed's J.W. Rose and J.R.Cooper, Scottish Academic Press, 1977. Table 4.55

T/K	O(g)	H(g)	N(g)	C(g)	C(graphite)	OH(g)	O2(g)	H2(g)	H2O(g)	N2(g)	NO(g)	CO(g)	CO2(g)	Ar (g)
298.15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
300	0.0413	0.0369	0.0370	0.0385	0.0170	0.0552	0.0543	0.0531	0.0623	0.0550	0.0552	0.0535	0.0686	0.0385
400	2.2077	2.1163	2.1170	2.1208	1.0460	3.0275	3.0258	2.9589	3.4505	2.9710	3.0418	2.9760	4.0033	2.1185
500	4.3437	4.1953	4.1960	4.2011	2.3810	5.9804	6.0847	5.8814	6.9220	5.9120	6.0655	5.9308	8.3061	4.1985
600	6.4624	6.2735	6.2760	6.2814	3.9620	8.9303	9.2474	8.8102	10.4964	8.8950	9.1575	8.9416	12.9073	6.2785
700	8.5699	8.3505	8.3550	8.3617	5.7400	11.8871	12.4992	11.7478	14.1841	11.9370	12.3294	12.0218	17.7548	8.3585
800	10.6711	10.4291	10.4300	10.4411	7.6650	14.8640	15.8363	14.7000	17.9912	15.0460	15.5783	15.1762	22.8074	10.4385
900	12.7669	12.5085	12.5100	12.5197	9.6940	17.8711	19.2421	17.6749	21.9220	18.2220	18.8970	18.4004	28.0316	12.5185
1000	14.8606	14.5880	14.5890	14.5992	11.8070	20.9166	22.7048	20.6794	25.9797	21.4640	22.2764	21.6890	33.3988	14.5985
1100	16.9509	16.6674	16.6690	16.6786	14.0000	24.0057	26.2143	23.7182	30.1637	24.7610	25.7077	25.0341	38.8865	16.6785
1200	19.0391	18.7456	18.7480	18.7573	16.2460	27.1407	29.7645	26.7956	34.4728	28.1080	29.1830	28.4290	44.4755	18.7585
1300	21.1261	20.8217	20.8230	20.8367	18.5390	30.3214	33.3481	29.9156	38.9015	31.5060	32.6969	31.8666	50.1503	20.8385
1400	23.2114	22.9012	22.9030	22.9166	20.8700	33.5477	36.9630	33.0795	43.4433	34.9370	36.2409	35.3410	55.8979	22.9185
1500	25.2967	24.9806	24.9820	24.9969	23.2300	36.8179	40.6060	36.2886	48.0921	38.4050	39.8099	38.8476	61.7078	24.9985
1750	30.5062	30.1767	30.1790	30.2059	29.2210	45.1679	49.8246	44.4939	60.1337	47.2040	48.8349	47.7289	76.4530	30.1985
2000	35.7128	35.3733	35.3750	35.4322	35.3170	53.7376	59.1951	52.9489	72.6861	56.1410	57.9639	56.7363	91.4393	35.3985
2250	40.9189	40.5694	40.5720	40.6856	41.4840	62.4888	68.7112	61.6257	85.6544	65.1790	67.1729	65.8373	106.6033	40.5985
2500	46.1297	45.7659	45.7770	45.9750	47.7060	71.3903	78.3700	70.4953	98.9608	74.3040	76.4369	75.0152	121.9055	45.7985
2750	51.3463	50.9662	51.0320	51.3084	53.9780	80.4164	88.1664	79.5361	112.5450	83.4880	85.7549	84.2385	137.3151	50.9985
3000	56.5734	56.1585	56.2200	56.6886	60.2960	89.5501	98.0934	88.7296	126.3576	92.7220	95.1099	93.5128	152.8135	56.1985
3500	67.0786	66.5507	66.7680	67.5971	73.0480	108.0781	118.3017	107.5451	154.5318	111.3200	113.9209	112.1692	184.0249	66.5985
4000	77.6754	76.9434	77.5290	78.6935	85.9640	126.8806	138.9108	126.8605	183.2734	130.0430	132.8369	130.9391	215.4639	76.9985
4500	88.3856	87.3360	88.6040	89.9493	99.0390	145.9082	159.8352	146.6253	212.4413	148.8710	151.8409	149.7985	247.0882	87.3985
5000	99.2217	97.7287	100.0930	101.3348	112.2900	165.1223	180.9852	166.8173	241.9477	167.7870	170.9239	168.7323	278.8712	97.7985

RELATIVE MOLAR GIBBS FUNCTION OF CARBON AND GASES

kJ/mol or MJ/kmol at the standard pressure of 101.325 kPa and relative to the chemical constituents in their standard state at 25ºC.

Based on Technical Data on Fuel, 7th ed'n, Ed's J.W. Rose and J.R.Cooper, Scottish Academic Press, 1977. Tables 4.53, 4.55 and 4.56

T/K	O(g)	H(g)	N(g)	C(g)	C(graphite)	OH(g)	O2(g)	H2(g)	H2O(g)	N2(g)	NO(g)	CO(g)	CO2(g)
298.15	201.184	183.828	427.007	669.566	-1.711	-15.292	-61.129	-38.931	-298.078	-57.085	27.409	-169.434	-457.218
300	200.887	183.614	426.722	669.275	-1.722	-15.632	-61.510	-39.173	-298.428	-57.439	27.019	-169.799	-457.614
400	184.451	171.828	411.078	653.149	-2.450	-34.463	-82.479	-52.685	-317.830	-77.045	5.492	-190.012	-479.585
500	167.472	159.516	394.910	636.497	-3.471	-54.043	-104.205	-66.935	-338.095	-97.387	-16.795	-210.967	-502.596
600	150.062	146.785	378.322	619.425	-4.784	-74.218	-126.558	-81.772	-359.070	-118.327	-39.696	-232.523	-526.502
700	132.302	133.707	361.385	602.007	-6.379	-94.885	-149.449	-97.104	-380.651	-139.769	-63.121	-254.587	-551.199
800	114.238	120.329	344.148	584.290	-8.245	-115.978	-172.812	-112.855	-402.771	-161.652	-87.007	-277.100	-576.606
900	95.911	106.693	326.654	566.312	-10.354	-137.444	-196.599	-128.977	-425.374	-183.931	-111.304	-300.009	-602.655
1000	77.353	92.827	308.926	548.106	-12.695	-159.250	-220.766	-145.430	-448.418	-206.564	-135.974	-323.283	-629.297
1100	58.585	78.754	290.995	529.688	-15.248	-181.364	-245.281	-162.186	-471.880	-229.526	-160.987	-346.889	-656.477
1200	39.627	64.489	272.867	511.083	-18.006	-203.759	-270.118	-179.223	-495.726	-252.790	-186.309	-370.802	-684.168
1300	20.489	50.046	254.570	492.302	-20.955	-226.416	-295.256	-196.518	-519.936	-276.337	-211.923	-395.002	-712.322
1400	1.199	35.448	236.115	473.358	-24.081	-249.319	-320.667	-214.058	-544.497	-300.147	-237.814	-419.463	-740.920
1500	-18.246	20.700	217.507	454.270	-27.374	-272.460	-346.342	-231.821	-569.379	-324.204	-263.959	-444.176	-769.930
1750	-67.438	-16.759	170.403	405.964	-36.275	-331.240	-411.556	-277.147	-632.935	-385.328	-330.327	-506.962	-844.110
2000	-117.383	-54.958	122.557	356.906	-46.045	-391.226	-478.105	-323.669	-698.254	-447.729	-398.006	-571.028	-920.425
2250	-167.986	-93.808	74.052	307.187	-56.591	-452.309	-545.836	-371.259	-765.160	-511.251	-466.822	-636.222	-998.633
2500	-219.155	-133.247	24.975	256.883	-67.814	-514.365	-614.638	-419.837	-833.538	-575.786	-536.683	-702.435	-1078.530
2750	-270.859	-173.190	-24.583	206.071	-79.675	-577.317	-684.416	-469.323	-903.265	-641.242	-607.465	-769.578	-1159.969
3000	-323.036	-213.615	-74.700	154.735	-92.098	-641.105	-755.080	-519.604	-974.239	-707.531	-679.095	-837.565	-1242.811
3500	-428.649	-295.735	-176.131	50.765	-118.511	-770.918	-898.872	-622.488	-1119.583	-842.371	-824.648	-975.788	-1412.299
4000	-535.795	-379.352	-279.095	-54.777	-146.752	-903.407	-1045.597	-728.080	-1269.005	-979.905	-972.899	-1116.703	-1586.262
4500	-644.268	-464.262	-383.410	-161.722	-176.622	-1038.267	-1194.935	-836.139	-1422.060	-1119.760	-1123.534	-1259.976	-1764.199
5000	-753.923	-550.319	-488.982	-269.920	-207.975	-1175.258	-1346.675	-946.418	-1578.386	-1261.738	-1276.286	-1405.338	-1945.639

SPECIFIC ENTHALPY (SENSIBLE HEAT) OF CARBON AND OF GASES

kJ/kg at the standard pressure of 101.325 kPa and relative to the same substance at 25ºC.

Based on Technical Data on Fuel, 7th ed'n, Ed's J.W. Rose and J.R.Cooper, Scottish Academic Press, 1977. Table 4.55

	C(graphite)	O2(g)	H2(g)	H2O(g)	N2(g)	NO(g)	CO(g)	CO2(g)	Ar (g)	Air
Molar mass	**12.01**	**32**	**2.016**	**18.016**	**28.014**	**30.007**	**28.01**	**44.01**	**40**	**28.97**
T/K										
298.15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
300	1.42	1.70	26.34	3.46	1.96	1.84	1.91	1.56	0.96	1.89
400	87.09	94.56	1467.71	191.52	106.05	101.37	106.25	90.96	52.96	102.71
500	198.25	190.15	2917.36	384.21	211.04	202.14	211.74	188.73	104.96	204.83
600	329.89	288.98	4370.14	582.62	317.52	305.18	319.23	293.28	156.96	308.85
700	477.94	390.60	5827.28	787.31	426.11	410.88	429.20	403.43	208.96	415.10
800	638.22	494.88	7291.67	998.62	537.09	519.16	541.81	518.23	260.96	523.77
900	807.16	601.32	8767.31	1216.81	650.46	629.75	656.92	636.94	312.96	634.76
1000	983.10	709.53	10257.64	1442.03	766.19	742.37	774.33	758.89	364.96	747.93
1100	1165.70	819.20	11764.98	1674.27	883.88	856.72	893.76	883.58	416.96	862.93
1200	1352.71	930.14	13291.47	1913.45	1003.36	972.54	1014.96	1010.58	468.96	979.57
1300	1543.63	1042.13	14839.09	2159.28	1124.65	1089.64	1137.69	1139.52	520.96	1097.83
1400	1737.72	1155.09	16408.48	2411.37	1247.13	1207.75	1261.73	1270.12	572.96	1217.20
1500	1934.22	1268.94	18000.30	2669.41	1370.92	1326.69	1386.92	1402.13	624.96	1337.78
1750	2433.06	1557.02	22070.39	3337.79	1685.01	1627.45	1704.00	1737.17	754.96	1643.50
2000	2940.63	1849.85	26264.34	4034.53	2004.03	1931.68	2025.57	2077.69	884.96	1954.05
2250	3454.12	2147.23	30568.30	4754.35	2326.66	2238.57	2350.49	2422.25	1014.96	2268.38
2500	3972.19	2449.06	34967.91	5492.94	2652.39	2547.30	2678.16	2769.95	1144.96	2586.08
2750	4494.42	2755.20	39452.43	6246.95	2980.22	2857.83	3007.44	3120.09	1274.96	2906.37
3000	5020.48	3065.42	44012.70	7013.63	3309.85	3169.59	3338.55	3472.24	1404.96	3228.96
3500	6082.26	3696.93	53345.78	8577.48	3973.73	3796.48	4004.61	4181.43	1664.96	3880.20
4000	7157.70	4340.96	62926.84	10172.81	4642.07	4426.86	4674.73	4895.79	1924.96	4537.71
4500	8246.38	4994.85	72730.80	11791.81	5314.16	5060.18	5348.04	5614.36	2184.96	5200.34
5000	9349.71	5655.79	82746.68	13429.60	5989.40	5696.13	6024.00	6336.54	2444.96	5866.97

Air composition	By vol./mole:	By mass:
	0.7809 N2	0.7552 N2
	0.2095 O2	0.2315 O2
	0.0093 Ar	0.0128 Ar
	0.0003 CO2	0.0005 CO2