1 2 3 4 5 6 7 8 9

No.	Substance	Formula	Molecular Weight	Lb per Cu Ft	Cu Ft per Lb	Sp Gr Air 1.0000	Heat of Combustion: Btu per Cu Ft Gross (High)	Heat of Combustion: Btu per Cu Ft Net (Low)	Heat of Combustion: Btu per Lb Gross (High)	Heat of Combustion: Btu per Lb Net (Low)	For 100% Total Air, Moles per Mole of Combustible or Cu Ft per Cu Ft of Combustible: Required for Combustion O_2	Required for Combustion N_2	Required for Combustion Air	Flue Products CO_2	Flue Products H_2O	Flue Products N_2	For 100% Total Air, Lb per Lb of Combustible: Required for Combustion O_2	Required for Combustion N_2	Required for Combustion Air	Flue Products CO_2	Flue Products H_2O	Flue Products N_2
1.	Carbon*	C	12.01	—	—	—	—	—	14,093	14,093	1.0	3.76	4.76	1.0	—	3.76	2.66	8.86	11.53	3.66	—	8.86
2.	Hydrogen	H_2	2.016	0.0053	187.723	0.0696	325	275	61,100	51,623	0.5	1.88	2.38	—	1.0	1.88	7.94	26.41	34.34	—	8.94	26.41
3.	Oxygen	O_2	32.000	0.0846	11.819	1.1053	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4.	Nitrogen (atm)	N_2	28.016	0.0744	13.443	0.9718	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5.	Carbon monoxide	CO	28.01	0.0740	13.506	0.9672	322	322	4,347	4,347	0.5	1.88	2.38	1.0	—	1.88	0.57	1.90	2.47	1.57	—	1.90
6.	Carbon dioxide	CO_2	44.01	0.1170	8.548	1.5282	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	Paraffin series																					
7.	Methane	CH_4	16.041	0.0424	23.565	0.5543	1013	913	23,879	21,520	2.0	7.53	9.53	1.0	2.0	7.53	3.99	13.28	17.27	2.74	2.25	13.28
8.	Ethane	C_2H_6	30.067	0.0803	12.455	1.0488	1797	1641	22,320	20,432	3.5	13.18	16.68	2.0	3.0	13.18	3.73	12.39	16.12	2.93	1.80	12.39
9.	Propane	C_3H_8	44.092	0.1196	8.365	1.5617	2590	2385	21,661	19,944	5.0	18.82	23.82	3.0	4.0	18.82	3.63	12.07	15.70	2.99	1.68	12.07
10.	n-Butane	C_4H_{10}	58.118	0.1582	6.321	2.0665	3370	3113	21,308	19,680	6.5	24.47	30.97	4.0	5.0	24.47	3.58	11.91	15.49	3.03	1.55	11.91
11.	Isobutane	C_4H_{10}	58.118	0.1582	6.321	2.0665	3363	3105	21,257	19,629	6.5	24.47	30.97	4.0	5.0	24.47	3.58	11.91	15.49	3.03	1.55	11.91
12.	n-Pentane	C_5H_{12}	72.144	0.1904	5.252	2.4872	4016	3709	21,091	19,517	8.0	30.11	38.11	5.0	6.0	30.11	3.55	11.81	15.35	3.05	1.50	11.81
13.	Isopentane C5	C_5H_{12}	72.144	0.1904	5.252	2.4872	4008	3716	21,052	19,478	8.0	30.11	38.11	5.0	6.0	30.11	3.55	11.81	15.35	3.05	1.50	11.81
14.	Neopentane	C_5H_{12}	72.144	0.1904	5.252	2.4872	3993	3693	20,970	19,396	8.0	30.11	38.11	5.0	6.0	30.11	3.55	11.81	15.35	3.05	1.50	11.81
15.	n-Hexane	C_6H_{14}	86.169	0.2274	4.398	2.9704	4762	4412	20,940	19,403	9.5	35.76	45.26	6.0	7.0	35.76	3.53	11.74	15.27	3.06	1.46	11.74
	Olefin series																					
16.	Ethylene	C_2H_4	28.051	0.0746	13.412	0.9740	1614	1513	21,644	20,295	3.0	11.29	14.29	2.0	2.0	11.29	3.42	11.39	14.81	3.14	1.29	11.39
17.	Propylene	C_3H_6	42.077	0.1110	9.007	1.4504	2336	2186	21,041	19,691	4.5	16.94	21.44	3.0	3.0	16.94	3.42	11.39	14.81	3.14	1.29	11.39
18.	n-Butene	C_4H_8	56.102	0.1480	6.756	1.9336	3084	2885	20,840	19,496	6.0	22.59	28.59	4.0	4.0	22.59	3.42	11.39	14.81	3.14	1.29	11.39
19.	Isobutene	C_4H_8	56.102	0.1480	6.756	1.9336	3068	2869	20,730	19,382	6.0	22.59	28.59	4.0	4.0	22.59	3.42	11.39	14.81	3.14	1.29	11.39
20.	n-Pentene C5	C_5H_{10}	70.128	0.1852	5.400	2.4190	3836	3586	20,712	19,363	7.5	28.23	35.73	5.0	5.0	28.23	3.42	11.39	14.81	3.14	1.29	11.39
	Aromatic series																					
21.	Benzene	C_6H_6	78.107	0.2060	4.852	2.6970	3751	3601	18,210	17,480	7.5	28.23	35.73	6.0	3.0	28.23	3.07	10.22	13.30	3.38	0.69	10.22
22.	Toluene	C_7H_8	92.132	0.2431	4.113	3.1760	4484	4284	18,440	17,670	9.0	33.88	42.88	7.0	4.0	33.88	3.13	10.40	13.53	3.34	0.78	10.40
23.	Xylene C8	C_8H_{10}	106.158	0.2803	3.567	3.6618	5230	4980	18,650	17,760	10.5	39.52	50.02	8.0	5.0	39.52	3.17	10.53	13.70	3.32	0.85	10.53
	Miscellaneous gases																					
24.	Acetylene	C_2H_2	26.036	0.0697	14.344	0.9107	1499	1448	21,500	20,776	2.5	9.41	11.91	2.0	1.0	9.41	3.07	10.22	13.30	3.38	0.69	10.22
25.	Naphthalene	$C_{10}H_8$	128.162	0.3384	2.955	4.4208	5854	5654	17,298	16,708	12.0	45.17	57.17	10.0	4.0	45.17	3.00	9.97	12.96	3.43	0.56	9.97
26.	Methyl alcohol	CH_3OH	32.041	0.0846	11.820	1.1052	868	768	10,259	9,078	1.5	5.65	7.15	1.0	2.0	5.65	1.50	4.98	6.48	1.37	1.13	4.98
27.	Ethyl alcohol	C_2H_6OH	46.067	0.1216	8.221	1.5890	1600	1451	13,161	11,929	3.0	11.29	14.29	2.0	3.0	11.29	2.08	6.93	9.02	1.92	1.17	6.93
28.	Ammonia	NH_3	17.031	0.0456	21.914	0.5961	441	365	9,668	8,001	0.75	2.82	3.57	—	1.5	3.32	1.41	4.69	6.10	—	1.59	5.51
29.	Sulfur*	S	32.06	—	—	—	—	—	3,983	3,983	1.0	3.76	4.76	SO_2 1.0	—	3.76	1.00	3.29	4.29	SO_2 2.00	—	3.29
30.	Hydrogen sulfide	H_2S	34.076	0.0911	10.979	1.1898	647	596	7,100	6,545	1.5	5.65	7.15	1.0	1.0	5.65	1.41	4.69	6.10	1.88	0.53	4.69
31.	Sulfur dioxide	SO_2	64.06	0.1733	5.770	2.2640	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32.	Water Vapor	H_2O	18.016	0.0476	21.017	0.6215	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
33.	Air	—	28.9	0.0766	13.063	1.0000	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

*Carbon and sulfur are considered as gases for molal calculations only.

NOTE: This table is reprinted from *Fuel Flue Gases*, courtesy of American Gas Association. All gas volumes corrected to 60°F and 30 in. Hg dry.

60°F = 15.6°C 1 atm = 30 in. Hg
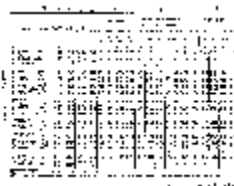
Figure 2-3. Combustion constants.