Dunn-Kang Air Plasma Kinetics for Re-Entry Flows

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TABLE 1.
Dunn-Kang 11-species 31-reaction high-temperature air model [1, 2].

	Reaction	A, $\mathrm{cm}^3 \cdot (\mathrm{mole} \cdot \mathrm{s})^{-1} \cdot \mathrm{K}^{-n}$	n	E, cal/mole
(1)	$O_2 + N \rightleftarrows 2O + N$	3.6×10^{18}	-1	118,800
(2)	$O_2 + NO \rightleftarrows 2O + NO$	3.6×10^{18}	-1	118,800
(3)	$N_2 + O \rightleftarrows 2N + O$	1.9×10^{17}	-0.5	226,000
(4)	$N_2 + NO \rightleftarrows 2N + NO$	1.9×10^{17}	-0.5	226,000
(5)	$N_2 + O_2 \rightleftarrows 2N + O_2$	1.9×10^{17}	-0.5	226,000
(6)	$NO + O_2 \rightleftarrows N + O + O_2$	3.9×10^{20}	-1.5	151,000
(7)	$NO + N_2 \rightleftarrows N + O + N_2$	3.9×10^{20}	-1.5	151,000
(8)	$O + NO \rightleftarrows N + O_2$	3.2×10^{9}	1	39,400
(9)	$O + N_2 \rightleftarrows N + NO$	7×10^{13}	0	76,000
(10)	$N + N_2 \rightleftarrows 2N + N$	4.085×10^{22}	-1.5	226,000
(11)	$O + N \rightleftarrows NO^+ + e^-$	1.4×10^{6}	1.5	63,800
(12)	$O + e^- \rightleftarrows O^+ + 2e^-$	3.6×10^{31}	-2.91	316,000
(13)	$N + e^- \rightleftarrows N^+ + 2e^-$	1.1×10^{32}	-3.14	338,000
(14)	$O + O \rightleftarrows O_2^+ + e^-$	1.6×10^{17}	-0.98	161,600
(15)	$O + O_2^+ \rightleftarrows O_2 + O^+$	2.92×10^{18}	-1.11	56,000
(16)	$N_2 + N^+ \rightleftarrows N + N_2^+$	2.02×10^{11}	0.81	26,000
(17)	$N + N \rightleftarrows N_2^+ + e^-$	1.4×10^{13}	0	135,600
(18)	$O + NO^+ \rightleftarrows NO + O^+$	3.63×10^{15}	-0.6	101,600
(19)	$N_2 + O^+ \rightleftarrows O + N_2^+$	3.4×10^{19}	-2	46,000
(20)	$N + NO^+ \rightleftarrows NO + N^+$	1×10^{19}	-0.93	122,000
(21)	$O_2 + NO^+ \rightleftarrows NO + O_2^+$	1.8×10^{15}	0.17	66,000
(22)	$O + NO^+ \rightleftarrows O_2 + N^+$	1.34×10^{13}	0.31	154,540
(23)	$O_2 + O \rightleftarrows 2O + O$	9×10^{19}	-1	119,000
(24)	$O_2 + O_2 \rightleftarrows 2O + O_2$	3.24×10^{19}	-1	119,000
(25)	$O_2 + N_2 \rightleftarrows 2O + N_2$	7.2×10^{18}	-1	119,000
(26)	$N_2 + N_2 \rightleftarrows 2N + N_2$	4.7×10^{17}	-0.5	226,000
(27)	$NO + O \rightleftarrows N + 2O$	7.8×10^{20}	-1.5	151,000
(28)	$NO + N \rightleftarrows O + 2N$	7.8×10^{20}	-1.5	151,000
(29)	$NO + NO \rightleftarrows N + O + NO$	7.8×10^{20}	-1.5	151,000
(30)	$O2 + N2 \rightleftarrows NO + NO^+ + e^-$	1.38×10^{20}	-1.84	282,000
(31)	$NO + N2 \rightleftarrows NO^+ + e^- + N_2$	2.2×10^{15}	-0.35	216,000

References

[1] DUNN, M. G. AND KANG, S. W., "Theroretical and Experimental Studies of Reentry Plasmas," *NASA CR-2232*, 1973.

[2] BUSSING, T. AND EBERHARDT, S., "Chemistry Associated with Hypersonic Vehicles," June 1987, AIAA Paper 87-1292.