

Numerical Study of Simultaneous Oxidation of NO and SO₂ by Ozone

Model I

Reaction	A (cm ³ /mol-s)	n	Ea (cal/mol)
O ₃ + H = O ₂ + OH	1.64E + 13	0.75	750
O ₃ + H = O + HO ₂	4.52E + 11	0	0
O ₃ + OH = O ₂ + HO ₂	1.15E + 12	0	1990
O ₃ + H ₂ O = O ₂ + H ₂ O ₂	6.62E + 10	0	0
O ₃ + HO ₂ = 2O ₂ + OH	1.19E + 08	4.57	1380
O ₃ + N = O ₂ + NO	6.00E + 07	0	0
O ₃ + NO = NO ₂ + O ₂	1.80E + 12	0	2722
O ₃ + NO ₂ = O ₂ + NO ₃	7.22E + 10	0	4870
O ₃ = O ₂ + O	2.00E + 15	0	23,250
O ₃ + O = 2O ₂	4.82E + 12	0	4093
H + O ₂ + M = HO ₂ + M	3.61E + 17	-0.72	0
H + H + M = H ₂ + M	1.00E + 18	-1	0
H + H + H ₂ = H ₂ + H ₂	9.20E + 16	-0.6	0
H + H + H ₂ O = H ₂ + H ₂ O	6.00E + 19	-1.25	0
H + OH + M = H ₂ O + M	1.60E + 22	-2	0
H + O + M = OH + M	6.20E + 16	-0.6	0
O + O + M = O ₂ + M	1.89E + 13	0	-1788
H ₂ O ₂ + M = OH + OH + M	1.30E + 17	0	45,500
H ₂ + O ₂ = 2OH	1.70E + 13	0	47,780
OH + H ₂ = H ₂ O + H	1.17E + 09	0	3626
O + OH = O ₂ + H	3.61E + 14	-0.5	0
O + H ₂ = OH + H	5.06E + 04	2.67	6290
O + HO ₂ = O ₂ + OH	1.40E + 13	0	1073
2OH = O + H ₂ O	6.00E + 08	1.3	0
H + HO ₂ = H ₂ + O ₂	1.25E + 13	0	0
H ₂ O ₂ + H = HO ₂ + H ₂	1.60E + 12	0	3800
N + O ₂ = NO + O	6.40E + 09	1	6280
N + OH = NO + H	3.80E + 13	0	0
NO + M = N + O + M	9.64E + 14	0	620,910
N + HO ₂ = NO + OH	1.00E + 13	0	8390
NO + N = N ₂ + O	3.27E + 12	0.3	0
NO + O + M = NO ₂ + M	1.30E + 15	-0.75	0
NO + OH = HNO ₂	5.45E + 17	0	0
HNO ₃ + O = NO ₃ + OH	1.81E + 07	0	0
HNO ₃ + H = NO ₃ + H ₂	3.40E + 12	1.53	16,332
HNO ₃ + H = NO ₂ + H ₂ O	8.39E + 09	3.29	6255
HNO ₃ + NO = NO ₂ + HNO ₂	4.48E + 03	0	0
HNO ₃ + OH = NO ₃ + H ₂ O	4.82E + 08	0	0
HNO ₃ + OH = NO ₂ + H ₂ O ₂	4.82E + 08	0	0
HNO ₃ = NO ₂ + OH	6.90E + 17	0	45,730
HNO + O = NO + OH	2.29E + 13	0	0
HNO + HNO = N ₂ O + H ₂ O	2.55E + 07	3.98	1188

$\text{HNO} + \text{H} = \text{NO} + \text{H}_2$	2.70E + 13	0.72	651
$\text{HNO} + \text{NO}_2 = \text{NO} + \text{HNO}_2$	6.03E + 11	0	1980
$\text{HNO} + \text{OH} = \text{NO} + \text{H}_2\text{O}$	4.82E + 13	0	990
$\text{H} + \text{HO}_2 = \text{OH} + \text{OH}$	8.22E + 12	0.75	0
$\text{NO}_2 + \text{HO}_2 = \text{HNO}_2 + \text{O}_2$	2.20E-01	0	0
$\text{NO} + \text{HO}_2 = \text{HNO} + \text{O}_2$	5.84E + 05	0	5600
$\text{NO} + \text{HO}_2 = \text{NO}_2 + \text{OH}$	6.32E + 11	0.58	1430
$\text{NO} + \text{HO}_2 = \text{HNO}_3$	3.47E + 12	0	-5720
$\text{H}_2\text{O} + \text{HO}_2 = \text{H}_2\text{O}_2 + \text{OH}$	2.80E + 13	0	32,790
$\text{H}_2\text{O}_2 + \text{HO}_2 = \text{O}_2 + \text{H}_2\text{O} + \text{OH}$	6.03E + 10	0	0
$\text{OH} + \text{HO}_2 = \text{O}_2 + \text{H}_2\text{O}$	4.28E + 13	-0.21	110
$\text{HO}_2 + \text{HO}_2 = \text{H}_2\text{O}_2 + \text{O}_2$	1.87E + 12	0	1540
$\text{HO}_2 = \text{H} + \text{O}_2$	1.45E + 16	-1.18	48,490
$\text{NO}_2 + \text{NO}_3 = \text{N}_2\text{O}_5$	7.98E + 17	-3.9	0
$\text{N} + \text{NO}_2 = \text{O} + \text{O} + \text{N}_2$	1.30E-01	0	0
$\text{NO}_2 + \text{H} = \text{NO} + \text{OH}$	2.41E + 14	0	680
$\text{NO} + \text{NO} = \text{O}_2 + \text{N}_2$	3.10E + 13	0	63,190
$\text{NO} + \text{N}_2\text{O} = \text{NO}_2 + \text{N}_2$	1.73E + 11	2.23	46,300
$\text{H}_2\text{S} + \text{M} = \text{S} + \text{H}_2 + \text{M}$	1.60E + 24	-2.61	44,800
$\text{H}_2\text{S} + \text{H} = \text{SH} + \text{H}_2$	1.20E + 07	2.1	350
$\text{H}_2\text{S} + \text{O} = \text{SH} + \text{OH}$	7.50E + 07	1.75	1460
$\text{H}_2\text{S} + \text{OH} = \text{SH} + \text{H}_2\text{O}$	2.70E + 12	0	0
$\text{H}_2\text{S} + \text{S} = 2\text{SH}$	8.30E + 13	0	3700
$\text{H}_2\text{S} + \text{S} = \text{HS}_2 + \text{H}$	2.00E + 13	0	3723.8
$\text{S} + \text{H}_2 = \text{SH} + \text{H}$	1.40E + 14	0	9700
$\text{SH} + \text{O} = \text{H} + \text{SO}$	1.00E + 14	0	0
$\text{SH} + \text{OH} = \text{S} + \text{H}_2\text{O}$	1.00E + 13	0	0
$\text{SH} + \text{HO}_2 = \text{HSO} + \text{OH}$	1.00E + 12	0	0
$\text{SH} + \text{O}_2 = \text{HSO} + \text{O}$	1.90E + 13	0	9000
$\text{S} + \text{OH} = \text{H} + \text{SO}$	4.00E + 13	0	0
$\text{S} + \text{O}_2 = \text{SO} + \text{O}$	5.20E + 06	1.81	-600
$2\text{SH} = \text{S}_2 + \text{H}_2$	1.00E + 12	0	0
$\text{SH} + \text{S} = \text{S}_2 + \text{H}$	1.00E + 13	0	0
$\text{S}_2 + \text{M} = 2\text{S} + \text{M}$	4.80E + 13	0	38,800
$\text{S}_2 + \text{H} + \text{M} = \text{HS}_2 + \text{M}$	1.00E + 16	0	0
$\text{S}_2 + \text{O} = \text{SO} + \text{S}$	1.00E + 13	0	0
$\text{HS}_2 + \text{H} = \text{S}_2 + \text{H}_2$	1.20E + 07	2.1	352.42
$\text{HS}_2 + \text{O} = \text{S}_2 + \text{OH}$	7.50E + 07	1.8	1460
$\text{HS}_2 + \text{OH} = \text{S}_2 + \text{H}_2\text{O}$	2.70E + 12	0	0
$\text{HS}_2 + \text{S} = \text{S}_2 + \text{SH}$	8.30E + 13	0	3700
$\text{HS}_2 + \text{H} + \text{M} = \text{H}_2\text{S}_2 + \text{M}$	1.00E + 16	0	0
$\text{N}_2/1.5/\text{SO}_2/10/\text{H}_2\text{O}$			
$\text{H}_2\text{S}_2 + \text{H} = \text{HS}_2 + \text{H}_2$	1.20E + 07	2.1	360
$\text{H}_2\text{S}_2 + \text{O} = \text{HS}_2 + \text{OH}$	7.50E + 07	1.8	1460
$\text{H}_2\text{S}_2 + \text{OH} = \text{HS}_2 + \text{H}_2\text{O}$	2.70E + 12	0	0
$\text{H}_2\text{S}_2 + \text{S} = \text{HS}_2 + \text{SH}$	8.30E + 13	0	3700
$\text{SO}_3 + \text{H} = \text{HOSO} + \text{O}$	2.50E + 05	2.92	25,300
$\text{SO}_3 + \text{O} = \text{SO}_2 + \text{O}_2$	2.00E + 12	0	10,000
$\text{SO}_3 + \text{SO} = 2\text{SO}_2$	1.00E + 12	0	5000
$\text{SO} + \text{O} (+\text{M}) = \text{SO}_2 (+\text{M})$	3.20E + 13	0	0

$\text{SO}_2 + \text{O} (+\text{M}) = \text{SO}_3 (+\text{M})$	9.20E + 10	0	1200
$\text{SO}_2 + \text{OH} (+\text{M}) = \text{HOSO}_2 (+\text{M})$	5.73E + 12	-0.27	0
$\text{SO}_2 + \text{OH} = \text{HOSO} + \text{O}$	3.90E + 08	1.89	38,200
$\text{SO}_2 + \text{OH} = \text{SO}_3 + \text{H}$	4.90E + 02	2.69	12,000
$\text{SO}_2 + \text{CO} = \text{SO} + \text{CO}_2$	2.70E + 12	0	24,300
$\text{SO} + \text{M} = \text{S} + \text{O} + \text{M}$	4.00E + 14	0	54,000
$\text{SO} + \text{H} + \text{M} = \text{HSO} + \text{M}$	5.00E + 15	0	0
$\text{HOSO} (+\text{M}) = \text{SO} + \text{OH} (+\text{M})$	9.94E + 21	-2.54	38,190
$\text{SO} + \text{OH} = \text{SO}_2 + \text{H}$	1.077E + 17	-1.35	0
$\text{SO} + \text{O}_2 = \text{SO}_2 + \text{O}$	7.60E + 03	2.37	1500
$2\text{SO} = \text{SO}_2 + \text{S}$	2.00E + 12	0	2000
$\text{HSO} + \text{H} = \text{HSOH}$	2.50E + 20	-3.14	460
$\text{HSO} + \text{H} = \text{SH} + \text{OH}$	4.90E + 19	-1.86	785
$\text{HSO} + \text{H} = \text{S} + \text{H}_2\text{O}$	1.60E + 09	1.37	-170
$\text{HSO} + \text{H} = \text{H}_2\text{SO}$	1.80E + 17	-2.47	25
$\text{HSO} + \text{H} = \text{H}_2\text{S} + \text{O}$	1.10E + 06	1.03	5230
$\text{HSO} + \text{H} = \text{SO} + \text{H}_2$	1.00E + 13	0	0
$\text{HSO} + \text{O} + \text{M} = \text{HSO}_2 + \text{M}$	1.10E + 19	-1.73	-25
$\text{HSO} + \text{O} = \text{SO}_2 + \text{H}$	4.50E + 14	-0.4	0
$\text{HSO} + \text{O} + \text{M} = \text{HOSO} + \text{M}$	6.90E + 19	-1.61	800
$\text{HSO} + \text{O} = \text{O} + \text{HOS}$	4.80E + 08	1.02	2700
$\text{HSO} + \text{O} = \text{OH} + \text{SO}$	1.40E + 13	0.15	150
$\text{HSO} + \text{OH} = \text{HOSHO}$	5.20E + 28	-5.44	1600
$\text{HSO} + \text{OH} = \text{HOSO} + \text{H}$	5.30E + 07	1.57	1900
$\text{HSO} + \text{OH} = \text{SO} + \text{H}_2\text{O}$	1.70E + 09	1.03	235
$\text{HSO} + \text{O}_2 = \text{SO}_2 + \text{OH}$	1.00E + 12	0	5000
$\text{HSOH} = \text{SH} + \text{OH}$	2.80E + 39	-8.75	37,800
$\text{HSOH} = \text{S} + \text{H}_2\text{O}$	5.80E + 29	-5.6	27,400
$\text{HSOH} = \text{H}_2\text{S} + \text{O}$	9.80E + 16	-3.4	43,500
$\text{H}_2\text{SO} = \text{H}_2\text{S} + \text{O}$	4.90E + 28	-6.66	36,000
$\text{H} + \text{SO}_2 (+\text{M}) = \text{HOSO} (+\text{M})$	3.12E + 08	1.61	3606
$\text{HOSO} + \text{M} = \text{O} + \text{HOS} + \text{M}$	2.50E + 30	-4.8	60,000
$\text{HOSO} + \text{H} = \text{SO}_2 + \text{H}_2$	3.00E + 13	0	0
$\text{HOSO} + \text{H} = \text{SO} + \text{H}_2\text{O}$	6.30E-10	6.29	-960
$\text{HOSO} + \text{OH} = \text{SO}_2 + \text{H}_2\text{O}$	1.00E + 12	0	0
$\text{HOSO} + \text{O}_2 = \text{HO}_2 + \text{SO}_2$	1.00E + 12	0	500
$\text{HSO}_2 + \text{H} = \text{SO}_2 + \text{H}_2$	3.00E + 13	0	0
$\text{HSO}_2 + \text{OH} = \text{SO}_2 + \text{H}_2\text{O}$	1.00E + 13	0	0
$\text{HSO}_2 + \text{O}_2 = \text{HO}_2 + \text{SO}_2$	1.00E + 13	0	0
$\text{H} + \text{SO}_2 (+\text{M}) = \text{HSO}_2 (+\text{M})$	1.06E + 09	1.48	594.6
$\text{HOSO}_2 = \text{HOSO} + \text{O}$	5.40E + 18	-2.34	53,500
$\text{HOSO}_2 = \text{SO}_3 + \text{H}$	1.40E + 18	-2.91	27,600
$\text{HOSO}_2 + \text{H} = \text{SO}_2 + \text{H}_2\text{O}$	1.00E + 12	0	0
$\text{HOSO}_2 + \text{O} = \text{SO}_3 + \text{OH}$	5.00E + 12	0	0
$\text{HOSO}_2 + \text{OH} = \text{SO}_3 + \text{H}_2\text{O}$	1.00E + 12	0	0
$\text{HOSO}_2 + \text{O}_2 = \text{HO}_2 + \text{SO}_3$	7.80E + 11	0	330
$\text{HOSHO} = \text{HOSO} + \text{H}$	6.40E + 30	-5.89	37,100
$\text{HOSHO} = \text{SO} + \text{H}_2\text{O}$	1.20E + 24	-3.59	30,000
$\text{HOSHO} + \text{H} = \text{HOSO} + \text{H}_2$	1.00E + 12	0	0
$\text{HOSHO} + \text{O} = \text{HOSO} + \text{OH}$	5.00E + 12	0	0

HOSHO + OH = HOSO + H ₂ O	1.00E + 12	0	0
C + SO ₂ = CO + SO	4.156E + 13	0.00	0
HOSO ₂ + H = SO ₃ + H ₂	1.00E + 12	0	0
S + CH ₄ = SH + CH ₃	6.00E + 14	0	1278.42
H ₂ S + CH ₃ = CH ₄ + SH	1.80E + 11	0	1177.53
SH + O = S + OH	1.00E + 14	0	0
C + H ₂ S = CH + SH	1.20E + 14	4450	0.32
O + COS = CO + SO	1.93E + 13	232	8.6
O + CS = CO + S	1.63E + 14	0	760.16
COS + M = CO + S + M	1.43E + 14	307	0.02
O + COS = CO ₂ + S	5.00E + 13	0	5530.4
SH + O ₂ = SO + OH	1.00E + 12	503	2.48
CH + SO = CO + SH	1.00E + 13	0	0
SO ₃ + S = SO + SO ₂	5.12E + 11	0	0
SH + NO = SN + OH	1.00E + 13	0	8900.7
S + NO = SN + O	1.00E + 12	0.5	17,501
SH + NH = SN + H ₂	1.00E + 14	0	0
N + SO = NO + S	6.31E + 11	0.5	1010.3
N + SH = SN + H	6.31E + 11	0.5	4030.6
SN + NO = N ₂ + SO	1.81E + 10	0	0
SN + O ₂ = SO + NO	3.00E + 08	0	0
SN + NO ₂ = S + NO + NO	8.00E + 15	-0.98	0
N + SN = N ₂ + S	6.30E + 11	0.5	0
SO ₂ + NO ₂ = NO + SO ₃	4.25E-19	8.9	3797.21
SO + NO ₂ = SO ₂ + NO	8.43E + 12	0	0
SN + O = SO + N	6.31E + 11	0.5	4030.6
S + NH = SH + N	1.00E + 13	0	0
NH + SO = NO + SH	3.01E + 13	0	0
HSO + NO ₂ = HOSO + NO	5.80E + 12	0	0
SO ₂ + O ₃ = O ₂ + SO ₃	1.81E + 12	0	13,910
SO ₃ + H ₂ O = H ₂ SO ₄	7.23E + 08	0	0

Model II

Reaction	A (cm ³ /mol-s)	n	Ea (cal/mol)
O ₃ ≥ O ₂ + O	4.31E + 14	0	22,277
O ₃ + O ≥ O ₂ + O ₂	4.82E + 12	0	4098
O + O ≥ O ₂	1.89E + 13	0	-1789
H ₂ O + O ₃ ≥ H ₂ O ₂ + O ₂	66.2	0	0
H ₂ O ₂ + O ≥ HO ₂ + OH	8.43E + 11	0	3978
H ₂ O ₂ + OH ≥ HO ₂ + H ₂ O	1.75E + 12	0	318
H ₂ O + O ≥ OH + OH	7.53E + 12	1.3	17,105
HO ₂ + O ≥ OH + O ₂	1.63E + 13	0	-444
HO ₂ + O ₃ ≥ OH + O ₂ + O ₂	1.19E + 08	4.57	-1377
HO ₂ + OH ≥ H ₂ O + O ₂	2.89E + 13	0	-497
HO ₂ + H ₂ O ≥ OH + H ₂ O ₂	2.80E + 13	0	32,775
HO ₂ + H ₂ O ₂ ≥ OH + H ₂ O + O ₂	6.03E + 10	0	0
HO ₂ + HO ₂ ≥ H ₂ O ₂ + O ₂	6.17E + 14	0	-1988
OH + OH ≥ H ₂ O + O	3.73E + 10	2.6	-1880
H ₂ O ₂ ≥ OH + OH	1.22E + 21	-4.86	53,349
OH + O ₃ ≥ HO ₂ + O ₂	1.02E + 12	0	1870
NO + O ≥ NO ₂	1.80E + 13	0.3	0

$\text{NO}_2 + \text{O} \geq \text{NO}_3$	1.38E + 13	0.24	0
$\text{NO}_3 + \text{O} \geq \text{O}_2 + \text{NO}_2$	1.02E + 13	0	0
$\text{NO} + \text{NO} + \text{O}_2 \geq \text{NO}_2 + \text{NO}_2$	1.20E + 09	0	-1055
$\text{NO} + \text{O}_3 \geq \text{NO}_2 + \text{O}_2$	8.43E + 11	0	2605
$\text{NO}_2 + \text{O}_3 \geq \text{NO}_3 + \text{O}_2$	8.43E + 10	0	4913
$\text{NO}_2 + \text{NO}_3 \geq \text{N}_2\text{O}_5$	1.14E + 12	0.2	0
$\text{NO} + \text{OH} \geq \text{HNO}_2$	1.99E + 13	-0.3	0
$\text{NO}_2 + \text{OH} \geq \text{HNO}_3$	9.06E + 17	-4.4	0
$\text{NO}_2 + \text{OH} \geq \text{HO}_2 + \text{NO}$	1.81E + 13	0	6684
$\text{NO}_3 + \text{OH} \geq \text{HO}_2 + \text{NO}_2$	1.20E + 13	0	0
$\text{NO} + \text{H}_2\text{O}_2 \geq \text{H}_2\text{O} + \text{NO}_2$	4.22E + 04	0	0
$\text{NO} + \text{H}_2\text{O}_2 \geq \text{OH} + \text{HNO}_2$	3.13E + 04	0	0
$\text{NO}_3 + \text{H}_2\text{O}_2 \geq \text{HO}_2 + \text{HNO}_3$	1.21E + 09	0	0
$\text{NO} + \text{HO}_2 \geq \text{OH} + \text{NO}_2$	2.17E + 12	0	-535
$\text{NO} + \text{HO}_2 \geq \text{HNO}_3$	3.85E + 07	0	-3270
$\text{NO} + \text{HO}_2 \geq \text{HNO}_2 + \text{O}$	3.01E + 08	0	0
$\text{NO}_3 + \text{HO}_2 \geq \text{HNO}_3 + \text{O}_2$	1.15E + 12	0	0
$\text{NO}_3 + \text{HO}_2 \geq \text{OH} + \text{O}_2 + \text{NO}_2$	1.51E + 12	0	0
$\text{H}_2\text{O} + \text{NO} + \text{NO}_2 \geq \text{HNO}_2 + \text{HNO}_2$	1.60E + 08	0	0
$\text{H}_2\text{O} + \text{N}_2\text{O}_5 \geq \text{HNO}_3 + \text{HNO}_3$	1.51E + 02	0	0
$\text{NO}_2 + \text{NO}_2 \geq \text{N}_2\text{O}_4$	6.02E + 11	0	0
$\text{N}_2\text{O}_4 \geq \text{NO}_2 + \text{NO}_2$	1.15E + 16	0	12,849
$\text{H}_2\text{O} + \text{N}_2\text{O}_4 \geq \text{HNO}_2 + \text{HNO}_3$	2.52E + 14	0	11,595
$\text{HNO}_2 + \text{OH} \geq \text{NO}_2 + \text{H}_2\text{O}$	1.51E + 12	0	-516
$\text{HNO}_2 + \text{NO}_3 \geq \text{HNO}_3 + \text{NO}_2$	1.21E + 09	0	0
$\text{HNO}_2 + \text{O}_3 \geq \text{HNO}_3 + \text{O}_2$	3.01E + 05	0	0
$\text{HNO}_3 + \text{OH} \geq \text{NO}_3 + \text{H}_2\text{O}$	9.04E + 10	0	0
$\text{HNO}_3 + \text{O} \geq \text{NO}_3 + \text{OH}$	1.81E + 07	0	0
$\text{NO}_3 \geq \text{NO} + \text{O}_2$	2.50E + 06	0	12,133
$\text{NO}_3 + \text{NO}_3 \geq \text{NO}_2 + \text{NO}_2 + \text{O}_2$	5.12E + 11	0	4873
$\text{NO}_2 + \text{NO}_3 \geq \text{NO} + \text{NO}_2 + \text{O}_2$	2.71E + 10	0	2507
$\text{N}_2\text{O}_5 \geq \text{NO}_2 + \text{NO}_3$	9.69E + 14	0.1	0
$\text{NO} + \text{NO}_3 \geq \text{NO}_2 + \text{NO}_2$	1.08E + 13	0	-217
$\text{HNO}_2 \geq \text{OH} + \text{NO}$	1.19E + 21	-3.8	50,239
$\text{HNO}_2 + \text{HNO}_2 \geq \text{H}_2\text{O} + \text{NO} + \text{NO}_2$	6.03E + 03	0	0
$\text{HNO}_3 + \text{NO} \geq \text{HNO}_2 + \text{NO}_2$	4.48E + 03	0	0
$\text{HNO}_3 \geq \text{OH} + \text{NO}_2$	6.90E + 17	0	45,933
$\text{HNO}_3 \geq \text{HO}_2 + \text{NO}$	4.76E + 22	-6.55	51,913
$\text{SO}_2 + \text{O} \geq \text{SO}_3$	9.20E + 10	0	1200
$\text{SO}_2 + \text{HO}_2 \geq \text{OH} + \text{SO}_3$	5.20E + 08	0	0
$\text{SO}_2 + \text{O}_3 \geq \text{SO}_3 + \text{O}_2$	1.81E + 12	0	13,923
$\text{SO}_2 + \text{OH} \geq \text{HSO}_3$	1.09E + 17	-3.3	0
$\text{HSO}_3 \geq \text{SO}_2 + \text{OH}$	1.90E + 20	-4.72	27,033
$\text{SO}_2 + \text{NO}_2 \geq \text{SO}_3 + \text{NO}$	0.01	0	0
$\text{SO}_2 + \text{NO}_3 \geq \text{SO}_3 + \text{NO}_2$	6.02E + 04	0	0
$\text{SO}_2 + \text{N}_2\text{O}_5 \geq \text{SO}_3 + \text{N}_2\text{O}_4$	5.48	0	0