●詳細化学反応モデル(Chemkin 形式)

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ELEMENTS
AL O C H
HE AR N
END

SPECIES
HE AR N2
O O2
CO CO2
H H2 OH H2O HO2 H2O2
AL ALO ALO2 ALO3
AL2 AL2O AL2O2 AL2O3 AL2O4
AL2(1) AL2O(3) AL2O2(3) AL2O3(1) AL2O4(1)
AL4O6 AL4O6(3)
AL8O12
!AL16O24
ALCO2
AL2CO2 AL2CO3 AL2CO4
AL2CO2(1)
ALOH ALO2H ALO3H
ALOH(3) ALO2H(3) ALO3H(3)
AL2OH AL2O2H AL2O3H AL2O4H
ALOH2 ALO2H2 ALO3H2
AL2OH2 AL2O2H2
AL2OH2(3)
ALO2H3

END

THERMO ALL
    200.000   1000.000   6000.000

!
! generated by KUCRS rev. 2011.01.07m7 (c) 2002-2015 by A. Miyoshi
!   on Apr 28, 2015.
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!

HE 120186HE 1 G 0300.00 5000.00 1000.00 1
0.02500000E+02 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 2
-0.07453750E+04 0.09153489E+01 0.02500000E+02 0.00000000E+00 0.00000000E+00 3
0.00000000E+00 0.00000000E+00-0.07453750E+04 0.09153488E+01 4
AR AR 1 G 200.0 6000.0 1000.0 1
2.50000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 2
-7.45375000E+02 4.37967490E+00 2.50000000E+00 0.00000000E+00 0.00000000E+00 3
0.00000000E+00 0.00000000E+00-7.45375000E+02 4.37967490E+00 4
N2 N 2 G 200.0 6000.0 1000.0 1
2.95254070E+00 1.39688380E-03-4.92625770E-07 7.86000910E-11-4.60749780E-15 2
-9.23937530E+02 5.87182210E+00 3.53096280E+00-1.23659500E-04-5.02993390E-07 3
2.43527680E-09-1.40879540E-12-1.04696370E+03 2.96743910E+00 4
H H 1 G 200.0 6000.0 1000.0 1
2.50000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 0.00000000E+00 2
2.54736600E+04-4.46682850E-01 2.50000000E+00 0.00000000E+00 0.00000000E+00 3
0.00000000E+00 0.00000000E+00 2.54736600E+04-4.46682850E-01 4
H2 H 2 G 200.0 6000.0 1000.0 1
2.93283050E+00 8.26598020E-04-1.46400570E-07 1.54098510E-11-6.88796150E-16 2
-8.13055820E+02-1.02431640E+00 2.34430290E+00 7.98042480E-03-1.94779170E-05 3
2.01569670E-08-7.37602890E-12-9.17924130E+02 6.83002180E-01 4
OH H 1O 1 G 200.0 6000.0 1000.0 1
2.83864607E+00 1.10725586E-03-2.93914978E-07 4.20524247E-11-2.42169092E-15 2
3.68599690E+03 5.84452662E+00 3.99201543E+00-2.40131752E-03 4.61793841E-06 3
-3.88113333E-09 1.36411470E-12 3.35711894E+03-1.03925458E-01 4
H2O H 2O 1 G 200.0 6000.0 1000.0 1
2.67703890E+00 2.97318160E-03-7.73768890E-07 9.44335140E-11-4.26899910E-15 2
-2.98858940E+04 6.88255000E+00 4.19863520E+00-2.03640170E-03 6.52034160E-06 3
-5.48792690E-09 1.77196800E-12-3.02937260E+04-8.49009010E-01 4
HO2 H 1O 2 G 200.0 6000.0 1000.0 1
4.17226590E+00 1.88120980E-03-3.46292970E-07 1.94685160E-11 1.76091530E-16 2
2.13222508E+02 2.95779740E+00 4.30178800E+00-4.74902010E-03 2.11579530E-05 3
-2.42759610E-08 9.29206700E-12 4.46212417E+02 3.71670100E+00 4
H2O2 H 2O 2 G 200.0 6000.0 1000.0 1
4.57333537E+00 4.04984070E-03-1.29479479E-06 1.97281710E-10-1.13402846E-14 2
-1.80040975E+04 7.04278488E-01 4.27611269E+00-5.42822417E-04 1.67335701E-05 3
-2.15770813E-08 8.62454363E-12-1.77035843E+04 3.43505074E+00 4

O O 1 G 200.00 6000.00 1000.00 1
2.54363697E+00-2.73162486E-05-4.19029520E-09 4.95481845E-12-4.79553694E-16 2
2.92260120E+04 4.92229457E+00 3.16826710E+00-3.27931884E-03 6.64306396E-06 3
-6.12806624E-09 2.11265971E-12 2.91222592E+04 2.05193346E+00 4
O2 O 2 G 200.00 6000.00 1000.00 1
3.66096083E+00 6.56365523E-04-1.41149485E-07 2.05797658E-11-1.29913248E-15 2
-1.21597725E+03 3.41536184E+00 3.78245636E+00-2.99673415E-03 9.84730200E-06 3
-9.68129508E-09 3.24372836E-12-1.06394356E+03 3.65767573E+00 4
CO O 1C 1 G 200.0 6000.0 1000.0 1
3.04848590E+00 1.35172810E-03-4.85794050E-07 7.88536440E-11-4.69807460E-15 2
-1.42661170E+04 6.01709770E+00 3.57953350E+00-6.10353690E-04 1.01681430E-06 3
9.07005860E-10-9.04424490E-13-1.43440860E+04 3.50840930E+00 4
CO2 O 2C 1 G 200.0 6000.0 1000.0 1
4.63651110E+00 2.74145690E-03-9.95897590E-07 1.60386660E-10-9.16198570E-15 2
-4.90249040E+04-1.93489550E+00 2.35681300E+00 8.98412990E-03-7.12206320E-06 3
2.45730080E-09-1.42885480E-13-4.83719710E+04 9.90090350E+00 4

! Saba
AL gpop AL 1 G 200.00 5000.00 1000.00 1
2.50020116E+00-3.69026530E-07 2.10431070E-10-4.77708721E-14 3.77466622E-18 2
3.89081168E+04 4.46992959E+00 2.49999845E+00 1.87697605E-07-1.03162967E-09 3
1.64634639E-12-8.02295825E-16 3.89081928E+04 4.47103098E+00 4
ALO gpop AL 1O 1 G 200.00 5000.00 1000.00 1
4.02172817E+00 5.45751690E-04-2.43254381E-07 4.78897459E-11-3.46139743E-15 2
8.14602279E+03 3.00465421E+00 3.26277711E+00 7.56276348E-04 4.91164781E-06 3
-8.23720259E-09 3.67515515E-12 8.41696057E+03 7.30136996E+00 4
ALO2 gpop AL 1O 2 G 200.00 5000.00 1000.00 1
6.73305978E+00 8.90821684E-04-4.01895916E-07 7.97970283E-11-5.80301064E-15 2
-9.88761249E+03-9.19591244E+00 3.49644637E+00 1.30967269E-02-1.80539255E-05 3
1.15444077E-08-2.78767588E-12-9.17971991E+03 6.65586185E+00 4
ALO3 gpop AL 1O 3 G 200.00 5000.00 1000.00 1
8.32477413E+00 1.92240636E-03-8.61233592E-07 1.70252808E-10-1.23449944E-14 2
-1.99451523E+04-1.38008090E+01 3.87221493E+00 1.75644971E-02-2.22757491E-05 3
1.37059561E-08-3.32306435E-12-1.88972486E+04 8.33732606E+00 4
AL2 gpop AL 2 G 200.00 5000.00 1000.00 1
4.44633621E+00 6.64350686E-05-3.13397267E-08 6.42257658E-12-4.77794557E-16 2
6.09418347E+04 3.12479668E+00 3.71552164E+00 4.42344638E-03-9.79759334E-06 3
9.59079411E-09-3.44479246E-12 6.10423315E+04 6.36548851E+00 4

AL2(1) gpop AL 2 G 200.00 5000.00 1000.00 1
4.46190253E+00 4.75910516E-05-2.26084322E-08 4.65945740E-12-3.48235900E-16 2
6.46445696E+04 2.33820809E+00 3.92615217E+00 3.28602433E-03-7.34744447E-06 3
7.23599767E-09-2.60953332E-12 6.47167178E+04 4.70487544E+00 4
AL2O gpop AL 2O 1 G 200.00 5000.00 1000.00 1
6.80158146E+00 8.07782226E-04-3.63619698E-07 7.21082687E-11-5.24004216E-15 2
-2.15742998E+04-8.19878619E+00 4.26949080E+00 1.03903725E-02-1.45563722E-05 3
9.75826087E-09-2.54913978E-12-2.10153449E+04 4.21331981E+00 4
AL2O(3) gpop AL 2O 1 G 200.00 5000.00 1000.00 1
6.37425217E+00 7.32663224E-04-3.32366728E-07 6.62486064E-11-4.83121377E-15 2
1.21965876E+04-3.89769014E+00 2.86604084E+00 1.58819595E-02-2.62049601E-05 3
2.04584346E-08-6.16550874E-12 1.28884376E+04 1.28659497E+01 4
AL2O2 gpop AL 2O 2 G 200.00 5000.00 1000.00 1
8.61945387E+00 1.61953471E-03-7.35753998E-07 1.46813996E-10-1.07153536E-14 2
-5.09517389E+04-1.76559788E+01 5.67327110E-01 3.71253219E-02-6.27436351E-05 3
5.00996501E-08-1.54093308E-11-4.93916979E+04 2.06630041E+01 4
AL2O2(3) gpop AL 2O 2 G 200.00 5000.00 1000.00 1
8.59160066E+00 1.64948219E-03-7.48460256E-07 1.49220031E-10-1.08842185E-14 2
-4.45150329E+04-1.64080153E+01 6.98448430E-01 3.57054112E-02-5.88340022E-05 3
4.58559461E-08-1.37948451E-11-4.29578872E+04 2.13132055E+01 4
AL2O3 gpop AL 2O 3 G 200.00 5000.00 1000.00 1
1.10850408E+01 2.23504287E-03-1.01191719E-06 2.01441179E-10-1.46774211E-14 2
-6.94204309E+04-2.67030084E+01 1.48092630E+00 4.25506255E-02-6.79778922E-05 3
5.16641177E-08-1.52228471E-11-6.74761512E+04 1.94550859E+01 4
AL2O3(1) gpop AL 2O 3 G 200.00 5000.00 1000.00 1
1.13333317E+01 2.47851605E-03-1.10823438E-06 2.18808911E-10-1.58523571E-14 2
-6.72432429E+04-2.75679922E+01 6.40419242E+00 1.87292059E-02-2.15235336E-05 3
1.17588402E-08-2.46213496E-12-6.60301001E+04-2.79685094E+00 4
AL2O4 gpop AL 2O 4 G 200.00 5000.00 1000.00 1
1.37942873E+01 2.57896315E-03-1.16908606E-06 2.32937818E-10-1.69834600E-14 2
-9.63892129E+04-3.90496141E+01 2.12458600E+00 5.28537706E-02-8.71210270E-05 3
6.82419803E-08-2.06791912E-11-9.40760874E+04 1.67588607E+01 4
AL2O4(1) gpop AL 2O 4 G 200.00 5000.00 1000.00 1
1.35722297E+01 2.82662575E-03-1.27773477E-06 2.54085020E-10-1.84992061E-14 2
-9.56612371E+04-3.94642104E+01 2.37218477E+00 4.86430062E-02-7.53488978E-05 3
5.56991225E-08-1.60087092E-11-9.33422121E+04 1.46380333E+01 4
AL4O6 gpop AL 4O 6 G 200.00 5000.00 1000.00 1
2.30299176E+01 5.81790409E-03-2.63957996E-06 5.26259504E-10-3.83876608E-14 2

-2.55535459E+05-9.12228789E+01-4.00143854E+00 1.24033753E-01-2.08099100E-04 3
1.65768868E-07-5.10059687E-11-2.50242657E+05 3.76780508E+01 4
AL4O6(3) gpop AL 4O 6 G 200.00 5000.00 1000.00 1
2.34700007E+01 5.28970306E-03-2.39625421E-06 4.77263661E-10-3.47893561E-14 2
-2.28078191E+05-8.51991237E+01 6.22273848E-01 1.03709184E-01-1.71235165E-04 3
1.34892933E-07-4.11833023E-11-2.23534783E+05 2.41092613E+01 4
AL8O12 gpop AL 8O 12 G 200.00 5000.00 1000.00 1
4.75824913E+01 1.21723443E-02-5.51689162E-06 1.09921994E-09-8.01482225E-14 2
-6.17025325E+05-2.09323577E+02-5.93820999E+00 2.46430150E-01-4.14651737E-04 3
3.32688275E-07-1.03271462E-10-6.06514246E+05 4.59620907E+01 4
!AL16O24 gpop AL 16O 24 G 200.00 5000.00 1000.00 1
! 9.68269604E+01 2.48318398E-02-1.12832191E-05 2.25217932E-09-1.64428855E-13 2
!-1.34979941E+06-4.65733875E+02-2.41167629E+01 5.74259541E-01-1.00575734E-03 3
! 8.33722597E-07-2.65644700E-10-1.32684971E+06 1.06738391E+02 4

ALCO2 gpop AL 1C 1O 2 G 200.00 5000.00 1000.00 1
7.59953704E+00 2.70744682E-03-1.20041363E-06 2.35744096E-10-1.70184746E-14 2
-1.93325258E+04-1.05752067E+01 4.18000088E+00 1.29199191E-02-1.28326475E-05 3
6.39165067E-09-1.33362726E-12-1.84174694E+04 6.92694023E+00 4
AL2CO2 gpop AL 2C 1O 2 G 200.00 5000.00 1000.00 1
1.04791497E+01 2.78233927E-03-1.21864199E-06 2.37569203E-10-1.70693567E-14 2
-1.81742264E+04-1.85528387E+01 5.01185634E+00 2.85721788E-02-5.12990832E-05 3
4.55451231E-08-1.55667282E-11-1.71253291E+04 7.24916390E+00 4
AL2CO2(1) gpop AL 2C 1O 2 G 200.00 5000.00 1000.00 1
1.03942695E+01 2.95586337E-03-1.31542646E-06 2.58978621E-10-1.87286249E-14 2
-1.71125710E+04-1.97026002E+01 5.25003151E+00 2.15018011E-02-2.88564376E-05 3
2.02954288E-08-5.91586745E-12-1.58906496E+04 5.85257282E+00 4
AL2CO3 gpop AL 2C 1O 3 G 200.00 5000.00 1000.00 1
1.29801698E+01 3.47090006E-03-1.55609761E-06 3.07730886E-10-2.23182556E-14 2
-7.14869019E+04-3.40445721E+01 4.53457356E+00 3.17418509E-02-3.65456625E-05 3
1.86156196E-08-3.16599667E-12-6.94618293E+04 8.20266157E+00 4
AL2CO4 gpop AL 2C 1O 4 G 200.00 5000.00 1000.00 1
1.42548127E+01 5.34882367E-03-2.37048061E-06 4.65359768E-10-3.35848099E-14 2
-1.20790209E+05-4.07030436E+01 3.56836793E+00 4.16814506E-02-4.90143780E-05 3
2.67304133E-08-5.30092309E-12-1.18234908E+05 1.26674405E+01 4

ALOH gpop AL 1H 1O 1 G 200.00 5000.00 1000.00 1
5.55374491E+00 1.24331659E-03-3.30379127E-07 3.98895416E-11-1.75624669E-15 2

-2.40430520E+04-3.43473973E+00 4.38701829E+00 6.84558577E-03-9.62307765E-06 3
6.46268466E-09-1.56739540E-12-2.38724647E+04 1.91928041E+00 4
ALOH(3) gpop AL 1H 1O 1 G 200.00 5000.00 1000.00 1
4.77732571E+00 1.61656762E-03-5.07405689E-07 7.57014360E-11-4.37894544E-15 2
1.26164751E+04 1.43237629E+00 2.77682400E+00 9.49025908E-03-1.10262204E-05 3
5.24904138E-09-5.32093897E-13 1.29986107E+04 1.10445506E+01 4
ALO2H gpop AL 1H 1O 2 G 200.00 5000.00 1000.00 1
7.23289230E+00 2.19470522E-03-7.58479368E-07 1.24717369E-10-7.91601824E-15 2
-4.67920602E+04-1.02437250E+01 3.85201688E+00 1.64507600E-02-2.39110269E-05 3
1.72073349E-08-4.81316536E-12-4.61313009E+04 5.93786052E+00 4
ALO2H(3) gpop AL 1H 1O 2 G 200.00 5000.00 1000.00 1
7.50551958E+00 1.92379118E-03-6.46122989E-07 1.03470245E-10-6.41683549E-15 2
-2.38483354E+04-8.97466682E+00 3.08716142E+00 2.26749788E-02-3.79174787E-05 3
3.02547151E-08-9.21913548E-12-2.30770533E+04 1.16835250E+01 4
ALO3H gpop AL 1H 1O 3 G 200.00 5000.00 1000.00 1
9.72944813E+00 2.79190934E-03-1.03154844E-06 1.79425828E-10-1.19194317E-14 2
-5.47325019E+04-2.07796602E+01 2.75727052E+00 3.32878159E-02-5.31433005E-05 3
4.09713367E-08-1.22158072E-11-5.33948937E+04 1.23960743E+01 4
ALO3H(3) gpop AL 1H 1O 3 G 200.00 5000.00 1000.00 1
9.93201227E+00 2.57764196E-03-9.39526775E-07 1.61667536E-10-1.06508542E-14 2
-4.72945195E+04-2.01313589E+01 2.74261508E+00 3.54311062E-02-5.94412941E-05 3
4.76822245E-08-1.46935076E-11-4.59748332E+04 1.37591854E+01 4
ALOH2 gpop AL 1H 2O 1 G 200.00 5000.00 1000.00 1
6.23928677E+00 3.27772567E-03-1.22741388E-06 2.15301133E-10-1.43784696E-14 2
-1.53238904E+04-6.37492540E+00 1.74125008E+00 2.41879883E-02-3.98369977E-05 3
3.30218017E-08-1.06235212E-11-1.44909204E+04 1.48077260E+01 4
ALO2H2 gpop AL 1H 2O 2 G 200.00 5000.00 1000.00 1
8.55271593E+00 3.20464096E-03-9.99954396E-07 1.48737636E-10-8.59650872E-15 2
-6.01270430E+04-1.59219351E+01 1.87342057E+00 3.68732388E-02-6.48919908E-05 3
5.41880134E-08-1.71451384E-11-5.90672117E+04 1.47654666E+01 4
ALO3H2 gpop AL 1H 2O 3 G 200.00 5000.00 1000.00 1
1.10455702E+01 3.77442809E-03-1.25377254E-06 1.98881229E-10-1.22358751E-14 2
-8.59351865E+04-2.61509069E+01 2.31495923E+00 4.58736446E-02-7.91061568E-05 3
6.51206073E-08-2.04501832E-11-8.44462311E+04 1.44539042E+01 4
AL2OH gpop AL 2H 1O 1 G 200.00 5000.00 1000.00 1
7.79139431E+00 2.46031884E-03-1.08274390E-06 2.11623787E-10-1.52279971E-14 2
-1.31617380E+04-1.00901110E+01 4.30996896E+00 1.49788924E-02-1.96734600E-05 3
1.37284835E-08-3.97851986E-12-1.23292506E+04 7.22071081E+00 4

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AL2O2H                gpop  AL  2H   1O   2     G   200.00    5000.00   1000.00       1
 9.68559592E+00 3.70160100E-03-1.63277529E-06 3.19725454E-10-2.30407528E-14    2
-6.24065836E+04-2.24762788E+01-3.86766400E-01 4.78599018E-02-7.95958862E-05    3
 6.44475798E-08-2.02737227E-11-6.04074952E+04 2.56111088E+01                   4
AL2O3H                gpop  AL  2H   1O   3     G   200.00    5000.00   1000.00       1
 1.21839317E+01 3.45518373E-03-1.33802271E-06 2.41147894E-10-1.64494428E-14    2
-1.06502743E+05-3.21326838E+01 7.16008720E-01 5.50101136E-02-9.21830558E-05    3
 7.35598323E-08-2.25771076E-11-1.04348147E+05 2.21531115E+01                   4
AL2O4H                gpop  AL  2H   1O   4     G   200.00    5000.00   1000.00       1
 1.46841434E+01 4.03011487E-03-1.59616244E-06 2.92270588E-10-2.01617951E-14    2
-1.30063629E+05-4.31357888E+01 1.62740390E+00 6.12563326E-02-1.00231960E-04    3
 7.84578982E-08-2.37194703E-11-1.27542944E+05 1.90182711E+01                   4
AL2OH2                gpop  AL  2H   2O   1     G   200.00    5000.00   1000.00       1
 8.61811444E+00 4.78949722E-03-2.08295878E-06 4.03970724E-10-2.89147163E-14    2
-2.98482065E+04-1.63368692E+01 3.17880286E+00 2.47887847E-02-3.28964364E-05    3
 2.37398845E-08-7.11132683E-12-2.85548755E+04 1.06359804E+01                   4
AL2OH2(3)             gpop  AL  2H   2O   1     G   200.00    5000.00   1000.00       1
 9.25471694E+00 4.14246199E-03-1.81506406E-06 3.53758918E-10-2.54073917E-14    2
-3.69157520E+03-1.64976339E+01 4.60517144E+00 2.10491544E-02-2.82826737E-05    3
 2.12606417E-08-6.72182740E-12-2.56027604E+03 6.65254513E+00                   4
AL2O2H2               gpop  AL  2H   2O   2     G   200.00    5000.00   1000.00       1
 1.10232536E+01 4.63222934E-03-1.82428657E-06 3.32135700E-10-2.27971579E-14    2
-7.58427525E+04-2.55899935E+01 2.41219661E+00 4.32233692E-02-7.08510521E-05    3
 5.74874919E-08-1.81314707E-11-7.41854480E+04 1.52907065E+01                   4
ALO2H3                gpop  AL  1H   3O   2     G   200.00    5000.00   1000.00       1
 9.52982640E+00 5.38694233E-03-1.94231803E-06 3.30744064E-10-2.15901291E-14    2
-7.78135955E+04-2.21201130E+01 1.03667467E-01 5.10746871E-02-8.80317057E-05    3
 7.38955175E-08-2.37585617E-11-7.61786454E+04 2.17630869E+01                   4

END

REACTIONS CAL/MOLE MOLE

!O2-O reactions
 O+O+M=O2+M                         1.620e+014    0.000    -1787.8
   N2/0.133/ O2/0.133/ CO/0.25/ CO2/0.5/ H2O/2.17/ AR/0.117/ HE/0.2/

!CO2-CO reactions
```

```
CO+O(+M)=CO2(+M)                    1.800E+10     0.000       2384.0
                              LOW /   1.350E+24   -2.788       4191.0 /
        H2/2.5/ H2O/12/ CO/1.9/ CO2/3.8/
CO+O2=CO2+O                         1.050E+12     0.          42540.0     ! Curran 2010
                              REV /   8.035E+15   -0.8         51230.0 / ! Curran 2010

!H2-H reactions
H+H+M=H2+M                          5.610e+018   -1.000          0.0
  N2/0.133/ O2/0.133/ CO/0.25/ CO2/0.5/ H2O/2.17/ H2/0/ AR/0.117/ HE/0.2/
H+H+H2=H2+H2                        9.20E16          -0.6            0.0 ! [1] (Miller and Melius 1992)

!H-O reactions
O2+H=OH+O                           9.756e+013     0.000     14844.6
H2+O=OH+H                           5.120e+004     2.670      6278.7
OH+OH=O+H2O                         1.510e+009     1.140       100.4
H2O+H=H2+OH                         4.520e+008     1.600     18422.6
H2O2+OH=H2O+HO2                     7.830e+012     0.000      1331.3
H+OH+M=H2O+M                        1.659e+023    -2.000          0.0
  N2/0.133/ O2/0.133/ CO/0.25/ CO2/0.5/ H2O/0.85/ AR/0.05/ HE/0.2/
O2+H+M=HO2+M                        6.300e+018    -0.800          0.0
  N2/0.223/ O2/0.133/ CO/0.25/ CO2/0.5/ H2O/0/ AR/0.0967/ HE/0.2/
O2+H+H2O=HO2+H2O                    6.890e+015     0.000     -2086.5     ! corrected
O+HO2=O2+OH                         3.190e+013     0.000          0.0
H+HO2=OH+OH                         1.690e+014     0.000        874.8
H+HO2=H2+O2                         4.280e+013     0.000       1410.1
H+HO2=H2O+O                         3.010e+013     0.000       1720.8
OH+HO2=H2O+O2                       2.890e+013     0.000       -497.1
HO2+HO2=H2O2+O2                     4.220e+014     0.000      11983.7
        duplicate
HO2+HO2=H2O2+O2                     1.320e+011     0.000      -1630.0
        duplicate
OH+OH(+M)=H2O2(+M)                  7.230E+013    -0.370          0.0
                              LOW /   5.530E+019   -0.760          0.0 /
        TROE / 1 1 1 1040 /
        N2/0.4/ O2/0.4/ CO/0.75/ CO2/1.5/ H2O/6.5/ AR/0.35/
H2O2+H=OH+H2O                       1.020e+013     0.000       3577.9
H2O2+H=HO2+H2                       1.690e+012     0.000       3754.8
H+O+M=OH+M                          3.540e+019    -1.000          0.0
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   N2/0.133/ O2/0.133/ CO/0.25/ CO2/0.5/ H2O/2.17/ AR/0.117/ HE/0.2/
 H2O2+O=OH+HO2                          6.620e+011     0.000       3974.7

!CO2-H2O reactions
 CO+OH=CO2+H                             1.400E+05     1.950     -1347.0
                              REV /    1.568E+07     1.950     20990.0 /
 CO+HO2=CO2+OH                           3.010E+13     0.000     23000.0
                              REV /    6.435E+15    -0.330     84610.0 /

!Al reactions (N2 is supposed as a third body)
!Al-O reactions
!Al1 reactions
AL          + O          <=> ALO                        3.475E+13   3.242E-01   0.000E+00 ! HPL

AL          + O2         <=> ALO2                       3.051E+14   1.694E-01   0.000E+00 !
HPL:10^12 atm
                                  plog /     1. 7.855E+02   1.768E+00   6.932E+03 /
                                  plog /    10. 1.757E+15 -1.143E+00   1.194E+03 /
                                  plog / 100. 3.390E+19 -1.916E+00   9.229E+02 /

ALO         + O          <=> ALO2                       7.500E+12   3.376E-01   0.000E+00 !
HPL:10^12 atm
                                  plog /     1. 9.517E+01   1.715E+00   6.385E+03 /
                                  plog /    10. 1.308E+13 -8.734E-01   4.788E+02 /
                                  plog / 100. 1.200E+17 -1.551E+00   3.274E+02 /

AL          + O2         <=> ALO       + O              5.224E-11   3.308E+00   0.000E+00 !
HPL:10^12 atm
                                  plog /     1. 5.990E+13   2.409E-01   0.000E+00 /
                                  plog /    10. 5.954E+13   2.418E-01   0.000E+00 /
                                  plog / 100. 3.329E+13   3.162E-01   0.000E+00 /

ALO         + O2         <=> ALO3                       4.142E+09   9.813E-01  -1.408E+03 !
HPL:10^12 atm
                                  plog /     1. 2.953E+28 -5.586E+00   2.723E+03 /
                                  plog /    10. 2.506E+27 -4.991E+00   2.878E+03 /
                                  plog / 100. 2.733E+24 -3.868E+00   2.510E+03 /
```

```
ALO2        + O             <=> ALO3                        1.020E+18  -1.269E+00    9.990E+02 !
HPL:10^12 atm
                                plog /     1. 1.473E+22 -4.431E+00    4.125E+04 /
                                plog /    10. 3.857E+19 -3.541E+00    2.732E+04 /
                                plog / 100. 1.127E+19 -3.145E+00    1.105E+04 /

ALO         + O2            <=> ALO2        + O             1.986E-07    3.941E+00    2.256E+04 !
HPL:10^12 atm
                                plog /     1. 1.274E+10    1.100E+00    2.494E+04 /
                                plog /    10. 1.274E+10    1.100E+00    2.494E+04 /
                                plog / 100. 1.272E+10    1.101E+00    2.494E+04 /

!Al2 reactions
AL          + AL            <=> AL2(1)                      2.986E+13    2.285E-01    0.000E+00 ! HPL

AL          + AL            <=> AL2                         7.222E+13    2.582E-01    0.000E+00 ! HPL

AL          + ALO           <=> AL2O                        2.222E+10    9.833E-01  -3.687E+02 !
HPL:10^12 atm
                                plog /     1. 1.304E+18 -2.008E+00    1.089E+03 /
                                plog /    10. 1.749E+18 -1.780E+00    1.490E+03 /
                                plog / 100. 1.628E+17 -1.257E+00    1.716E+03 /

AL2         + O             <=> AL2O                        2.855E+11    6.894E-01  -4.417E+02 !
HPL:10^12 atm
                                plog /     1. 9.049E-03    2.919E+00    1.640E+05 /
                                plog /    10. 5.732E-07    4.138E+00    1.331E+05 /
                                plog / 100. 6.808E-08    6.597E+00    8.638E+04 /

AL          + ALO           <=> AL2         + O             3.870E+03    1.254E+00    8.508E+04 !
HPL:10^12 atm
                                plog /     1. 2.237E+12    6.912E-01    8.603E+04 /
                                plog /    10. 2.236E+12    6.912E-01    8.603E+04 /
                                plog / 100. 2.233E+12    6.914E-01    8.603E+04 /

AL          + ALO           <=> AL2O(3)                     4.245E+15  -3.231E-01    3.229E+02 !
HPL:10^12 atm
                                plog /     1. 8.678E+17 -2.127E+00    5.891E+02 /
```

plog / 10. 7.590E+18 -2.110E+00 7.298E+02 /
plog / 100. 4.708E+19 -2.053E+00 9.786E+02 /

AL + ALO2 <=> AL2O2 1.015E+12 6.912E-01 -4.105E+02 ! HPL:10^12 atm
plog / 1. 1.618E+03 1.658E+00 1.202E+04 /
plog / 10. 1.459E+12 -4.444E-01 2.056E+03 /
plog / 100. 3.140E+17 -1.359E+00 1.098E+03 /

ALO + ALO <=> AL2O2 4.453E+13 -1.160E-01 -9.782E+02 ! HPL:10^12 atm
plog / 1. 2.141E+22 -3.008E+00 1.172E+03 /
plog / 10. 2.246E+20 -2.256E+00 9.554E+02 /
plog / 100. 6.381E+16 -1.111E+00 -2.528E+01 /

AL2 + O2 <=> AL2O2 5.709E+16 -1.027E+00 9.622E+02 ! HPL:10^12 atm
plog / 1. 3.974E-07 3.849E+00 1.087E+05 /
plog / 10. 2.021E-07 3.899E+00 5.983E+04 /
plog / 100. 5.921E-06 3.822E+00 1.152E+04 /

AL + ALO2 <=> ALO + ALO 1.032E+13 4.031E-01 1.312E+02 ! HPL:10^12 atm
plog / 1. 2.565E+14 0.000E+00 5.537E+02 /
plog / 10. 2.567E+14 0.000E+00 5.542E+02 /
plog / 100. 2.551E+14 0.000E+00 6.919E+02 /
duplicate

AL + ALO2 <=> AL2 + O2 5.606E-20 1.394E+00 5.651E+04 ! HPL:10^12 atm
plog / 1. 3.651E+19 -1.572E+00 5.989E+04 /
plog / 10. 3.724E+19 -1.575E+00 5.990E+04 /
plog / 100. 4.445E+19 -1.600E+00 5.992E+04 /

ALO + ALO <=> AL2 + O2 8.619E-23 2.144E+00 8.294E+04 ! HPL:10^12 atm
plog / 1. 3.229E+17 -1.236E+00 8.692E+04 /
plog / 10. 3.750E+17 -1.248E+00 8.715E+04 /

plog / 100. 3.801E+17 -1.250E+00 8.718E+04 /

AL + ALO2 <=> AL2O2(3) 2.406E+13 3.482E-01 0.000E+00 !
HPL:10^12 atm
plog / 1. 1.957E+08 0.000E+00 5.550E+04 /
plog / 10. 2.620E+08 0.000E+00 3.506E+04 /
plog / 100. 1.592E+09 0.000E+00 1.196E+04 /

ALO + ALO <=> AL2O2(3) 6.141E+18 -1.285E+00 1.389E+03 !
HPL:10^12 atm
plog / 1. 3.084E+17 -2.232E+00 1.149E+04 /
plog / 10. 1.014E+21 -2.939E+00 4.512E+03 /
plog / 100. 2.779E+25 -3.772E+00 3.232E+03 /

AL2O + O <=> AL2O2(3) 3.832E+13 2.625E-01 3.826E+02 !
HPL:10^12 atm
plog / 1. 8.069E+27 -4.596E+00 3.648E+03 /
plog / 10. 1.308E+26 -3.860E+00 3.613E+03 /
plog / 100. 4.142E+22 -2.634E+00 2.981E+03 /

AL + ALO2 <=> ALO + ALO 5.500E-02 2.212E+00 -1.272E+03 !
HPL:10^12 atm
plog / 1. 9.602E+10 8.236E-01 -3.684E+02 /
plog / 10. 9.596E+10 8.237E-01 -3.684E+02 /
plog / 100. 9.515E+10 8.246E-01 -3.688E+02 /
duplicate

AL + ALO2 <=> AL2O + O 8.105E+00 1.796E+00 -1.067E+03 !
HPL:10^12 atm
plog / 1. 2.154E+13 3.318E-01 0.000E+00 /
plog / 10. 2.154E+13 3.318E-01 0.000E+00 /
plog / 100. 2.156E+13 3.318E-01 0.000E+00 /

ALO + ALO <=> AL2O + O 7.604E-03 2.426E+00 -1.505E+03 !
HPL:10^12 atm
plog / 1. 2.049E+18 -1.166E+00 1.163E+03 /
plog / 10. 2.055E+18 -1.166E+00 1.164E+03 /
plog / 100. 1.352E+18 -1.114E+00 1.184E+03 /

```
AL          + ALO3       <=> AL2O3(1)                    3.891E+09    1.303E+00  -1.078E+03 !
HPL:10^12 atm
                                plog /     1. 2.230E-09   5.346E+00   1.210E+04 /
                                plog /    10. 8.677E+01   2.932E+00  -7.489E+02 /
                                plog / 100. 9.706E+08   1.362E+00  -1.032E+03 /

ALO         + ALO2       <=> AL2O3(1)                    2.605E+18  -1.603E+00   5.709E+02 !
HPL:10^12 atm
                                plog /     1. 1.841E+26  -4.343E+00   2.484E+03 /
                                plog /    10. 4.347E+23  -3.293E+00   2.051E+03 /
                                plog / 100. 5.638E+19  -2.027E+00   9.663E+02 /

AL2O2(3)  + O            <=> AL2O3(1)                    8.348E+12    1.419E-01   3.624E+02 !
HPL:10^12 atm
                                plog /     1. 1.330E+19  -1.847E+00   2.137E+03 /
                                plog /    10. 6.308E+15  -7.801E-01   1.190E+03 /
                                plog / 100. 4.383E+13  -8.874E-02   5.696E+02 /

AL          + ALO3       <=> ALO          + ALO2          7.236E-21    2.443E+00  -2.252E+03 !
HPL:10^12 atm
                                plog /     1. 5.779E+08   1.297E+00  -1.003E+03 /
                                plog /    10. 6.786E+08   1.266E+00  -9.884E+02 /
                                plog / 100. 4.141E+08   1.239E+00  -1.001E+03 /
                                duplicate

AL          + ALO3       <=> AL2O2(3)  + O                3.312E-26    4.896E+00  -4.614E+03 !
HPL:10^12 atm
                                plog /     1. 3.034E+09   1.315E+00  -1.107E+03 /
                                plog /    10. 3.185E+09   1.309E+00  -1.100E+03 /
                                plog / 100. 2.850E+09   1.264E+00  -1.103E+03 /

ALO         + ALO2       <=> AL2O2(3)  + O                2.592E-35    7.048E+00  -5.753E+03 !
HPL:10^12 atm
                                plog /     1. 7.708E+18  -1.749E+00   1.091E+03 /
                                plog /    10. 5.326E+15  -8.624E-01   8.132E+02 /
                                plog / 100. 7.131E+10   4.037E-01  -2.364E+02 /
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```
AL          + ALO3        <=> AL2O3                      2.230E+13   4.764E-01   4.660E+02 !
HPL:10^12 atm
                                plog /     1. 1.205E-10   4.223E+00   7.206E+04 /
                                plog /    10. 1.140E-09   3.992E+00   2.594E+04 /
                                plog / 100. 8.639E+10 -8.017E-01   5.015E+03 /

ALO         + ALO2        <=> AL2O3                      5.154E+12   4.188E-01  -9.082E+02 !
HPL:10^12 atm
                                plog /     1. 2.770E+07   1.611E-01   1.368E+04 /
                                plog /    10. 5.400E+16 -1.948E+00   2.623E+03 /
                                plog / 100. 3.894E+20 -2.361E+00   1.326E+03 /

AL2O        + O2          <=> AL2O3                      7.715E+06   2.049E+00   4.221E+03 !
HPL:10^12 atm
                                plog /     1. 3.139E+28 -5.048E+00   9.792E+03 /
                                plog /    10. 5.893E+24 -3.763E+00   9.032E+03 /
                                plog / 100. 3.388E+20 -2.386E+00   7.879E+03 /

AL2O2       + O           <=> AL2O3                      4.235E+13   3.089E-01   1.197E+02 !
HPL:10^12 atm
                                plog /     1. 1.410E+30 -4.990E+00   4.788E+03 /
                                plog /    10. 7.668E+24 -3.248E+00   3.484E+03 /
                                plog / 100. 1.364E+19 -1.421E+00   1.802E+03 /

AL          + ALO3        <=> ALO         + ALO2          1.494E-42   8.169E+00  -5.485E+03 !
HPL:10^12 atm
                                plog /     1. 1.569E+09   9.552E-01   0.000E+00 /
                                plog /    10. 1.313E+09   9.776E-01   0.000E+00 /
                                plog / 100. 1.154E+09   9.920E-01   0.000E+00 /
                                duplicate

AL          + ALO3        <=> AL2O        + O2            1.665E+01   2.356E+00  -1.254E+03 !
HPL:10^12 atm
                                plog /     1. 1.895E+12   7.782E-01   0.000E+00 /
                                plog /    10. 1.895E+12   7.782E-01   0.000E+00 /
                                plog / 100. 1.895E+12   7.782E-01   0.000E+00 /

AL          + ALO3        <=> AL2O2       + O             6.283E-21   4.036E+00  -2.604E+03 !
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```
HPL:10^12 atm
                                plog /     1. 2.693E+12   0.000E+00   6.478E+02 /
                                plog /    10. 3.637E+12   0.000E+00   6.476E+02 /
                                plog / 100. 2.723E+12   0.000E+00   6.457E+02 /

ALO         + ALO2       <=> AL2O       + O2              4.915E-64   1.464E+01  -1.250E+04 !
HPL:10^12 atm
                                plog /     1. 4.523E+13   0.000E+00  -4.639E+02 /
                                plog /    10. 4.533E+13   0.000E+00  -4.654E+02 /
                                plog / 100. 4.503E+13   0.000E+00  -3.295E+02 /

ALO         + ALO2       <=> AL2O2      + O               3.077E-30   8.353E+00  -7.891E+03 !
HPL:10^12 atm
                                plog /     1. 8.042E+13   0.000E+00  -3.815E+02 /
                                plog /    10. 8.043E+13   0.000E+00  -3.794E+02 /
                                plog / 100. 7.870E+13   0.000E+00  -2.069E+02 /

AL2O        + O2         <=> AL2O2      + O               7.986E-56   1.361E+01   2.359E+03 !
HPL:10^12 atm
                                plog /     1. 2.059E+15  -7.758E-01   9.150E+03 /
                                plog /    10. 1.248E+12   1.672E-01   9.423E+03 /
                                plog / 100. 3.885E+06   1.720E+00   8.980E+03 /

ALO         + ALO3       <=> AL2O4(1)                    5.792E+24  -3.378E+00   3.225E+03 !
HPL:10^12 atm
                                plog /     1. 1.492E+09  -1.095E+00   3.679E+04 /
                                plog /    10. 1.069E+17  -2.951E+00   1.154E+04 /
                                plog / 100. 2.968E+31  -6.238E+00   6.030E+03 /

ALO2        + ALO2       <=> AL2O4(1)                    7.357E+13   0.000E+00  -2.813E+02 !
HPL:10^12 atm
                                plog /     1. 3.296E+09  -1.050E+00   1.392E+04 /
                                plog /    10. 9.229E+20  -3.693E+00   3.351E+03 /
                                plog / 100. 4.087E+26  -4.488E+00   2.924E+03 /

AL2O2(3) + O2            <=> AL2O4(1)                    1.042E+13   0.000E+00  -2.631E+02 !
HPL:10^12 atm
                                plog /     1. 2.826E+29  -5.243E+00   4.547E+03 /
```

plog / 10. 1.079E+24 -3.496E+00 3.034E+03 /
plog / 100. 2.868E+19 -2.029E+00 1.724E+03 /

AL2O3 + O <=> AL2O4(1) 2.989E+13 0.000E+00 2.751E+01 !
HPL:10^12 atm
plog / 1. 1.020E+32 -6.185E+00 4.817E+03 /
plog / 10. 9.067E+25 -4.073E+00 3.627E+03 /
plog / 100. 3.245E+19 -1.966E+00 1.920E+02 /

ALO + ALO3 <=> ALO2 + ALO2 7.550E-07 2.894E+00 0.000E+00 !
HPL:10^12 atm
plog / 1. 1.174E+12 0.000E+00 2.185E+03 /
plog / 10. 1.173E+12 0.000E+00 2.210E+03 /
plog / 100. 1.158E+12 0.000E+00 2.427E+03 /
duplicate

ALO + ALO3 <=> AL2O2(3) + O2 8.776E-10 2.262E+00 -1.357E+03 !
HPL:10^12 atm
plog / 1. 1.647E+25 -3.545E+00 3.398E+03 /
plog / 10. 1.648E+25 -3.545E+00 3.398E+03 /
plog / 100. 1.605E+25 -3.541E+00 3.394E+03 /

ALO + ALO3 <=> AL2O3 + O 4.684E-10 1.737E+00 -6.512E+02 !
HPL:10^12 atm
plog / 1. 4.803E+22 -3.012E+00 3.042E+03 /
plog / 10. 4.679E+22 -3.008E+00 3.040E+03 /
plog / 100. 3.368E+22 -2.969E+00 3.012E+03 /

ALO2 + ALO2 <=> AL2O2(3) + O2 7.586E-28 7.657E+00 -6.713E+03 !
HPL:10^12 atm
plog / 1. 5.202E+13 0.000E+00 -4.640E+02 /
plog / 10. 5.204E+13 0.000E+00 -4.645E+02 /
plog / 100. 5.337E+13 0.000E+00 -3.298E+02 /

ALO2 + ALO2 <=> AL2O3 + O 1.722E-27 6.967E+00 -5.360E+03 !
HPL:10^12 atm
plog / 1. 1.244E+10 8.396E-01 -1.039E+03 /
plog / 10. 1.190E+10 8.452E-01 -1.036E+03 /

plog / 100. 7.926E+09 8.988E-01 -8.636E+02 /

AL2O2(3) + O2 <=> AL2O3 + O 4.275E-60 1.413E+01 5.842E+03 !
HPL:10^12 atm
plog / 1. 8.376E+12 0.000E+00 1.453E+04 /
plog / 10. 1.082E+13 0.000E+00 1.621E+04 /
plog / 100. 9.664E+12 0.000E+00 1.825E+04 /

ALO + ALO3 <=> AL2O4 3.057E+18 -1.323E+00 1.779E+03 !
HPL:10^12 atm
plog / 1. 3.216E+08 -6.973E-01 1.521E+04 /
plog / 10. 2.477E+25 -4.703E+00 5.426E+03 /
plog / 100. 2.613E+28 -4.773E+00 4.446E+03 /

ALO2 + ALO2 <=> AL2O4 9.658E+16 -7.344E-01 9.561E+02 !
HPL:10^12 atm
plog / 1. 5.004E+21 -4.022E+00 6.258E+03 /
plog / 10. 1.276E+31 -5.863E+00 4.589E+03 /
plog / 100. 2.569E+27 -4.181E+00 3.765E+03 /

AL2O2 + O2 <=> AL2O4 1.934E+12 5.331E-01 -1.177E+03 !
HPL:10^12 atm
plog / 1. 2.903E+29 -5.186E+00 2.994E+03 /
plog / 10. 5.870E+27 -4.508E+00 2.974E+03 /
plog / 100. 7.612E+25 -3.842E+00 2.655E+03 /

AL2O3 + O <=> AL2O4 4.058E+11 6.957E-01 -1.123E+03 !
HPL:10^12 atm
plog / 1. 2.116E+32 -6.035E+00 4.575E+03 /
plog / 10. 1.143E+25 -3.563E+00 2.877E+03 /
plog / 100. 6.142E+17 -1.245E+00 7.641E+02 /

ALO + ALO3 <=> ALO2 + ALO2 1.333E-33 1.125E+01 -6.721E+03 !
HPL:10^12 atm
plog / 1. 2.204E+07 1.416E+00 1.073E+03 /
plog / 10. 1.929E+07 1.434E+00 1.166E+03 /
plog / 100. 2.244E+06 1.704E+00 1.440E+03 /
duplicate

```
ALO       + ALO3      <=> AL2O2     + O2              1.113E-104  2.536E+01  -2.061E+04 !
HPL:10^12 atm
                                plog /     1. 6.040E+20 -2.212E+00   2.368E+03 /
                                plog /    10. 7.132E+20 -2.231E+00   2.380E+03 /
                                plog / 100. 4.920E+20 -2.177E+00   2.438E+03 /

ALO       + ALO3      <=> AL2O3(1)  + O               4.647E-28    1.027E+01  -7.961E+03 !
HPL:10^12 atm
                                plog /     1. 4.167E+17 -1.099E+00   1.729E+03 /
                                plog /    10. 3.798E+17 -1.087E+00   1.730E+03 /
                                plog / 100. 5.956E+16 -8.571E-01   1.740E+03 /

ALO2      + ALO2      <=> AL2O2     + O2              2.048E-131  3.298E+01  -2.974E+04 !
HPL:10^12 atm
                                plog /     1. 4.979E+19 -1.724E+00   1.486E+03 /
                                plog /    10. 7.461E+19 -1.772E+00   1.562E+03 /
                                plog / 100. 3.483E+18 -1.377E+00   1.793E+03 /

ALO2      + ALO2      <=> AL2O3(1)  + O               9.498E-43    1.453E+01  -1.311E+04 !
HPL:10^12 atm
                                plog /     1. 4.738E+14 -1.070E-01   7.158E+02 /
                                plog /    10. 4.684E+14 -1.017E-01   8.957E+02 /
                                plog / 100. 9.632E+12   3.866E-01   1.127E+03 /

AL2O2     + O2        <=> AL2O3(1)  + O               1.457E-146  3.708E+01   1.720E+03 !
HPL:10^12 atm
                                plog /     1. 7.281E+14 -1.648E-01   3.088E+04 /
                                plog /    10. 3.031E+11   8.140E-01   3.086E+04 /
                                plog / 100. 1.366E+04   2.863E+00   2.917E+04 /

!Al4 reactions
AL2O3(1)  + AL2O3(1)  <=> AL4O6                       6.494E+22  -2.561E+00   2.249E+03 !
HPL:10^12 atm
                                plog /     1. 6.495E+22 -2.561E+00   2.249E+03 /
                                plog /    10. 6.494E+22 -2.561E+00   2.249E+03 /
                                plog / 100. 6.494E+22 -2.561E+00   2.249E+03 /
```

AL2O3 + AL2O3 <=> AL4O6 1.125E+12 2.045E-01 1.103E+02 ! HPL:10^12 atm

plog / 1. 6.371E+11 2.758E-01 0.000E+00 /
plog / 10. 6.371E+11 2.758E-01 0.000E+00 /
plog / 100. 6.371E+11 2.758E-01 0.000E+00 /

AL2O3(1) + AL2O3(1) <=> AL2O3 + AL2O3 3.527E-155 3.724E+01 -2.192E+04 ! HPL:10^12 atm

plog / 1. 3.262E+11 -1.026E+00 1.135E+04 /
plog / 10. 2.755E+09 -7.235E-01 1.120E+04 /
plog / 100. 3.637E+04 3.314E-01 1.043E+04 /

AL2O2 + AL2O4 <=> AL4O6(3) 8.438E+14 -2.793E-01 -1.694E+01 ! HPL:10^12 atm

plog / 1. 9.432E+14 -2.941E-01 0.000E+00 /
plog / 10. 9.226E+14 -2.906E-01 0.000E+00 /
plog / 100. 9.210E+14 -2.903E-01 0.000E+00 /

AL2O3(1) + AL2O3 <=> AL4O6(3) 2.182E+16 -8.490E-01 3.932E+02 ! HPL:10^12 atm

plog / 1. 2.948E+15 -5.990E-01 0.000E+00 /
plog / 10. 2.881E+15 -5.953E-01 0.000E+00 /
plog / 100. 2.875E+15 -5.950E-01 0.000E+00 /

AL2O2 + AL2O4 <=> AL2O3(1) + AL2O3 1.686E-75 2.305E+01 -5.960E+03 ! HPL:10^12 atm

plog / 1. 1.710E-08 5.629E+00 1.176E+04 /
plog / 10. 5.952E-09 5.452E+00 1.188E+04 /
plog / 100. 3.432E-10 5.515E+00 1.150E+04 /

AL2O3(1) + AL2O4(1) <=> AL4O6(3) + O 6.1E+10 0.0E+00 -1.7E+03 ! rough rrkm estimation from (3)+(3)

plog / 1. 6.1E+10 0.0E+00 -1.7E+03 /
plog / 10. 6.1E+10 0.0E+00 -1.7E+03 /
plog / 100. 6.1E+10 0.0E+00 -1.7E+03 /

AL2O3 + AL2O4 <=> AL4O6(3) + O 6.1E+10 0.0E+00 -1.7E+03 ! HPL:10^12 atm rough rrkm estimation

```
                                    plog /     1. 6.1E+10    0.0E+00 -1.7E+03 /
                                    plog /    10. 6.1E+10    0.0E+00 -1.7E+03 /
                                    plog / 100. 6.1E+10    0.0E+00 -1.7E+03 /

AL2O3(1) + AL2O4      <=> AL4O6      + O                4.4E+11    6.5E-01 -1.1E+03 ! HPL:10^12 atm
rough rrkm estimation
                                    plog /     1. 2.2E+16 -8.2E-01    3.3E+02 /
                                    plog /    10. 1.5E+13    1.7E-01 -6.5E+02 /
                                    plog / 100. 7.7E+11    5.8E-01 -1.0E+03 /

AL2O3      + AL2O4(1) <=> AL4O6      + O                4.4E+11    6.5E-01 -1.1E+03 ! rough estimation
from (1)+(3)
                                    plog /     1. 2.2E+16 -8.2E-01    3.3E+02 /
                                    plog /    10. 1.5E+13    1.7E-01 -6.5E+02 /
                                    plog / 100. 7.7E+11    5.8E-01 -1.0E+03 /

AL2O4(1) + AL2O4(1) <=> AL4O6(3) + O2                 1.1E+06    1.8E+00 -1.2E+03 ! rough estimation
from (3)+(3)
                                    plog /     1. 2.6E+14 -1.1E+00    0.0E+00 /
                                    plog /    10. 2.5E+12 -3.3E-01    0.0E+00 /
                                    plog / 100. 4.8E+10    3.2E-01    0.0E+00 /

AL2O4      + AL2O4      <=> AL4O6(3) + O2                 1.1E+06    1.8E+00 -1.2E+03 ! HPL:10^12 atm
rough rrkm estimation
                                    plog /     1. 2.6E+14 -1.1E+00    0.0E+00 /
                                    plog /    10. 2.5E+12 -3.3E-01    0.0E+00 /
                                    plog / 100. 4.8E+10    3.2E-01    0.0E+00 /

AL2O4(1) + AL2O4      <=> AL4O6      + O2                 1.8E+07    1.9E+00 -1.8E+03 ! HPL:10^12 atm
rough rrkm estimation
                                    plog /     1. 1.6E+25 -3.8E+00    3.9E+03 /
                                    plog /    10. 4.7E+19 -2.1E+00    2.3E+03 /
                                    plog / 100. 5.2E+14 -4.8E-01    8.7E+02 /

!Al8 reactions
AL4O6      + AL4O6      <=> AL8O12                  2.8E+32  -6.2E+00    7.1E+03 ! HPL:10^12
atm rough rrkm estimation
                                    plog /     1. 2.8E+32 -6.2E+00    7.1E+03 /
```

plog / 10. 2.8E+32 -6.2E+00 7.1E+03 /
plog / 100. 2.8E+32 -6.2E+00 7.1E+03 /

AL4O6(3) + AL4O6(3) <=> AL8O12 2.8E+32 -6.2E+00 7.1E+03 ! rough estimation from (1)+(1)
plog / 1. 2.8E+32 -6.2E+00 7.1E+03 /
plog / 10. 2.8E+32 -6.2E+00 7.1E+03 /
plog / 100. 2.8E+32 -6.2E+00 7.1E+03 /

!Al16 reactions
!AL8O12 + AL8O12 <=> AL16O24 6.7E+12 5.0E-01 0.0E+00 ! by collision rate

!Al-C reactions
!Al1 reactions
AL + CO2 <=> ALCO2 5.944E+07 2.117E+00 1.936E+02 ! HPL:10^12 atm
plog / 1. 3.013E+25 -4.428E+00 3.684E+03 /
plog / 10. 7.888E+25 -4.282E+00 4.011E+03 /
plog / 100. 2.948E+25 -3.891E+00 4.304E+03 /

ALO + CO <=> ALCO2 1.627E+01 3.468E+00 -4.433E+03 ! HPL:10^12 atm
plog / 1. 1.871E+18 -3.248E+00 1.066E+04 /
plog / 10. 7.128E+16 -2.603E+00 6.100E+03 /
plog / 100. 3.496E+17 -2.523E+00 1.541E+03 /

AL + CO2 <=> ALO + CO 3.683E-15 6.909E+00 3.665E+03 ! HPL:10^12 atm
plog / 1. 1.253E+08 2.061E+00 6.121E+03 /
plog / 10. 1.252E+08 2.061E+00 6.120E+03 /
plog / 100. 1.224E+08 2.064E+00 6.113E+03 /

!Al2 reactions
AL2O + CO <=> AL2CO2(1) 1.286E+05 2.080E+00 3.991E+04 ! HPL:10^12 atm
plog / 1. 1.452E+27 -6.579E+00 4.310E+04 /
plog / 10. 3.225E+28 -6.664E+00 4.372E+04 /

```
                                plog / 100. 1.578E+30 -6.842E+00   4.468E+04 /

AL          + ALCO2      <=> AL2CO2(1)                  6.434E+09   1.203E+00  -1.648E+03 !
HPL:10^12 atm
                                plog /   1. 2.143E+23 -5.238E+00   1.202E+05 /
                                plog /  10. 3.959E+22 -4.753E+00   1.186E+05 /
                                plog / 100. 4.729E-05  2.436E+00   7.246E+04 /

AL2O        + CO         <=> AL          + ALCO2        7.720E-25   9.425E+00   9.995E+04 !
HPL:10^12 atm
                                plog /   1. 2.296E+10  8.004E-01   1.088E+05 /
                                plog /  10. 2.296E+10  8.004E-01   1.088E+05 /
                                plog / 100. 2.295E+10  8.004E-01   1.088E+05 /

AL2         + CO2        <=> AL2CO2                     4.413E+06   2.376E+00   3.791E+03 !
HPL:10^12 atm
                                plog /   1. 1.296E+22 -2.715E+00   7.774E+03 /
                                plog /  10. 5.137E+17 -1.282E+00   6.595E+03 /
                                plog / 100. 2.003E+14 -1.846E-01   5.630E+03 /

AL          + ALCO2      <=> AL2CO2                     8.998E+13   0.000E+00  -1.720E+02 !
HPL:10^12 atm
                                plog /   1. 2.823E+27 -4.516E+00   3.247E+03 /
                                plog /  10. 1.064E+24 -3.219E+00   2.744E+03 /
                                plog / 100. 8.134E+18 -1.560E+00   1.334E+03 /

AL2         + CO2        <=> AL          + ALCO2        3.641E-91   2.486E+01  -4.140E+03 !
HPL:10^12 atm
                                plog /   1. 1.525E+13  1.529E-01   1.730E+04 /
                                plog /  10. 2.538E+10  9.622E-01   1.749E+04 /
                                plog / 100. 1.246E+04  2.711E+00   1.612E+04 /

AL2O        + CO2        <=> AL2CO3                     1.049E+07   2.166E+00   2.429E+04 !
HPL:10^12 atm
                                plog /   1. 5.564E+36 -8.107E+00   3.046E+04 /
                                plog /  10. 3.695E+36 -7.760E+00   3.121E+04 /
                                plog / 100. 9.667E+34 -7.019E+00   3.151E+04 /
```

```
AL2O2     + CO        <=> AL2CO3                    3.330E+03   2.603E+00   2.992E+04 !
HPL:10^12 atm
                              plog /    1. 7.481E+15 -3.686E+00   4.808E+04 /
                              plog /   10. 2.316E+16 -3.600E+00   3.996E+04 /
                              plog / 100. 3.044E+22 -4.981E+00   3.534E+04 /

ALO       + ALCO2     <=> AL2CO3                    8.099E+07   1.646E+00  -1.993E+03 !
HPL:10^12 atm
                              plog /    1. 3.622E+23 -5.608E+00   1.648E+05 /
                              plog /   10. 2.744E+21 -4.735E+00   1.626E+05 /
                              plog / 100. 1.453E+01   7.062E-01   1.207E+05 /

AL2O      + CO2       <=> AL2O2     + CO            1.246E-19   7.416E+00   3.897E+04 !
HPL:10^12 atm
                              plog /    1. 1.002E+04   2.419E+00   4.174E+04 /
                              plog /   10. 1.002E+04   2.419E+00   4.174E+04 /
                              plog / 100. 1.003E+04   2.419E+00   4.174E+04 /

AL2O      + CO2       <=> ALO       + ALCO2         1.221E-01   3.109E+00   1.148E+05 !
HPL:10^12 atm
                              plog /    1. 2.139E+10   1.375E+00   1.165E+05 /
                              plog /   10. 2.139E+10   1.375E+00   1.165E+05 /
                              plog / 100. 2.139E+10   1.375E+00   1.165E+05 /

AL2O2     + CO        <=> ALO       + ALCO2         2.751E-06   3.648E+00   1.030E+05 !
HPL:10^12 atm
                              plog /    1. 1.097E+05   2.160E+00   1.043E+05 /
                              plog /   10. 1.096E+05   2.160E+00   1.043E+05 /
                              plog / 100. 1.096E+05   2.160E+00   1.043E+05 /

AL2O2     + CO2       <=> AL2CO4                    4.884E+03   2.578E+00   2.087E+03 !
HPL:10^12 atm
                              plog /    1. 1.406E+26 -4.629E+00   8.498E+03 /
                              plog /   10. 3.516E+19 -2.502E+00   6.646E+03 /
                              plog / 100. 1.060E+13 -4.120E-01   4.776E+03 /

AL2O3(1)  + CO        <=> AL2CO4                    1.497E+06   1.561E+00   2.665E+04 !
HPL:10^12 atm
```

```
                                plog /     1. 1.043E+34 -9.734E+00   2.830E+04 /
                                plog /    10. 1.119E+35 -9.729E+00   2.891E+04 /
                                plog / 100. 7.192E+36 -9.470E+00   3.165E+04 /

AL2O2       + CO2          <=> AL2O3(1) + CO              3.074E-103  2.874E+01   6.300E+04 !
HPL:10^12 atm
                                plog /     1. 9.025E+03   2.679E+00   8.708E+04 /
                                plog /    10. 9.025E+03   2.679E+00   8.708E+04 /
                                plog / 100. 9.004E+03   2.679E+00   8.704E+04 /

!Al4 reactions
AL2CO3      + AL2O4(1) <=> AL4O6      + CO          1.4E+13   5.0E-01   0.0E+00 ! by collision
rate
AL2CO3      + AL2O4    <=> AL4O6(3)   + CO          1.3E+13   5.0E-01   0.0E+00 ! by collision
rate
AL2CO4      + AL2O3(1) <=> AL4O6      + CO          1.4E+13   5.0E-01   0.0E+00 ! by collision
rate
AL2CO4      + AL2O3    <=> AL4O6(3)   + CO          1.3E+13   5.0E-01   0.0E+00 ! by collision
rate
AL2CO4      + AL2O4(1) <=> AL4O6      + CO2         1.3E+13   5.0E-01   0.0E+00 ! by collision
rate
AL2CO4      + AL2O4    <=> AL4O6(3)   + CO2         1.3E+13   5.0E-01   0.0E+00 ! by collision
rate

AL2CO4      + AL2CO4   <=> AL4O6      + CO + CO     6.7E+12   5.0E-01   0.0E+00 ! by collision
rate


!Al-H reactions
!Al1-H1 reactions
ALO         + H            <=> ALOH                       6.024E+12   2.784E-01   0.000E+00 !
HPL:10^12 atm
                                plog /     1. 2.504E+18 -2.041E+00   8.340E+02 /
                                plog /    10. 4.845E+18 -1.859E+00   1.218E+03 /
                                plog / 100. 7.063E+17 -1.397E+00   1.460E+03 /

AL          + OH           <=> ALOH                       1.047E+11   9.363E-01   0.000E+00 !
HPL:10^12 atm
```

plog / 1. 2.080E+11 -2.853E-01 2.690E+04 /
plog / 10. 2.134E+06 1.273E+00 1.312E+04 /
plog / 100. 6.453E+09 5.895E-01 2.801E+03 /

ALO + H <=> AL + OH 7.071E-01 1.689E+00 1.602E+04 !
HPL:10^12 atm
plog / 1. 8.239E+13 0.000E+00 1.773E+04 /
plog / 10. 8.245E+13 0.000E+00 1.773E+04 /
plog / 100. 8.276E+13 0.000E+00 1.772E+04 /
duplicate

ALO + H <=> ALOH(3) 1.158E+13 9.632E-01 0.000E+00 !
HPL:10^12 atm
plog / 1. 4.284E+16 -1.844E+00 5.310E+02 /
plog / 10. 1.443E+18 -1.983E+00 5.706E+02 /
plog / 100. 1.891E+19 -2.007E+00 6.572E+02 /

AL + OH <=> ALOH(3) 1.972E+17 -7.144E-01 5.255E+02 !
HPL:10^12 atm
plog / 1. 3.255E+27 -4.947E+00 4.167E+04 /
plog / 10. 1.772E+22 -3.250E+00 3.527E+04 /
plog / 100. 2.440E+15 -1.146E+00 2.591E+04 /

ALO + H <=> AL + OH 3.238E-05 2.112E+00 1.528E+04 !
HPL:10^12 atm
plog / 1. 1.575E+16 -5.527E-01 1.735E+04 /
plog / 10. 1.572E+16 -5.525E-01 1.735E+04 /
plog / 100. 1.576E+16 -5.528E-01 1.735E+04 /
duplicate

ALO2 + H <=> ALO2H 1.362E+16 -6.321E-01 7.900E+02 !
HPL:10^12 atm
plog / 1. 4.066E+16 -1.924E+00 3.594E+03 /
plog / 10. 2.203E+04 -2.877E+00 2.027E+03 /
plog / 100. 1.454E+22 -2.693E+00 2.292E+03 /

ALO + OH <=> ALO2H 1.800E+13 0.000E+00 -5.158E+02 !
HPL:10^12 atm

plog / 1. 4.699E+18 -2.079E+00 0.000E+00 /
plog / 10. 2.256E+17 -1.478E+00 0.000E+00 /
plog / 100. 7.439E+15 -8.907E-01 0.000E+00 /

ALO2 + H <=> ALO + OH 2.040E-02 1.953E+00 -6.426E+02 !
HPL:10^12 atm
plog / 1. 3.931E+16 -8.046E-01 8.469E+02 /
plog / 10. 3.639E+16 -7.943E-01 8.765E+02 /
plog / 100. 3.159E+15 -4.909E-01 1.090E+03 /
duplicate

ALO2 + H <=> ALO2H(3) 4.193E+14 1.488E-01 0.000E+00 !
HPL:10^12 atm
plog / 1. 5.250E+15 -1.792E+00 3.459E+04 /
plog / 10. 9.829E+12 -8.633E-01 2.304E+04 /
plog / 100. 6.486E+11 -3.221E-01 8.208E+03 /

ALOH + O <=> ALO2H(3) 3.197E+16 -5.960E-01 1.161E+03 !
HPL:10^12 atm
plog / 1. 2.970E+24 -3.841E+00 1.909E+03 /
plog / 10. 3.755E+24 -3.596E+00 2.363E+03 /
plog / 100. 5.078E+23 -3.092E+00 2.655E+03 /

ALO + OH <=> ALO2H(3) 2.131E+12 7.400E-01 -1.394E+03 !
HPL:10^12 atm
plog / 1. 6.013E+15 -1.677E+00 1.688E+04 /
plog / 10. 1.413E+13 -7.222E-01 8.589E+03 /
plog / 100. 7.119E+15 -1.205E+00 1.804E+03 /

ALO2 + H <=> ALOH + O 3.267E-15 4.503E+00 -2.855E+03 !
HPL:10^12 atm
plog / 1. 9.971E+16 -6.764E-01 5.681E+02 /
plog / 10. 9.986E+16 -6.766E-01 5.683E+02 /
plog / 100. 1.014E+17 -6.782E-01 5.700E+02 /

ALO2 + H <=> ALO + OH 3.360E-19 5.638E+00 -2.912E+03 !
HPL:10^12 atm t
plog / 1. 3.480E+13 2.742E-01 0.000E+00 /

plog / 10. 3.464E+13 2.748E-01 0.000E+00 /
plog / 100. 3.301E+13 2.807E-01 0.000E+00 /
duplicate

ALOH + O <=> ALO + OH 1.063E-02 2.693E+00 1.059E+04 !
HPL:10^12 atm
plog / 1. 1.489E+16 -4.603E-01 1.281E+04 /
plog / 10. 1.492E+16 -4.605E-01 1.281E+04 /
plog / 100. 1.503E+16 -4.614E-01 1.281E+04 /

ALO3 + H <=> ALO3H 1.990E+10 9.298E-01 -1.242E+03 !
HPL:10^12 atm
plog / 1. 3.987E+13 -1.460E+00 3.965E+03 /
plog / 10. 3.500E+20 -2.804E+00 1.716E+03 /
plog / 100. 6.331E+17 -1.520E+00 9.091E+02 /

ALO2 + OH <=> ALO3H 6.059E+07 1.825E+00 -2.633E+03 !
HPL:10^12 atm
plog / 1. 4.078E+20 -2.567E+00 0.000E+00 /
plog / 10. 5.133E+18 -1.832E+00 0.000E+00 /
plog / 100. 3.104E+17 -1.364E+00 0.000E+00 /

ALO3 + H <=> ALO2 + OH 2.028E-21 5.264E+00 -3.702E+03 !
HPL:10^12 atm
plog / 1. 7.969E+10 7.407E-01 -1.063E+03 /
plog / 10. 6.643E+10 7.644E-01 -1.045E+03 /
plog / 100. 2.287E+08 1.458E+00 -1.308E+03 /
duplicate

ALO3 + H <=> ALO3H(3) 7.821E+11 6.802E-01 -6.124E+02 !
HPL:10^12 atm
plog / 1. 4.700E+02 7.504E-01 5.581E+04 /
plog / 10. 1.366E+02 1.002E+00 3.131E+04 /
plog / 100. 2.482E+07 -1.920E-01 9.135E+03 /

ALO2H + O <=> ALO3H(3) 1.563E+09 1.464E+00 -7.436E+02 !
HPL:10^12 atm
plog / 1. 3.302E+27 -4.786E+00 3.481E+03 /

plog / 10. 2.256E+26 -4.114E+00 3.893E+03 /
plog / 100. 1.207E+22 -2.628E+00 3.045E+03 /

ALOH + O2 <=> ALO3H(3) 5.167E+06 2.046E+00 7.317E+03 !
HPL:10^12 atm
plog / 1. 1.141E+21 -3.145E+00 9.958E+03 /
plog / 10. 1.460E+19 -2.394E+00 9.543E+03 /
plog / 100. 4.163E+18 -2.037E+00 9.833E+03 /

ALO2 + OH <=> ALO3H(3) 4.509E+18 -1.200E+00 1.569E+03 !
HPL:10^12 atm
plog / 1. 3.597E+13 -1.426E+00 1.594E+04 /
plog / 10. 8.075E+18 -2.611E+00 5.524E+03 /
plog / 100. 2.004E+27 -4.477E+00 4.051E+03 /

ALO3 + H <=> ALO2H + O 1.060E-16 4.631E+00 -3.311E+03 !
HPL:10^12 atm
plog / 1. 5.119E+10 6.091E-01 -4.686E+02 /
plog / 10. 5.118E+10 6.091E-01 -4.686E+02 /
plog / 100. 5.106E+10 6.094E-01 -4.687E+02 /

ALO3 + H <=> ALOH + O2 7.642E+00 2.291E+00 -1.805E+03 !
HPL:10^12 atm
plog / 1. 2.045E+12 5.580E-01 -4.421E+02 /
plog / 10. 2.045E+12 5.580E-01 -4.421E+02 /
plog / 100. 2.045E+12 5.580E-01 -4.421E+02 /

ALO3 + H <=> ALO2 + OH 6.386E-20 5.262E+00 -3.394E+03 !
HPL:10^12 atm
plog / 1. 1.197E+08 1.082E+00 -6.909E+02 /
plog / 10. 1.194E+08 1.083E+00 -6.909E+02 /
plog / 100. 1.164E+08 1.086E+00 -6.914E+02 /
duplicate

ALO2H + O <=> ALOH + O2 2.944E-34 9.769E+00 -2.155E+03 !
HPL:10^12 atm
plog / 1. 6.019E+12 3.270E-01 8.596E+02 /
plog / 10. 1.051E+13 2.913E-01 2.195E+03 /

plog / 100. 2.121E+10 1.090E+00 2.663E+03 /

ALO2H + O <=> ALO2 + OH 5.022E-03 2.661E+00 2.163E+04 !
HPL:10^12 atm
plog / 1. 7.108E+17 -9.429E-01 2.407E+04 /
plog / 10. 7.024E+17 -9.415E-01 2.407E+04 /
plog / 100. 5.585E+17 -9.126E-01 2.410E+04 /

ALOH + O2 <=> ALO2 + OH 6.582E-22 6.055E+00 3.455E+04 !
HPL:10^12 atm
plog / 1. 2.004E+16 -8.824E-01 3.970E+04 /
plog / 10. 2.043E+16 -8.848E-01 3.971E+04 /
plog / 100. 2.152E+16 -8.906E-01 3.971E+04 /

!Al2-H1 reactions
AL2O + H <=> AL2OH 5.388E+13 3.344E-01 2.205E+02 !
HPL:10^12 atm
plog / 1. 2.553E+26 -4.383E+00 2.075E+03 /
plog / 10. 1.930E+26 -4.074E+00 2.627E+03 /
plog / 100. 9.857E+24 -3.445E+00 2.874E+03 /

AL2 + OH <=> AL2OH 1.175E+15 0.000E+00 -4.171E+02 !
HPL:10^12 atm
plog / 1. 1.001E+22 -3.912E+00 1.861E+05 /
plog / 10. 8.972E+07 3.082E-01 1.772E+05 /
plog / 100. 1.346E-09 4.700E+00 1.278E+05 /

AL + ALOH <=> AL2OH 1.042E+16 -4.687E-01 0.000E+00 !
HPL:10^12 atm
plog / 1. 2.170E+28 -5.611E+00 3.706E+03 /
plog / 10. 1.382E+31 -6.087E+00 3.220E+03 /
plog / 100. 5.707E+32 -6.223E+00 3.872E+03 /

AL2O + H <=> AL2 + OH 3.778E-03 0.000E+00 1.184E+05 !
HPL:10^12 atm
plog / 1. 1.571E+21 -1.519E+00 1.202E+05 /
plog / 10. 1.571E+21 -1.519E+00 1.202E+05 /
plog / 100. 1.575E+21 -1.519E+00 1.202E+05 /

```
AL2O      + H       <=> AL       + ALOH        1.482E-39   9.869E+00   1.615E+04 !
HPL:10^12 atm
                              plog /     1. 6.650E+14 -2.100E-01   1.982E+04 /
                              plog /    10. 8.386E+14 -2.375E-01   1.989E+04 /
                              plog / 100. 3.118E+15 -3.898E-01   2.058E+04 /

AL2       + OH      <=> AL       + ALOH        9.469E+01   2.045E+00  -2.399E+03 !
HPL:10^12 atm
                              plog /     1. 8.331E+14   0.000E+00 -4.047E+02 /
                              plog /    10. 8.331E+14   0.000E+00 -4.047E+02 /
                              plog / 100. 8.332E+14   0.000E+00 -4.046E+02 /

AL2O2     + H       <=> AL2O2H                  2.593E+13   3.961E-01  -2.637E+02 !
HPL:10^12 atm
                              plog /     1. 2.803E+25 -3.399E+00   3.355E+03 /
                              plog /    10. 1.572E+21 -2.048E+00   2.155E+03 /
                              plog / 100. 2.384E+17 -8.471E-01   9.522E+02 /

AL2OH     + O       <=> AL2O2H                  3.859E+14  -1.944E-01   6.365E+02 !
HPL:10^12 atm
                              plog /     1. 1.052E-06   3.490E+00   6.619E+04 /
                              plog /    10. 5.641E-07   3.662E+00   2.795E+04 /
                              plog / 100. 2.894E+09 -1.854E-01   5.564E+03 /

AL2O      + OH      <=> AL2O2H                  1.217E+15  -3.175E-01   0.000E+00 !
HPL:10^12 atm
                              plog /     1. 4.028E+27 -4.455E+00   3.232E+03 /
                              plog /    10. 2.022E+24 -3.258E+00   2.666E+03 /
                              plog / 100. 8.980E+19 -1.849E+00   1.473E+03 /

AL        + ALO2H   <=> AL2O2H                  1.564E+13   5.025E-01  -5.152E+02 !
HPL:10^12 atm
                              plog /     1. 9.784E+18 -2.552E+00   4.372E+03 /
                              plog /    10. 6.008E+24 -3.656E+00   2.697E+03 /
                              plog / 100. 3.083E+22 -2.542E+00   2.090E+03 /

ALO       + ALOH    <=> AL2O2H                  6.080E+12   1.017E-01   0.000E+00 !
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HPL:10^12 atm
                                plog /     1. 4.803E+25 -4.282E+00   3.155E+03 /
                                plog /    10. 2.816E+22 -3.056E+00   2.601E+03 /
                                plog / 100. 6.125E+17 -1.514E+00   1.399E+03 /

AL2O2      + H          <=> AL2OH      + O              7.497E-10   3.559E+00   7.904E+04 !
HPL:10^12 atm
                                plog /     1. 4.650E+18 -7.938E-01   8.284E+04 /
                                plog /    10. 4.696E+18 -7.949E-01   8.284E+04 /
                                plog / 100. 4.923E+18 -8.001E-01   8.285E+04 /

AL2O2      + H          <=> AL2O       + OH             1.308E-26   7.141E+00   1.071E+04 !
HPL:10^12 atm
                                plog /     1. 6.098E+23 -2.340E+00   1.679E+04 /
                                plog /    10. 3.106E+20 -1.391E+00   1.684E+04 /
                                plog / 100. 2.257E+14   3.126E-01   1.562E+04 /

AL2O2      + H          <=> AL         + ALO2H          2.104E-21   5.863E+00   2.912E+04 !
HPL:10^12 atm
                                plog /     1. 5.862E+18 -9.558E-01   3.387E+04 /
                                plog /    10. 6.467E+18 -9.669E-01   3.389E+04 /
                                plog / 100. 1.330E+17 -4.822E-01   3.393E+04 /

AL2O2      + H          <=> ALO        + ALOH           1.066E-26   7.225E+00   1.308E+04 !
HPL:10^12 atm
                                plog /     1. 1.114E+23 -2.146E+00   1.912E+04 /
                                plog /    10. 3.511E+20 -1.411E+00   1.940E+04 /
                                plog / 100. 4.963E+14   2.316E-01   1.835E+04 /

AL2OH      + O          <=> AL2O       + OH             2.001E-15   4.023E+00  -3.283E+03 !
HPL:10^12 atm
                                plog /     1. 2.712E+14 -2.944E-01   6.838E+02 /
                                plog /    10. 2.715E+14 -2.945E-01   6.839E+02 /
                                plog / 100. 2.752E+14 -2.960E-01   6.850E+02 /

AL2OH      + O          <=> AL         + ALO2H          1.821E-14   3.551E+00  -2.271E+03 !
HPL:10^12 atm
                                plog /     1. 3.073E+11   4.617E-01   0.000E+00 /
```

plog / 10. 3.062E+11 4.621E-01 0.000E+00 /
plog / 100. 2.941E+11 4.667E-01 0.000E+00 /

AL2OH + O <=> ALO + ALOH 2.443E-15 4.002E+00 -3.182E+03 !
HPL:10^12 atm
plog / 1. 1.352E+14 -1.716E-01 6.111E+02 /
plog / 10. 1.350E+14 -1.715E-01 6.110E+02 /
plog / 100. 1.336E+14 -1.703E-01 6.099E+02 /

AL2O + OH <=> AL + ALO2H 2.298E-09 3.950E+00 1.639E+04 !
HPL:10^12 atm
plog / 1. 3.089E+12 3.643E-01 1.878E+04 /
plog / 10. 2.533E+12 3.898E-01 1.881E+04 /
plog / 100. 2.003E+10 9.901E-01 1.875E+04 /

AL2O + OH <=> ALO + ALOH 1.746E-11 4.471E+00 2.071E+03 !
HPL:10^12 atm
plog / 1. 1.634E+15 -3.877E-01 5.007E+03 /
plog / 10. 1.314E+13 2.199E-01 5.370E+03 /
plog / 100. 5.202E+07 1.730E+00 4.434E+03 /

AL + ALO2H <=> ALO + ALOH 4.793E-09 4.106E+00 -2.368E+03 !
HPL:10^12 atm
plog / 1. 4.330E+12 5.563E-01 -2.192E+02 /
plog / 10. 2.271E+12 6.371E-01 -2.083E+02 /
plog / 100. 5.975E+09 1.372E+00 -4.309E+02 /

AL2O3 + H <=> AL2O3H 1.719E-144 4.273E+01 2.309E+04 !
HPL:10^12 atm
plog / 1. 3.572E+13 -4.309E+00 1.506E+04 /
plog / 10. 6.604E+12 -4.140E+00 1.469E+04 /
plog / 100. 3.838E+07 -2.831E+00 1.269E+04 /

AL2O2H + O <=> AL2O3H 1.694E-50 1.712E+01 5.305E+04 !
HPL:10^12 atm
plog / 1. 2.766E+35 -9.979E+00 5.327E+04 /
plog / 10. 4.849E+35 -9.957E+00 5.210E+04 /
plog / 100. 3.347E+33 -9.284E+00 4.874E+04 /

```
AL2OH     + O2        <=> AL2O3H                    2.820E+53 -1.169E+01  8.326E+04 !
HPL:10^12 atm
                              plog /   1. 2.234E+30 -8.101E+00  8.529E+04 /
                              plog /  10. 4.348E+31 -8.348E+00  8.484E+04 /
                              plog / 100. 4.014E+34 -9.045E+00  8.271E+04 /

AL2O2     + OH        <=> AL2O3H                    7.091E-107  3.287E+01  2.835E+04 !
HPL:10^12 atm
                              plog /   1. 9.692E-01  0.000E+00 -1.320E+03 /
                              plog /  10. 6.853E-01  0.000E+00 -1.312E+03 /
                              plog / 100. 1.748E-01  0.000E+00 -3.854E+02 /

ALO       + ALO2H     <=> AL2O3H                    9.250E+62 -1.385E+01  1.343E+05 !
HPL:10^12 atm
                              plog /   1. 1.318E+18 -5.252E+00  2.132E+04 /
                              plog /  10. 9.196E+16 -4.962E+00  2.062E+04 /
                              plog / 100. 2.058E+05 -1.871E+00  1.556E+04 /

ALO2      + ALOH      <=> AL2O3H                    2.431E+65 -1.472E+01  1.429E+05 !
HPL:10^12 atm
                              plog /   1. 4.479E+24 -7.253E+00  2.951E+04 /
                              plog /  10. 2.988E+23 -6.936E+00  2.891E+04 /
                              plog / 100. 5.615E+16 -5.228E+00  2.589E+04 /

AL2O3     + H         <=> AL2O2H    + O             1.649E-21  4.601E+00  1.363E+04 !
HPL:10^12 atm
                              plog /   1. 3.049E+13 -2.500E-01  1.646E+04 /
                              plog /  10. 5.975E+13 -2.965E-01  1.709E+04 /
                              plog / 100. 2.485E+09  9.932E-01  1.678E+04 /

AL2O3     + H         <=> AL2OH     + O2            2.575E-56  4.921E+00  3.019E+04 !
HPL:10^12 atm
                              plog /   1. 3.679E+28 -4.311E+00  3.850E+04 /
                              plog /  10. 1.599E+29 -4.480E+00  3.883E+04 /
                              plog / 100. 3.683E+22 -2.648E+00  3.753E+04 /

AL2O3     + H         <=> AL2O2     + OH            1.009E+13  2.830E-01  2.959E+02 !
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```
HPL:10^12 atm
                                plog /     1. 3.387E+14 -2.625E-01   5.199E+02 /
                                plog /    10. 4.816E+14 -3.033E-01   6.054E+02 /
                                plog / 100. 9.505E+14 -3.704E-01   7.850E+02 /

AL2O3      + H          <=> ALO         + ALO2H         8.510E-10   1.684E+00   3.140E+03 !
HPL:10^12 atm
                                plog /     1. 1.476E+17 -9.680E-01   5.267E+03 /
                                plog /    10. 1.825E+17 -9.923E-01   5.415E+03 /
                                plog / 100. 5.471E+15 -5.666E-01   5.297E+03 /

AL2O3      + H          <=> ALO2        + ALOH          1.164E-08   1.453E+00   6.754E+03 !
HPL:10^12 atm
                                plog /     1. 1.713E+18 -1.205E+00   8.914E+03 /
                                plog /    10. 3.443E+18 -1.285E+00   9.153E+03 /
                                plog / 100. 8.152E+16 -8.216E-01   8.990E+03 /

AL2O2H     + O          <=> AL2OH       + O2            1.630E-25   1.382E+00   1.372E+04 !
HPL:10^12 atm
                                plog /     1. 8.450E+19 -1.738E+00   2.186E+04 /
                                plog /    10. 1.073E+22 -2.337E+00   2.195E+04 /
                                plog / 100. 9.567E+23 -2.872E+00   2.201E+04 /

AL2O2H     + O          <=> AL2O2       + OH            1.414E-13   2.687E+00  -6.140E+03 !
HPL:10^12 atm
                                plog /     1. 3.319E+14 -2.635E-01   4.646E+02 /
                                plog /    10. 4.193E+14 -2.983E-01   4.498E+02 /
                                plog / 100. 3.183E+15 -5.504E-01   7.274E+02 /

AL2O2H     + O          <=> ALO         + ALO2H         7.219E-39   4.960E+00  -7.747E+03 !
HPL:10^12 atm
                                plog /     1. 1.485E+13   1.004E-01   5.691E+02 /
                                plog /    10. 1.696E+13   7.053E-02   5.482E+02 /
                                plog / 100. 6.343E+12   1.580E-01   5.657E+02 /

AL2O2H     + O          <=> ALO2        + ALOH          9.248E-40   5.280E+00  -6.912E+03 !
HPL:10^12 atm
                                plog /     1. 8.097E+12   2.002E-01   1.600E+03 /
```

plog / 10. 1.169E+13 1.543E-01 1.676E+03 /
plog / 100. 5.785E+12 2.180E-01 1.726E+03 /

AL2OH + O2 <=> AL2O2 + OH 4.454E-64 6.676E+00 -1.074E+04 !
HPL:10^12 atm
plog / 1. 7.056E+17 -1.590E+00 1.014E+03 /
plog / 10. 1.541E+18 -1.720E+00 1.008E+03 /
plog / 100. 9.239E+17 -1.835E+00 1.756E+02 /

AL2OH + O2 <=> ALO + ALO2H 1.634E-88 8.694E+00 -1.268E+04 !
HPL:10^12 atm
plog / 1. 2.196E+17 -1.467E+00 1.086E+03 /
plog / 10. 1.223E+17 -1.441E+00 8.047E+02 /
plog / 100. 1.240E+16 -1.367E+00 -1.345E+02 /

AL2OH + O2 <=> ALO2 + ALOH 1.114E-90 9.362E+00 -1.324E+04 !
HPL:10^12 atm
plog / 1. 1.245E+16 -1.111E+00 7.316E+02 /
plog / 10. 1.866E+16 -1.194E+00 6.943E+02 /
plog / 100. 3.501E+14 -9.006E-01 -5.222E+02 /

AL2O2 + OH <=> ALO + ALO2H 2.487E-06 1.137E+00 5.717E+03 !
HPL:10^12 atm
plog / 1. 3.045E+21 -1.731E+00 8.370E+03 /
plog / 10. 2.326E+21 -1.695E+00 8.415E+03 /
plog / 100. 1.879E+19 -1.111E+00 8.049E+03 /

AL2O2 + OH <=> ALO2 + ALOH 2.201E-05 9.643E-01 9.858E+03 !
HPL:10^12 atm
plog / 1. 8.838E+21 -1.797E+00 1.236E+04 /
plog / 10. 1.206E+22 -1.825E+00 1.254E+04 /
plog / 100. 9.448E+19 -1.229E+00 1.216E+04 /

ALO + ALO2H <=> ALO2 + ALOH 1.693E+17 -8.558E-01 3.480E+03 !
HPL:10^12 atm
plog / 1. 1.489E+20 -1.709E+00 7.445E+03 /
plog / 10. 2.957E+20 -1.786E+00 7.569E+03 /
plog / 100. 2.163E+19 -1.449E+00 6.913E+03 /

AL2O3H + O <=> AL2O4H 1.185E-17 6.153E+00 8.275E+03 !
HPL:10^12 atm
plog / 1. 2.441E+32 -9.757E+00 2.210E+04 /
plog / 10. 1.342E+33 -9.912E+00 2.265E+04 /
plog / 100. 7.014E+31 -9.408E+00 2.264E+04 /

AL2O2H + O2 <=> AL2O4H 4.913E+41 -9.469E+00 6.156E+04 !
HPL:10^12 atm
plog / 1. 1.852E+23 -7.701E+00 1.511E+04 /
plog / 10. 7.692E+18 -6.494E+00 1.385E+04 /
plog / 100. 1.875E+11 -4.425E+00 1.119E+04 /

AL2O3 + OH <=> AL2O4H 6.655E-18 5.595E+00 4.748E+03 !
HPL:10^12 atm
plog / 1. 3.664E+24 -7.805E+00 1.566E+04 /
plog / 10. 2.754E+27 -8.558E+00 1.761E+04 /
plog / 100. 4.032E+26 -8.203E+00 1.790E+04 /

ALO2 + ALO2H <=> AL2O4H 3.169E-143 4.100E+01 -1.263E+04 !
HPL:10^12 atm
plog / 1. 1.899E+25 -7.943E+00 3.376E+04 /
plog / 10. 1.548E+29 -9.095E+00 3.424E+04 /
plog / 100. 3.562E+30 -9.384E+00 3.459E+04 /

ALO3 + ALOH <=> AL2O4H 1.384E-40 1.467E+01 4.574E+04 !
HPL:10^12 atm
plog / 1. 6.491E+27 -7.753E+00 7.079E+04 /
plog / 10. 4.806E+35 -9.654E+00 7.283E+04 /
plog / 100. 7.518E+34 -9.182E+00 7.007E+04 /

AL2O3H + O <=> AL2O2H + O2 1.316E-02 -2.654E-01 1.354E+04 !
HPL:10^12 atm
plog / 1. 5.130E+28 -4.008E+00 1.632E+04 /
plog / 10. 3.628E+28 -3.967E+00 1.640E+04 /
plog / 100. 6.237E+25 -3.202E+00 1.582E+04 /

AL2O3H + O <=> AL2O3 + OH 6.678E+20 -1.789E+00 1.509E+04 !

HPL:10^12 atm

plog / 1. 2.091E+23 -2.685E+00 1.552E+04 /
plog / 10. 6.487E+22 -2.501E+00 1.547E+04 /
plog / 100. 3.536E+22 -2.375E+00 1.552E+04 /

AL2O3H + O <=> ALO2 + ALO2H 8.155E+03 -1.765E+00 2.808E+04 !
HPL:10^12 atm

plog / 1. 4.453E+29 -4.347E+00 3.013E+04 /
plog / 10. 2.023E+29 -4.182E+00 3.034E+04 /
plog / 100. 2.550E+27 -3.627E+00 2.996E+04 /

AL2O3H + O <=> ALO3 + ALOH 3.270E-17 1.062E+00 5.142E+04 !
HPL:10^12 atm

plog / 1. 4.797E+26 -3.507E+00 5.289E+04 /
plog / 10. 1.296E+24 -2.773E+00 5.313E+04 /
plog / 100. 4.852E+19 -1.654E+00 5.284E+04 /

AL2O2H + O2 <=> AL2O3 + OH 4.627E-26 5.502E+00 -2.996E+03 !
HPL:10^12 atm

plog / 1. 4.934E+12 -1.119E-01 3.828E+03 /
plog / 10. 1.690E+07 1.378E+00 1.512E+03 /
plog / 100. 1.687E+02 2.611E+00 -5.811E+02 /

AL2O2H + O2 <=> ALO2 + ALO2H 1.598E-43 5.585E+00 6.616E+03 !
HPL:10^12 atm

plog / 1. 3.896E+17 -1.444E+00 1.508E+04 /
plog / 10. 9.555E+11 7.334E-02 1.271E+04 /
plog / 100. 1.211E+06 1.532E+00 1.051E+04 /

AL2O2H + O2 <=> ALO3 + ALOH 5.179E-61 7.555E+00 2.921E+04 !
HPL:10^12 atm

plog / 1. 1.362E+15 -8.153E-01 3.671E+04 /
plog / 10. 1.030E+07 1.349E+00 3.418E+04 /
plog / 100. 2.515E-01 3.146E+00 3.226E+04 /

AL2O3 + OH <=> ALO2 + ALO2H 4.506E-08 1.365E+00 1.366E+04 !
HPL:10^12 atm

plog / 1. 2.785E+15 -3.532E-01 1.447E+04 /

```
                                plog /    10. 1.097E+16 -4.754E-01    1.498E+04 /
                                plog / 100. 1.491E+15 -2.185E-01    1.506E+04 /

AL2O3       + OH          <=> ALO3        + ALOH          8.166E-25    3.152E+00    3.709E+04 !
HPL:10^12 atm
                                plog /     1. 3.877E+15 -3.810E-01    3.720E+04 /
                                plog /    10. 7.942E+13    7.556E-02    3.766E+04 /
                                plog / 100. 5.651E+10    8.220E-01    3.792E+04 /

ALO2        + ALO2H       <=> ALO3        + ALOH          2.295E-51    5.568E+00    1.646E+04 !
HPL:10^12 atm
                                plog /     1. 3.569E+07    1.609E+00    2.269E+04 /
                                plog /    10. 6.375E+05    2.060E+00    2.298E+04 /
                                plog / 100. 1.057E+04    2.402E+00    2.360E+04 /

!Al1-H2 reactions
ALOH        + H           <=> ALOH2                       6.155E+11    9.988E-01    1.917E+02 !
HPL:10^12 atm
                                plog /     1. 1.821E+23 -3.853E+00    1.465E+03 /
                                plog /    10. 9.422E+23 -3.774E+00    1.817E+03 /
                                plog / 100. 2.534E+24 -3.619E+00    2.298E+03 /

ALO         + H2          <=> ALOH2                       4.840E+06    1.968E+00    1.239E+04 !
HPL:10^12 atm
                                plog /     1. 1.035E-05    2.818E+00    3.715E+04 /
                                plog /    10. 2.784E-07    3.477E+00    3.220E+04 /
                                plog / 100. 1.469E-08    4.048E+00    2.579E+04 /

AL          + H2O         <=> ALOH2                       1.203E+07    2.224E+00    2.379E+03 !
HPL:10^12 atm
                                plog /     1. 4.800E+07    0.000E+00    3.218E+04 /
                                plog /    10. 1.862E+08    0.000E+00    2.749E+04 /
                                plog / 100. 7.347E+08    0.000E+00    2.132E+04 /

ALOH        + H           <=> ALO         + H2            4.227E+08    1.389E+00    1.956E+04 !
HPL:10^12 atm
                                plog /     1. 2.961E+08    1.445E+00    1.954E+04 /
                                plog /    10. 2.961E+08    1.445E+00    1.954E+04 /
```

plog / 100. 2.961E+08 1.445E+00 1.954E+04 /

ALOH + H <=> AL + H2O 3.102E-05 3.654E+00 1.471E+04 !
HPL:10^12 atm
plog / 1. 2.888E+09 1.121E+00 1.614E+04 /
plog / 10. 2.888E+09 1.121E+00 1.614E+04 /
plog / 100. 2.888E+09 1.121E+00 1.614E+04 /

ALO + H2 <=> AL + H2O 2.260E-13 5.337E+00 1.143E+04 !
HPL:10^12 atm
plog / 1. 3.414E+00 2.991E+00 1.259E+04 /
plog / 10. 3.413E+00 2.991E+00 1.259E+04 /
plog / 100. 3.412E+00 2.991E+00 1.259E+04 /

ALO2H + H <=> ALO2H2 3.858E+10 9.952E-01 -1.404E+03 !
HPL:10^12 atm
plog / 1. 1.774E+27 -4.536E+00 2.728E+03 /
plog / 10. 9.194E+23 -3.349E+00 2.229E+03 /
plog / 100. 2.529E+19 -1.840E+00 1.092E+03 /

ALO2 + H2 <=> ALO2H2 7.652E+07 1.649E+00 7.653E+03 !
HPL:10^12 atm
plog / 1. 2.811E+00 1.702E+00 2.357E+04 /
plog / 10. 1.069E+08 -9.731E-02 1.340E+04 /
plog / 100. 1.440E+18 -2.385E+00 1.073E+04 /

ALOH2 + O <=> ALO2H2 8.457E+12 3.122E-01 0.000E+00 !
HPL:10^12 atm
plog / 1. 3.465E-03 2.637E+00 9.416E+04 /
plog / 10. 8.766E-05 3.142E+00 6.228E+04 /
plog / 100. 5.254E-05 3.309E+00 2.491E+04 /

ALOH + OH <=> ALO2H2 7.955E+12 1.130E-01 -4.787E+02 !
HPL:10^12 atm
plog / 1. 8.993E+27 -4.894E+00 3.253E+03 /
plog / 10. 1.036E+25 -3.822E+00 2.815E+03 /
plog / 100. 6.348E+20 -2.428E+00 1.760E+03 /

ALO + H2O <=> ALO2H2 6.364E+02 3.077E+00 9.486E+03 !
HPL:10^12 atm
plog / 1. 8.206E+15 -2.025E+00 1.130E+04 /
plog / 10. 1.176E+19 -2.457E+00 1.325E+04 /
plog / 100. 2.973E+16 -1.335E+00 1.328E+04 /

ALO2H + H <=> ALO2 + H2 5.744E-27 7.237E+00 2.361E+04 !
HPL:10^12 atm
plog / 1. 1.705E+05 2.160E+00 2.690E+04 /
plog / 10. 1.790E+05 2.154E+00 2.692E+04 /
plog / 100. 1.702E+05 2.160E+00 2.692E+04 /

ALO2H + H <=> ALOH2 + O 6.801E-09 2.673E+00 6.671E+04 !
HPL:10^12 atm
plog / 1. 6.869E+12 4.706E-01 6.853E+04 /
plog / 10. 7.236E+12 4.644E-01 6.855E+04 /
plog / 100. 7.301E+12 4.633E-01 6.855E+04 /

ALO2H + H <=> ALOH + OH 5.420E-17 6.383E+00 -1.894E+03 !
HPL:10^12 atm
plog / 1. 5.025E+13 1.186E-01 1.703E+03 /
plog / 10. 8.597E+12 3.790E-01 2.756E+03 /
plog / 100. 4.494E+07 1.861E+00 1.900E+03 /

ALO2H + H <=> ALO + H2O 6.928E-35 9.534E+00 3.093E+03 !
HPL:10^12 atm
plog / 1. 7.220E+04 2.365E+00 6.009E+03 /
plog / 10. 5.136E+05 2.140E+00 6.967E+03 /
plog / 100. 1.563E+05 2.311E+00 7.985E+03 /

ALO2 + H2 <=> ALOH2 + O 3.463E-03 2.555E+00 4.741E+04 !
HPL:10^12 atm
plog / 1. 5.573E+08 1.303E+00 4.840E+04 /
plog / 10. 5.564E+08 1.303E+00 4.840E+04 /
plog / 100. 5.471E+08 1.305E+00 4.840E+04 /

ALO2 + H2 <=> ALOH + OH 2.899E-24 6.635E+00 4.162E+03 !
HPL:10^12 atm

plog / 1. 2.674E+08 1.429E+00 7.794E+03 /
plog / 10. 2.678E+08 1.429E+00 7.794E+03 /
plog / 100. 2.673E+08 1.429E+00 7.798E+03 /

ALO2 + H2 <=> ALO + H2O 6.757E-14 5.408E+00 5.592E+03 !
HPL:10^12 atm
plog / 1. 5.966E+02 2.815E+00 7.146E+03 /
plog / 10. 5.868E+02 2.817E+00 7.149E+03 /
plog / 100. 5.001E+02 2.838E+00 7.187E+03 /

ALOH2 + O <=> ALOH + OH 2.961E-09 2.586E+00 -2.033E+03 !
HPL:10^12 atm
plog / 1. 8.738E+12 2.265E-01 0.000E+00 /
plog / 10. 8.738E+12 2.265E-01 0.000E+00 /
plog / 100. 8.746E+12 2.264E-01 0.000E+00 /

ALOH2 + O <=> ALO + H2O 3.274E-01 1.993E+00 -1.419E+03 !
HPL:10^12 atm
plog / 1. 2.655E+10 7.923E-01 -3.407E+02 /
plog / 10. 2.652E+10 7.924E-01 -3.408E+02 /
plog / 100. 2.633E+10 7.933E-01 -3.415E+02 /

ALOH + OH <=> ALO + H2O 6.655E-35 9.256E+00 2.602E+03 !
HPL:10^12 atm
plog / 1. 6.522E+04 2.113E+00 5.573E+03 /
plog / 10. 4.664E+05 1.887E+00 6.532E+03 /
plog / 100. 1.080E+05 2.091E+00 7.503E+03 /

ALO3 + H2 <=> ALO3H2 2.744E+06 1.910E+00 4.933E+03 !
HPL:10^12 atm
plog / 1. 8.814E+07 -7.876E-01 1.152E+04 /
plog / 10. 7.492E+20 -3.935E+00 8.995E+03 /
plog / 100. 9.932E+24 -4.442E+00 9.510E+03 /

ALO2H2 + O <=> ALO3H2 9.603E+13 -1.177E-01 2.113E+02 !
HPL:10^12 atm
plog / 1. 6.844E+23 -4.542E+00 4.544E+03 /
plog / 10. 1.145E+31 -6.066E+00 4.645E+03 /

plog / 100. 6.304E+30 -5.525E+00 5.075E+03 /

ALOH2 + O2 <=> ALO3H2 3.677E+13 -1.810E-01 -1.854E+02 !
HPL:10^12 atm
plog / 1. 3.830E+19 -3.799E+00 1.431E+04 /
plog / 10. 8.497E+25 -5.192E+00 5.370E+03 /
plog / 100. 6.675E+29 -5.703E+00 4.269E+03 /

ALO2H + OH <=> ALO3H2 8.555E+05 2.430E+00 -3.556E+03 !
HPL:10^12 atm
plog / 1. 6.272E+20 -2.481E+00 0.000E+00 /
plog / 10. 3.611E+18 -1.620E+00 0.000E+00 /
plog / 100. 6.754E+16 -9.381E-01 0.000E+00 /

ALO2 + H2O <=> ALO3H2 9.815E+17 -9.062E-01 9.937E+02 !
HPL:10^12 atm
plog / 1. 4.766E+31 -5.444E+00 4.434E+03 /
plog / 10. 1.509E+28 -4.215E+00 3.771E+03 /
plog / 100. 1.117E+24 -2.865E+00 2.678E+03 /

ALO3 + H2 <=> ALO2H2 + O 6.585E-39 9.893E+00 1.152E+03 !
HPL:10^12 atm
plog / 1. 6.075E-01 3.259E+00 4.331E+03 /
plog / 10. 6.002E-01 3.261E+00 4.362E+03 /
plog / 100. 6.007E-01 3.270E+00 4.790E+03 /

ALO3 + H2 <=> ALOH2 + O2 7.023E-19 6.602E+00 7.188E+03 !
HPL:10^12 atm
plog / 1. 2.329E+01 3.149E+00 8.350E+03 /
plog / 10. 2.962E+01 3.121E+00 8.469E+03 /
plog / 100. 7.546E+01 3.081E+00 9.115E+03 /

ALO3 + H2 <=> ALO2H + OH 2.794E+06 1.894E+00 5.202E+03 !
HPL:10^12 atm
plog / 1. 1.663E+06 1.952E+00 4.845E+03 /
plog / 10. 1.666E+06 1.951E+00 4.845E+03 /
plog / 100. 2.794E+06 1.894E+00 5.202E+03 /

```
ALO3     + H2          <=> ALO2     + H2O              1.409E-32   8.274E+00   1.276E+03 !
HPL:10^12 atm
                              plog /     1. 8.919E+06   1.363E+00   5.187E+03 /
                              plog /    10. 9.071E+06   1.361E+00   5.181E+03 /
                              plog / 100. 1.729E+07   1.288E+00   5.514E+03 /

ALO2H2 + O           <=> ALOH2    + O2               2.932E-31   7.713E+00   2.290E+04 !
HPL:10^12 atm
                              plog /     1. 1.540E+11   0.000E+00   2.790E+04 /
                              plog /    10. 1.545E+11   0.000E+00   2.793E+04 /
                              plog / 100. 1.635E+11   0.000E+00   2.828E+04 /

ALO2H2 + O           <=> ALO2H    + OH               3.700E-12   4.941E+00  -2.920E+03 !
HPL:10^12 atm
                              plog /     1. 3.561E+13   0.000E+00   2.100E+02 /
                              plog /    10. 3.561E+13   0.000E+00   2.100E+02 /
                              plog / 100. 4.025E+13   0.000E+00   1.095E+03 /

ALO2H2 + O           <=> ALO2     + H2O              2.060E-10   4.085E+00  -2.516E+03 !
HPL:10^12 atm
                              plog /     1. 2.851E+16  -1.164E+00   1.105E+03 /
                              plog /    10. 3.797E+16  -1.197E+00   1.239E+03 /
                              plog / 100. 9.517E+15  -1.003E+00   1.891E+03 /

ALOH2    + O2        <=> ALO2H    + OH               4.671E-27   6.933E+00  -5.017E+03 !
HPL:10^12 atm
                              plog /     1. 1.020E+14  -3.219E-01   0.000E+00 /
                              plog /    10. 1.016E+14  -3.215E-01   0.000E+00 /
                              plog / 100. 4.322E+13  -2.164E-01   0.000E+00 /

ALOH2    + O2        <=> ALO2     + H2O              2.933E-25   6.059E+00  -4.276E+03 !
HPL:10^12 atm
                              plog /     1. 4.873E+13  -6.011E-01   0.000E+00 /
                              plog /    10. 5.035E+13  -6.051E-01   0.000E+00 /
                              plog / 100. 2.816E+13  -5.323E-01   0.000E+00 /

ALO2H    + OH        <=> ALO2     + H2O              4.381E-16   6.076E+00   4.251E+03 !
HPL:10^12 atm
```

plog / 1. 5.072E+18 -1.267E+00 9.706E+03 /
plog / 10. 2.101E+16 -5.570E-01 1.023E+04 /
plog / 100. 4.188E+10 1.071E+00 9.341E+03 /

!Al2-H2 reactions
AL2OH + H <=> AL2OH2 6.082E+13 0.000E+00 2.103E+02 !
HPL:10^12 atm
plog / 1. 8.936E+28 -5.150E+00 3.711E+03 /
plog / 10. 3.491E+26 -4.180E+00 3.566E+03 /
plog / 100. 2.516E+22 -2.780E+00 2.620E+03 /

AL2O + H2 <=> AL2OH2 4.700E+07 1.730E+00 4.464E+04 !
HPL:10^12 atm
plog / 1. 6.326E+10 0.000E+00 4.449E+04 /
plog / 10. 2.781E+11 0.000E+00 4.459E+04 /
plog / 100. 1.104E+12 0.000E+00 4.493E+04 /

AL + ALOH2 <=> AL2OH2 1.392E+14 0.000E+00 0.000E+00 !
HPL:10^12 atm
plog / 1. 5.316E+11 -1.133E+00 1.170E+04 /
plog / 10. 1.724E+16 -2.071E+00 3.073E+03 /
plog / 100. 1.506E+21 -2.952E+00 2.010E+03 /

AL2OH + H <=> AL2O + H2 1.779E-15 5.730E+00 -2.022E+03 !
HPL:10^12 atm
plog / 1. 6.144E+15 -6.583E-01 1.605E+03 /
plog / 10. 3.468E+14 -2.824E-01 2.383E+03 /
plog / 100. 1.268E+10 9.786E-01 1.941E+03 /

AL2OH + H <=> AL + ALOH2 1.292E-39 9.485E+00 1.499E+04 !
HPL:10^12 atm
plog / 1. 2.539E+13 -1.645E-01 2.114E+04 /
plog / 10. 2.520E+13 -1.636E-01 2.114E+04 /
plog / 100. 2.053E+13 -1.361E-01 2.123E+04 /
duplicate

AL2O + H2 <=> AL + ALOH2 2.784E-03 3.466E+00 8.902E+04 !
HPL:10^12 atm

plog / 1. 1.306E+17 -6.176E-01 9.257E+04 /
plog / 10. 1.307E+17 -6.177E-01 9.257E+04 /
plog / 100. 1.264E+17 -6.137E-01 9.257E+04 /

AL2OH + H <=> AL2OH2(3) 5.202E+13 2.048E-01 3.254E+02 !
HPL:10^12 atm
plog / 1. 5.760E+34 -7.013E+00 4.889E+03 /
plog / 10. 8.506E+33 -6.490E+00 5.360E+03 /
plog / 100. 2.927E+31 -5.515E+00 5.253E+03 /

AL2 + H2O <=> AL2OH2(3) 4.963E+02 3.272E+00 5.872E+02 !
HPL:10^12 atm
plog / 1. 1.436E+11 -1.577E+00 1.841E+04 /
plog / 10. 4.963E+11 -1.439E+00 8.713E+03 /
plog / 100. 1.187E+22 -3.873E+00 6.298E+03 /

AL + ALOH2 <=> AL2OH2(3) 3.533E+15 -2.547E-01 6.777E+02 !
HPL:10^12 atm
plog / 1. 1.404E+36 -7.709E+00 4.577E+03 /
plog / 10. 1.206E+36 -7.356E+00 4.922E+03 /
plog / 100. 2.516E+33 -6.293E+00 4.682E+03 /

AL2OH + H <=> AL2 + H2O 1.901E-55 1.404E+01 2.604E+04 !
HPL:10^12 atm
plog / 1. 2.980E+09 1.173E+00 3.691E+04 /
plog / 10. 2.964E+09 1.174E+00 3.691E+04 /
plog / 100. 2.794E+09 1.181E+00 3.691E+04 /

AL2OH + H <=> AL + ALOH2 6.624E-62 1.659E+01 1.141E+04 !
HPL:10^12 atm
plog / 1. 9.189E+16 -9.335E-01 2.149E+04 /
plog / 10. 7.287E+17 -1.169E+00 2.255E+04 /
plog / 100. 4.128E+17 -1.074E+00 2.361E+04 /
duplicate

AL2 + H2O <=> AL + ALOH2 2.111E-72 1.961E+01 -1.184E+04 !
HPL:10^12 atm
plog / 1. 1.250E+05 2.318E+00 1.121E+03 /

plog / 10. 1.272E+05 2.316E+00 1.123E+03 /
plog / 100. 1.504E+05 2.296E+00 1.147E+03 /

AL2O2H + H <=> AL2O2H2 1.481E+13 2.248E-01 0.000E+00 !
HPL:10^12 atm
plog / 1. 5.413E+33 -6.683E+00 4.964E+03 /
plog / 10. 7.569E+31 -5.775E+00 5.317E+03 /
plog / 100. 9.343E+23 -3.243E+00 3.086E+03 /

AL2O2 + H2 <=> AL2O2H2 1.016E+09 2.433E+00 3.224E+04 !
HPL:10^12 atm
plog / 1. 1.847E+33 -5.542E+00 3.851E+04 /
plog / 10. 2.563E+29 -4.180E+00 3.782E+04 /
plog / 100. 1.801E+28 -3.635E+00 3.805E+04 /

AL2OH + OH <=> AL2O2H2 1.132E+15 -7.361E-01 6.518E+02 !
HPL:10^12 atm
plog / 1. 6.732E-01 1.435E+00 3.734E+04 /
plog / 10. 2.336E+02 9.332E-01 1.370E+04 /
plog / 100. 2.148E+17 -2.729E+00 3.688E+03 /

AL2O + H2O <=> AL2O2H2 2.869E+03 2.762E+00 5.104E+03 !
HPL:10^12 atm
plog / 1. 3.547E-03 3.248E+00 0.000E+00 /
plog / 10. 7.160E-04 3.656E+00 0.000E+00 /
plog / 100. 3.155E-04 3.978E+00 0.000E+00 /

AL + ALO2H2 <=> AL2O2H2 1.383E+16 -6.711E-01 8.848E+02 !
HPL:10^12 atm
plog / 1. 1.220E+14 -2.262E+00 7.060E+03 /
plog / 10. 4.507E+23 -4.443E+00 3.397E+03 /
plog / 100. 1.124E+27 -4.809E+00 4.113E+03 /

ALO + ALOH2 <=> AL2O2H2 1.924E+12 1.850E-01 0.000E+00 !
HPL:10^12 atm
plog / 1. 3.499E-01 1.608E+00 4.516E+04 /
plog / 10. 2.044E+00 1.564E+00 1.870E+04 /
plog / 100. 2.087E+12 -1.312E+00 3.830E+03 /

```
ALOH        + ALOH        <=> AL2O2H2                 9.641E+09   8.496E-01  -1.676E+03 !
HPL:10^12 atm
                                plog /     1. 5.508E+08 -2.218E-01 -4.954E+03 /
                                plog /    10. 2.254E+11 -7.343E-01 -4.014E+03 /
                                plog / 100. 1.874E+14 -1.351E+00 -2.775E+03 /

AL2O2H      + H           <=> AL2O2       + H2          3.156E-43   1.178E+01  -3.668E+03 !
HPL:10^12 atm
                                plog /     1. 1.269E+18 -1.387E+00  3.873E+03 /
                                plog /    10. 1.082E+17 -1.056E+00  4.926E+03 /
                                plog / 100. 3.186E+12  2.539E-01  5.372E+03 /

AL2O2H      + H           <=> AL2OH       + OH          1.445E+05   0.000E+00   4.619E+04 !
HPL:10^12 atm
                                plog /     1. 1.400E+20 -2.103E+00  4.754E+04 /
                                plog /    10. 1.398E+20 -2.103E+00  4.754E+04 /
                                plog / 100. 1.373E+20 -2.101E+00  4.754E+04 /

AL2O2H      + H           <=> AL2O        + H2O         7.844E-42   1.187E+01  -6.905E+03 !
HPL:10^12 atm
                                plog /     1. 1.367E+14 -3.434E-01  1.544E+03 /
                                plog /    10. 5.849E+12  6.762E-02  2.292E+03 /
                                plog / 100. 1.126E+10  8.488E-01  2.536E+03 /

AL2O2H      + H           <=> AL          + ALO2H2      5.874E-40   1.101E-01   1.360E+04 !
HPL:10^12 atm
                                plog /     1. 1.487E+12  0.000E+00  2.293E+04 /
                                plog /    10. 1.500E+12  0.000E+00  2.297E+04 /
                                plog / 100. 1.670E+12  0.000E+00  2.320E+04 /

AL2O2H      + H           <=> ALO         + ALOH2       2.101E+05   0.000E+00   5.007E+04 !
HPL:10^12 atm
                                plog /     1. 6.004E+18 -1.677E+00  5.097E+04 /
                                plog /    10. 6.004E+18 -1.677E+00  5.097E+04 /
                                plog / 100. 5.986E+18 -1.677E+00  5.097E+04 /

AL2O2H      + H           <=> ALOH        + ALOH        2.675E-29   8.578E+00  -3.382E+03 !
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HPL:10^12 atm
                                plog /     1. 2.291E+15 -4.574E-01   1.612E+03 /
                                plog /    10. 8.775E+13 -3.276E-02   2.340E+03 /
                                plog / 100. 1.525E+11   7.606E-01   2.565E+03 /

AL2O2      + H2          <=> AL2OH      + OH           1.282E-35   1.046E+01   7.351E+04 !
HPL:10^12 atm
                                plog /     1. 2.755E+20 -1.559E+00   8.549E+04 /
                                plog /    10. 2.774E+20 -1.560E+00   8.550E+04 /
                                plog / 100. 2.973E+20 -1.568E+00   8.550E+04 /

AL2O2      + H2          <=> AL2O       + H2O          6.289E-95   2.632E+01   1.562E+04 !
HPL:10^12 atm
                                plog /     1. 2.467E+15   0.000E+00   3.566E+04 /
                                plog /    10. 3.221E+15   0.000E+00   3.764E+04 /
                                plog / 100. 3.505E+15   0.000E+00   4.043E+04 /

AL2O2      + H2          <=> AL         + ALO2H2       1.852E-83   2.251E+01   4.029E+04 !
HPL:10^12 atm
                                plog /     1. 2.484E+14   0.000E+00   6.086E+04 /
                                plog /    10. 2.485E+14   0.000E+00   6.085E+04 /
                                plog / 100. 2.800E+14   0.000E+00   6.136E+04 /

AL2O2      + H2          <=> ALO        + ALOH2        9.852E-35   1.025E+01   7.759E+04 !
HPL:10^12 atm
                                plog /     1. 1.356E+15   0.000E+00   8.721E+04 /
                                plog /    10. 1.356E+15   0.000E+00   8.721E+04 /
                                plog / 100. 1.354E+15   0.000E+00   8.720E+04 /

AL2O2      + H2          <=> ALOH       + ALOH         1.284E-76   2.115E+01   2.085E+04 !
HPL:10^12 atm
                                plog /     1. 1.721E+16   0.000E+00   3.557E+04 /
                                plog /    10. 2.232E+16   0.000E+00   3.755E+04 /
                                plog / 100. 2.396E+16   0.000E+00   4.032E+04 /

AL2OH      + OH           <=> AL2O       + H2O          4.644E-23   6.200E+00  -4.929E+03 !
HPL:10^12 atm
                                plog /     1. 5.974E+14 -9.788E-01   9.728E+02 /
```

plog / 10. 5.976E+14 -9.788E-01 9.729E+02 /
plog / 100. 6.006E+14 -9.794E-01 9.733E+02 /

AL2OH + OH <=> AL + ALO2H2 6.973E-29 7.056E+00 -4.415E+03 !
HPL:10^12 atm
plog / 1. 1.403E+06 1.022E+00 0.000E+00 /
plog / 10. 1.373E+06 1.025E+00 0.000E+00 /
plog / 100. 1.103E+06 1.052E+00 0.000E+00 /

AL2OH + OH <=> ALO + ALOH2 2.392E-12 3.734E+00 4.583E+03 !
HPL:10^12 atm
plog / 1. 1.448E+00 2.533E+00 3.983E+03 /
plog / 10. 1.474E+00 2.531E+00 3.995E+03 /
plog / 100. 1.707E+00 2.515E+00 4.104E+03 /

AL2OH + OH <=> ALOH + ALOH 4.279E-12 3.351E+00 -2.651E+03 !
HPL:10^12 atm
plog / 1. 4.644E+15 -1.002E+00 9.846E+02 /
plog / 10. 1.081E+15 -8.264E-01 7.166E+02 /
plog / 100. 1.091E+15 -8.274E-01 7.172E+02 /

AL2O + H2O <=> AL + ALO2H2 1.926E-30 1.143E+01 4.984E+04 !
HPL:10^12 atm
plog / 1. 2.971E+13 0.000E+00 6.166E+04 /
plog / 10. 2.971E+13 0.000E+00 6.166E+04 /
plog / 100. 2.974E+13 0.000E+00 6.167E+04 /

AL2O + H2O <=> ALO + ALOH2 4.183E-40 1.194E+01 7.727E+04 !
HPL:10^12 atm
plog / 1. 1.605E+13 0.000E+00 8.870E+04 /
plog / 10. 1.605E+13 0.000E+00 8.870E+04 /
plog / 100. 1.604E+13 0.000E+00 8.870E+04 /

AL2O + H2O <=> ALOH + ALOH 2.396E-56 1.777E+01 -9.974E+02 !
HPL:10^12 atm
plog / 1. 7.417E+03 2.621E+00 5.290E+03 /
plog / 10. 1.371E+04 2.547E+00 5.488E+03 /
plog / 100. 7.735E+04 2.339E+00 6.064E+03 /

```
AL          + ALO2H2      <=> ALO         + ALOH2        1.108E-36   1.011E+01   2.028E+04 !
HPL:10^12 atm
                                plog /     1. 1.299E+11   0.000E+00   2.877E+04 /
                                plog /    10. 1.299E+11   0.000E+00   2.878E+04 /
                                plog / 100. 1.298E+11   0.000E+00   2.880E+04 /

AL          + ALO2H2      <=> ALOH        + ALOH         9.722E-45   1.450E+01  -1.409E+04 !
HPL:10^12 atm
                                plog /     1. 2.177E+15  -4.903E-01   5.089E+02 /
                                plog /    10. 2.179E+15  -4.904E-01   5.090E+02 /
                                plog / 100. 2.090E+15  -4.841E-01   5.115E+02 /

ALO         + ALOH2       <=> ALOH        + ALOH         3.105E-12   3.542E+00  -2.471E+03 !
HPL:10^12 atm
                                plog /     1. 1.358E+12   1.319E-01   0.000E+00 /
                                plog /    10. 1.351E+12   1.324E-01   0.000E+00 /
                                plog / 100. 1.364E+12   1.314E-01   0.000E+00 /

!Al1-H3 reactions
ALO2H2  + H         <=> ALO2H3                         1.637E+13   2.710E-01   0.000E+00 !
HPL:10^12 atm
                                plog /     1. 1.943E+29  -5.635E+00   3.497E+03 /
                                plog /    10. 1.541E+30  -5.426E+00   4.188E+03 /
                                plog / 100. 7.556E+25  -3.841E+00   3.465E+03 /

ALO2H   + H2        <=> ALO2H3                         2.601E+06   2.707E+00   5.850E+03 !
HPL:10^12 atm
                                plog /     1. 1.350E+26  -4.170E+00   1.117E+04 /
                                plog /    10. 1.318E+21  -2.553E+00   1.032E+04 /
                                plog / 100. 7.974E+15  -9.041E-01   8.764E+03 /

ALOH2   + OH        <=> ALO2H3                         1.097E+14  -1.806E-01   3.619E+02 !
HPL:10^12 atm
                                plog /     1. 1.712E+01   1.252E+00   5.278E+04 /
                                plog /    10. 5.365E+01   1.251E+00   2.602E+04 /
                                plog / 100. 8.782E+10  -9.494E-01   6.579E+03 /
```

ALOH + H2O <=> ALO2H3 3.985E+02 3.061E+00 2.350E+04 !
HPL:10^12 atm
plog / 1. 6.269E+24 -4.043E+00 2.982E+04 /
plog / 10. 6.398E+19 -2.374E+00 2.865E+04 /
plog / 100. 9.007E+13 -5.043E-01 2.697E+04 /

ALO2H2 + H <=> ALO2H + H2 4.348E-14 5.468E+00 -2.906E+03 !
HPL:10^12 atm
plog / 1. 1.127E+15 -4.381E-01 4.829E+02 /
plog / 10. 1.769E+15 -4.775E-01 1.248E+03 /
plog / 100. 1.630E+12 3.964E-01 1.289E+03 /

ALO2H2 + H <=> ALOH2 + OH 2.151E-01 2.053E+00 4.302E+04 !
HPL:10^12 atm
plog / 1. 7.009E+16 -9.286E-01 4.543E+04 /
plog / 10. 6.998E+16 -9.284E-01 4.543E+04 /
plog / 100. 6.882E+16 -9.263E-01 4.543E+04 /

ALO2H2 + H <=> ALOH + H2O 2.346E-15 6.095E+00 2.431E+04 !
HPL:10^12 atm
plog / 1. 1.299E+13 2.327E-01 3.083E+02 /
plog / 10. 2.373E+13 1.757E-01 1.137E+03 /
plog / 100. 4.105E+10 9.736E-01 1.299E+03 /

ALO2H + H2 <=> ALOH2 + OH 5.014E-01 2.123E+00 7.036E+04 !
HPL:10^12 atm
plog / 1. 4.635E+16 -7.049E-01 7.275E+04 /
plog / 10. 4.641E+16 -7.051E-01 7.275E+04 /
plog / 100. 4.709E+16 -7.068E-01 7.275E+04 /

ALO2H + H2 <=> ALOH + H2O 9.673E-26 8.849E+00 8.994E+03 !
HPL:10^12 atm
plog / 1. 1.085E+11 8.610E-01 1.489E+04 /
plog / 10. 1.160E+07 2.000E+00 1.469E+04 /
plog / 100. 4.769E+00 3.802E+00 1.343E+04 /

ALOH2 + OH <=> ALOH + H2O 3.632E-04 2.729E+00 -1.989E+03 !
HPL:10^12 atm

plog / 1. 8.098E+13 -2.217E-01 3.884E+02 /
plog / 10. 8.100E+13 -2.217E-01 3.884E+02 /
plog / 100. 8.124E+13 -2.221E-01 3.886E+02 /

!Al4 reactions

AL2O2 + AL2O4H <=> AL4O6 + H 6.390E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O2 + AL2O4H <=> AL4O6(3) + H 6.390E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O2(3) + AL2O4H <=> AL4O6 + H 6.390E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O2(3) + AL2O4H <=> AL4O6(3) + H 6.390E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3(1) + AL2O3H <=> AL4O6 + H 6.676E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3(1) + AL2O3H <=> AL4O6(3) + H 6.676E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3 + AL2O3H <=> AL4O6 + H 6.495E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3 + AL2O3H <=> AL4O6(3) + H 6.495E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O4(1) + AL2O2H <=> AL4O6 + H 6.848E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O4(1) + AL2O2H <=> AL4O6(3) + H 6.848E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O4 + AL2O2H <=> AL4O6 + H 6.679E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O4 + AL2O2H <=> AL4O6(3) + H 6.679E+12 5.000E-01 0.000E+00 ! by collision rate

AL2O3(1) + AL2O4H <=> AL4O6 + OH 6.399E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3(1) + AL2O4H <=> AL4O6(3) + OH 6.399E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3 + AL2O4H <=> AL4O6 + OH 6.225E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3 + AL2O4H <=> AL4O6(3) + OH 6.225E+12 5.000E-01 0.000E+00 ! by

collision rate
AL2O4(1) + AL2O3H <=> AL4O6 + OH 6.483E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O4(1) + AL2O3H <=> AL4O6(3) + OH 6.483E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O4 + AL2O3H <=> AL4O6 + OH 6.322E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O4 + AL2O3H <=> AL4O6(3) + OH 6.322E+12 5.000E-01 0.000E+00 ! by collision rate

AL2O4(1) + AL2O2H2 <=> AL4O6 + H2 1.374E+13 5.000E-01 0.000E+00 ! by collision rate
AL2O4 + AL2O2H2 <=> AL4O6(3) + H2 1.340E+13 5.000E-01 0.000E+00 ! by collision rate

AL2O2H + AL2O4H <=> AL4O6 + H2 6.592E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O2H + AL2O4H <=> AL4O6(3) + H2 6.592E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3H + AL2O3H <=> AL4O6 + H2 3.254E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3H + AL2O3H <=> AL4O6(3) + H2 3.254E+12 5.000E-01 0.000E+00 ! by collision rate

AL2O3H + AL2O4H <=> AL4O6 + H2O 6.238E+12 5.000E-01 0.000E+00 ! by collision rate
AL2O3H + AL2O4H <=> AL4O6(3) + H2O 6.238E+12 5.000E-01 0.000E+00 ! by collision rate

AL2O4H + AL2O2H2 <=> AL4O6 + H2 + H 1.350E+13 5.000E-01 0.000E+00 ! by collision rate
END