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        NASA-GLENN CHEMICAL EQUILIBRIUM PROGRAM CEA2, FEBRUARY 5, 2004
                    BY  BONNIE MCBRIDE AND SANFORD GORDON
         REFS: NASA RP-1311, PART I, 1994 AND NASA RP-1311, PART II, 1996

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### CEA analysis performed on Sat 09-Nov-2024 01:27:28

# Problem Type: "Rocket" (Infinite Area Combustor)

prob case=_____1032 ro equilibrium

# Pressure (10 values):
p,atm= 9.869, 19.738, 29.607, 39.476, 49.345, 59.214, 69.083, 78.952, 88.821, 98
.69
# Chamber/Exit Pressure Ratio (1 value):
pi/p= 99

# Oxidizer/Fuel Wt. ratio (1 value):
o/f= 3.0

# You selected the following fuels and oxidizers:
reac
fuel AL                wt%= 11.0000
fuel C2H5OH            wt%= 12.2000
fuel C3H8O,2propanol   wt%=  4.1000
fuel HNCO              wt%=  2.7000
fuel NH4CLO4(I)        wt%= 70.0000
oxid NH4CLO4(I)        wt%=100.0000

# You selected these options for output:
# short version of output
output short
# Proportions of any products will be expressed as Mass Fractions.
output massf
# Heat will be expressed as siunits
output siunits

# Input prepared by this script:/var/www/sites/cearun.grc.nasa.gov/cgi-bin/CEARU
N/prepareInputFile.cgi

### IMPORTANT:  The following line is the end of your CEA input file!
end

             THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

          COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin =   145.0 PSIA
CASE = _____1032 ro equilibrium

            REACTANT                    WT FRACTION      ENERGY      TEMP
                                         (SEE NOTE)     KJ/KG-MOL      K
FUEL        AL                           0.1100000         0.000      0.000
FUEL        C2H5OH                       0.1220000         0.000      0.000
FUEL        C3H8O,2propanol              0.0410000         0.000      0.000
FUEL        HNCO                         0.0270000         0.000      0.000
FUEL        NH4CLO4(I)                   0.7000000         0.000      0.000
OXIDANT     NH4CLO4(I)                   1.0000000         0.000      0.000
```

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7280	99.000
P, BAR	9.9998	5.7869	0.10101
T, K	3162.02	3006.00	1931.36
RHO, KG/CU M	1.0180 0	6.2713-1	1.8025-2
H, KJ/KG	0.00000	-520.82	-3494.36
U, KJ/KG	-982.31	-1443.59	-4054.73
G, KJ/KG	-32621.1	-31532.3	-23419.3
S, KJ/(KG)(K)	10.3165	10.3165	10.3165
M, (1/n)	26.764	27.085	28.657
MW, MOL WT	26.420	26.726	28.244
(dLV/dLP)t	-1.02873	-1.02383	-1.00195
(dLV/dLT)p	1.5544	1.4844	1.0548
Cp, KJ/(KG)(K)	5.2352	4.9031	2.0909
GAMMAs	1.1295	1.1288	1.1798
SON VEL,M/SEC	1053.3	1020.6	813.1
MACH NUMBER	0.000	1.000	3.251

PERFORMANCE PARAMETERS

Ae/At	1.0000	13.432
CSTAR, M/SEC	1562.3	1562.3
CF	0.6533	1.6921
Ivac, M/SEC	1924.7	2855.6
Isp, M/SEC	1020.6	2643.6

MASS FRACTIONS

ALCL	0.00020	0.00010	0.00000
ALCL2	0.00006	0.00003	0.00000
ALCL3	0.00009	0.00006	0.00000
*ALO	0.00005	0.00002	0.00000
ALOCL	0.00069	0.00041	0.00000
ALOCL2	0.00001	0.00001	0.00000
ALOH	0.00028	0.00013	0.00000
ALOHCL	0.00017	0.00008	0.00000
ALOHCL2	0.00098	0.00065	0.00001
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00009	0.00004	0.00000
AL(OH)2CL	0.00066	0.00042	0.00000
AL(OH)3	0.00040	0.00025	0.00000
*CO	0.01850	0.01522	0.00031
*CO2	0.05863	0.06379	0.08721
*CL	0.07281	0.06925	0.02562
CLO	0.00105	0.00081	0.00007
CL2	0.00052	0.00046	0.00034
*H	0.00045	0.00034	0.00000
HALO2	0.00003	0.00002	0.00000
HCL	0.20922	0.21373	0.26028
HOCL	0.00023	0.00017	0.00002
HO2	0.00017	0.00012	0.00000
*H2	0.00170	0.00138	0.00004
H2O	0.23625	0.24307	0.26669
H2O2	0.00001	0.00001	0.00000
*NO	0.01846	0.01568	0.00226
NOCL	0.00001	0.00000	0.00000
NO2	0.00004	0.00003	0.00000
*N2	0.10384	0.10514	0.11142
*O	0.01340	0.01065	0.00028
*OH	0.04804	0.04085	0.00338
*O2	0.16331	0.16646	0.19009
AL2O3(a)	0.00000	0.00000	0.05195

AL2O3(L) 0.04962 0.05062 0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 290.1 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000
FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7304	99.000
P, BAR	20.000	11.558	0.20202
T, K	3233.54	3066.37	1927.94
RHO, KG/CU M	2.0055 0	1.2359 0	3.6162-2
H, KJ/KG	0.00000	-529.63	-3520.56
U, KJ/KG	-997.23	-1464.75	-4079.20
G, KJ/KG	-32665.2	-31506.0	-22996.6
S, KJ/(KG)(K)	10.1020	10.1020	10.1020
M, (1/n)	26.960	27.264	28.695
MW, MOL WT	26.615	26.903	28.281
(dLV/dLP)t	-1.02597	-1.02130	-1.00162
(dLV/dLT)p	1.4874	1.4226	1.0447
Cp, KJ/(KG)(K)	4.7574	4.4566	1.9989
GAMMAs	1.1331	1.1327	1.1856
SON VEL,M/SEC	1063.0	1029.2	813.8
MACH NUMBER	0.000	1.000	3.260

PERFORMANCE PARAMETERS

Ae/At	1.0000	13.256
CSTAR, M/SEC	1572.2	1572.2
CF	0.6546	1.6877
Ivac, M/SEC	1937.8	2864.0
Isp, M/SEC	1029.2	2653.5

MASS FRACTIONS

ALCL	0.00017	0.00008	0.00000
ALCL2	0.00007	0.00004	0.00000
ALCL3	0.00014	0.00010	0.00000
*ALO	0.00004	0.00001	0.00000
ALOCL	0.00070	0.00041	0.00000
ALOCL2	0.00002	0.00001	0.00000
ALOH	0.00024	0.00011	0.00000
ALOHCL	0.00021	0.00010	0.00000
ALOHCL2	0.00155	0.00103	0.00001
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00011	0.00005	0.00000
AL(OH)2CL	0.00106	0.00067	0.00000

AL(OH)3	0.00063	0.00039	0.00000
*CO	0.01705	0.01378	0.00021
*CO2	0.06091	0.06604	0.08737
*CL	0.06748	0.06398	0.02168
CLO	0.00136	0.00104	0.00009
CL2	0.00072	0.00064	0.00050
*H	0.00036	0.00027	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.21363	0.21838	0.26415
HNO	0.00001	0.00000	0.00000
HOCL	0.00033	0.00026	0.00003
HO2	0.00023	0.00016	0.00000
*H2	0.00150	0.00119	0.00003
H2O	0.23846	0.24500	0.26616
H2O2	0.00002	0.00001	0.00000
*NO	0.01983	0.01679	0.00224
NOCL	0.00001	0.00001	0.00000
NO2	0.00006	0.00004	0.00000
*N2	0.10319	0.10462	0.11143
*O	0.01170	0.00919	0.00019
*OH	0.04629	0.03905	0.00279
*O2	0.16285	0.16630	0.19115
AL2O3(a)	0.00000	0.00000	0.05195
AL2O3(L)	0.04899	0.05023	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 435.1 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000
FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7318	99.000
P, BAR	29.999	17.322	0.30302
T, K	3274.66	3100.73	1925.62
RHO, KG/CU M	2.9833 0	1.8389 0	5.4346-2
H, KJ/KG	0.00000	-534.59	-3534.69
U, KJ/KG	-1005.58	-1476.59	-4092.27
G, KJ/KG	-32671.9	-31471.2	-22747.0
S, KJ/(KG)(K)	9.9772	9.9772	9.9772
M, (1/n)	27.076	27.368	28.714
MW, MOL WT	26.732	27.007	28.300
(dLV/dLP)t	-1.02443	-1.01990	-1.00147
(dLV/dLT)p	1.4502	1.3886	1.0397
Cp, KJ/(KG)(K)	4.5017	4.2188	1.9542
GAMMAs	1.1351	1.1350	1.1887
SON VEL,M/SEC	1068.4	1034.0	814.1
MACH NUMBER	0.000	1.000	3.266

PERFORMANCE PARAMETERS

Ae/At	1.0000	13.159
CSTAR, M/SEC	1577.7	1577.7
CF	0.6554	1.6852
Ivac, M/SEC	1945.0	2868.5
Isp, M/SEC	1034.0	2658.8

MASS FRACTIONS

ALCL	0.00016	0.00007	0.00000
ALCL2	0.00008	0.00004	0.00000
ALCL3	0.00019	0.00013	0.00000
*ALO	0.00003	0.00001	0.00000
ALOCL	0.00069	0.00040	0.00000
ALOCL2	0.00002	0.00001	0.00000
ALOH	0.00022	0.00010	0.00000
ALOHCL	0.00024	0.00011	0.00000
ALOHCL2	0.00201	0.00134	0.00001
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00013	0.00006	0.00000
AL(OH)2CL	0.00139	0.00087	0.00000
AL(OH)3	0.00083	0.00051	0.00000
*CO	0.01614	0.01291	0.00017
*CO2	0.06233	0.06741	0.08743
*CL	0.06433	0.06088	0.01961
CLO	0.00157	0.00121	0.00010
CL2	0.00088	0.00078	0.00063
*H	0.00032	0.00023	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.21604	0.22096	0.26613
HNO	0.00001	0.00000	0.00000
HNO2	0.00001	0.00000	0.00000
HOCL	0.00041	0.00032	0.00004
HO2	0.00027	0.00018	0.00000
*H2	0.00138	0.00109	0.00002
H2O	0.23975	0.24610	0.26588
H2O2	0.00002	0.00001	0.00000
*NO	0.02064	0.01744	0.00223
NOCL	0.00002	0.00001	0.00000
NO2	0.00007	0.00005	0.00000
*N2	0.10280	0.10431	0.11143
*O	0.01074	0.00837	0.00016
*OH	0.04512	0.03787	0.00249
*O2	0.16262	0.16626	0.19169
AL2O3(a)	0.00000	0.00000	0.05195
AL2O3(L)	0.04848	0.04991	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 580.1 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000

FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7328	99.000
P, BAR	39.999	23.083	0.40403
T, K	3303.40	3124.60	1923.89
RHO, KG/CU M	3.9552 0	2.4383 0	7.2558-2
H, KJ/KG	0.00000	-538.01	-3544.16
U, KJ/KG	-1011.31	-1484.72	-4101.00
G, KJ/KG	-32667.3	-31437.2	-22569.5
S, KJ/(KG)(K)	9.8890	9.8890	9.8890
M, (1/n)	27.159	27.442	28.727
MW, MOL WT	26.816	27.080	28.312
(dLV/dLP)t	-1.02339	-1.01896	-1.00137
(dLV/dLT)p	1.4247	1.3655	1.0367
Cp, KJ/(KG)(K)	4.3306	4.0603	1.9259
GAMMAs	1.1365	1.1366	1.1907
SON VEL,M/SEC	1072.1	1037.3	814.3
MACH NUMBER	0.000	1.000	3.270

PERFORMANCE PARAMETERS

Ae/At	1.0000	13.093
CSTAR, M/SEC	1581.5	1581.5
CF	0.6559	1.6835
Ivac, M/SEC	1950.0	2871.5
Isp, M/SEC	1037.3	2662.4

MASS FRACTIONS

ALCL	0.00014	0.00006	0.00000
ALCL2	0.00009	0.00004	0.00000
ALCL3	0.00022	0.00016	0.00000
*ALO	0.00003	0.00001	0.00000
ALOCL	0.00068	0.00039	0.00000
ALOCL2	0.00002	0.00001	0.00000
ALOH	0.00020	0.00009	0.00000
ALOHCL	0.00025	0.00012	0.00000
ALOHCL2	0.00242	0.00161	0.00002
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00014	0.00006	0.00000
AL(OH)2CL	0.00169	0.00105	0.00000
AL(OH)3	0.00100	0.00062	0.00000
*CO	0.01548	0.01228	0.00014
*CO2	0.06337	0.06839	0.08747
*CL	0.06208	0.05869	0.01825
CLO	0.00173	0.00133	0.00011
CL2	0.00101	0.00090	0.00074
*H	0.00029	0.00021	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.21764	0.22271	0.26741
HNO	0.00001	0.00001	0.00000
HNO2	0.00001	0.00000	0.00000
HOCL	0.00048	0.00037	0.00005
HO2	0.00030	0.00021	0.00000
*H2	0.00130	0.00102	0.00002
H2O	0.24066	0.24688	0.26570
H2O2	0.00003	0.00002	0.00000
*NO	0.02121	0.01789	0.00222
NOCL	0.00002	0.00001	0.00000

NO2	0.00008	0.00006	0.00000
*N2	0.10253	0.10409	0.11144
*O	0.01008	0.00782	0.00013
*OH	0.04422	0.03698	0.00230
*O2	0.16247	0.16624	0.19205
AL2O3(a)	0.00000	0.00000	0.05195
AL2O3(L)	0.04803	0.04963	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 725.2 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000
FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7336	99.000
P, BAR	49.999	28.842	0.50504
T, K	3325.40	3142.79	1922.52
RHO, KG/CU M	4.9229 0	3.0352 0	9.0791-2
H, KJ/KG	0.00000	-540.59	-3551.20
U, KJ/KG	-1015.63	-1490.84	-4107.46
G, KJ/KG	-32657.9	-31405.1	-22431.8
S, KJ/(KG)(K)	9.8208	9.8208	9.8208
M, (1/n)	27.224	27.499	28.736
MW, MOL WT	26.882	27.138	28.321
(dLV/dLP)t	-1.02261	-1.01825	-1.00131
(dLV/dLT)p	1.4055	1.3481	1.0344
Cp, KJ/(KG)(K)	4.2037	3.9429	1.9058
GAMMAs	1.1375	1.1378	1.1921
SON VEL,M/SEC	1074.9	1039.8	814.3
MACH NUMBER	0.000	1.000	3.273

PERFORMANCE PARAMETERS

Ae/At	1.0000	13.043
CSTAR, M/SEC	1584.2	1584.2
CF	0.6563	1.6822
Ivac, M/SEC	1953.7	2873.8
Isp, M/SEC	1039.8	2665.0

MASS FRACTIONS

ALCL	0.00013	0.00006	0.00000
ALCL2	0.00009	0.00004	0.00000
ALCL3	0.00026	0.00018	0.00000
*ALO	0.00003	0.00001	0.00000
ALOCL	0.00067	0.00038	0.00000
ALOCL2	0.00003	0.00001	0.00000

ALOH	0.00019	0.00008	0.00000
ALOHCL	0.00027	0.00012	0.00000
ALOHCL2	0.00279	0.00185	0.00002
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00015	0.00006	0.00000
AL(OH)2CL	0.00195	0.00122	0.00001
AL(OH)3	0.00116	0.00071	0.00000
*CO	0.01496	0.01180	0.00013
*CO2	0.06418	0.06916	0.08750
*CL	0.06033	0.05698	0.01726
CLO	0.00187	0.00144	0.00011
CL2	0.00112	0.00100	0.00083
*H	0.00026	0.00019	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.21882	0.22401	0.26833
HNO	0.00001	0.00001	0.00000
HNO2	0.00001	0.00001	0.00000
HOCL	0.00055	0.00042	0.00005
HO2	0.00033	0.00023	0.00000
*H2	0.00124	0.00097	0.00002
H2O	0.24135	0.24747	0.26556
H2O2	0.00003	0.00002	0.00000
*NO	0.02164	0.01824	0.00221
NOCL	0.00002	0.00002	0.00000
NO2	0.00009	0.00007	0.00000
*N2	0.10232	0.10393	0.11144
*O	0.00957	0.00740	0.00012
*OH	0.04348	0.03627	0.00216
*O2	0.16237	0.16624	0.19230
AL2O3(a)	0.00000	0.00000	0.05195
AL2O3(L)	0.04762	0.04937	0.00000

 * THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 870.2 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000
FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7342	99.000
P, BAR	59.999	34.598	0.60605
T, K	3343.16	3157.42	1921.39
RHO, KG/CU M	5.8876 0	3.6302 0	1.0904-1
H, KJ/KG	0.00000	-542.66	-3556.74
U, KJ/KG	-1019.07	-1495.72	-4112.54
G, KJ/KG	-32646.4	-31375.2	-22319.4
S, KJ/(KG)(K)	9.7651	9.7651	9.7651
M, (1/n)	27.277	27.545	28.743

MW, MOL WT	26.936	27.184	28.329
(dLV/dLP)t	-1.02199	-1.01769	-1.00126
(dLV/dLT)p	1.3901	1.3342	1.0328
Cp, KJ/(KG)(K)	4.1037	3.8507	1.8904
GAMMAs	1.1384	1.1388	1.1933
SON VEL,M/SEC	1077.1	1041.8	814.4
MACH NUMBER	0.000	1.000	3.275

PERFORMANCE PARAMETERS

Ae/At	1.0000	13.004
CSTAR, M/SEC	1586.5	1586.5
CF	0.6567	1.6812
Ivac, M/SEC	1956.6	2875.5
Isp, M/SEC	1041.8	2667.1

MASS FRACTIONS

ALCL	0.00013	0.00006	0.00000
ALCL2	0.00010	0.00005	0.00000
ALCL3	0.00029	0.00020	0.00000
*ALO	0.00002	0.00001	0.00000
ALOCL	0.00066	0.00038	0.00000
ALOCL2	0.00003	0.00002	0.00000
ALOH	0.00018	0.00008	0.00000
ALOHCL	0.00028	0.00013	0.00000
ALOHCL2	0.00313	0.00208	0.00002
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00016	0.00007	0.00000
AL(OH)2CL	0.00220	0.00137	0.00001
AL(OH)3	0.00131	0.00080	0.00000
*CO	0.01453	0.01140	0.00011
*CO2	0.06486	0.06979	0.08752
*CL	0.05890	0.05559	0.01648
CLO	0.00199	0.00153	0.00012
CL2	0.00122	0.00109	0.00092
*H	0.00025	0.00017	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.21973	0.22503	0.26903
HNO	0.00001	0.00001	0.00000
HNO2	0.00001	0.00001	0.00000
HOCL	0.00060	0.00046	0.00006
HO2	0.00036	0.00024	0.00000
*H2	0.00119	0.00092	0.00001
H2O	0.24192	0.24795	0.26546
H2O2	0.00004	0.00002	0.00000
*NO	0.02200	0.01853	0.00221
NOCL	0.00003	0.00002	0.00000
NO2	0.00010	0.00007	0.00000
*N2	0.10215	0.10379	0.11144
N2O	0.00001	0.00000	0.00000
*O	0.00917	0.00706	0.00011
*OH	0.04286	0.03567	0.00205
*O2	0.16229	0.16625	0.19250
AL2O3(a)	0.00000	0.00000	0.05195
AL2O3(L)	0.04724	0.04913	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1015.2 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000
FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7347	99.000
P, BAR	69.998	40.353	0.70705
T, K	3358.02	3169.62	1920.44
RHO, KG/CU M	6.8497 0	4.2237 0	1.2730-1
H, KJ/KG	0.00000	-544.36	-3561.28
U, KJ/KG	-1021.91	-1499.75	-4116.69
G, KJ/KG	-32633.8	-31347.3	-22224.5
S, KJ/(KG)(K)	9.7182	9.7182	9.7182
M, (1/n)	27.322	27.584	28.749
MW, MOL WT	26.983	27.224	28.334
(dLV/dLP)t	-1.02148	-1.01723	-1.00122
(dLV/dLT)p	1.3773	1.3227	1.0314
Cp, KJ/(KG)(K)	4.0217	3.7751	1.8781
GAMMAs	1.1390	1.1396	1.1942
SON VEL,M/SEC	1078.9	1043.4	814.4
MACH NUMBER	0.000	1.000	3.277

PERFORMANCE PARAMETERS

Ae/At		1.0000	12.972
CSTAR, M/SEC		1588.3	1588.3
CF		0.6569	1.6803
Ivac, M/SEC		1959.1	2876.9
Isp, M/SEC		1043.4	2668.8

MASS FRACTIONS

ALCL	0.00012	0.00005	0.00000
ALCL2	0.00010	0.00005	0.00000
ALCL3	0.00032	0.00022	0.00000
*ALO	0.00002	0.00001	0.00000
ALOCL	0.00065	0.00037	0.00000
ALOCL2	0.00003	0.00002	0.00000
ALOH	0.00017	0.00007	0.00000
ALOHCL	0.00029	0.00013	0.00000
ALOHCL2	0.00344	0.00229	0.00002
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00016	0.00007	0.00000
AL(OH)2CL	0.00243	0.00151	0.00001
AL(OH)3	0.00144	0.00088	0.00000
*CO	0.01416	0.01106	0.00011
*CO2	0.06544	0.07032	0.08753
*CL	0.05768	0.05442	0.01585
CLO	0.00210	0.00162	0.00012
CL2	0.00131	0.00118	0.00100
*H	0.00023	0.00016	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.22046	0.22586	0.26959
HNO	0.00001	0.00001	0.00000

HNO2	0.00001	0.00001	0.00000
HOCL	0.00066	0.00050	0.00006
HO2	0.00038	0.00026	0.00000
*H2	0.00114	0.00089	0.00001
H2O	0.24239	0.24834	0.26538
H2O2	0.00004	0.00003	0.00000
*NO	0.02230	0.01877	0.00220
NOCL	0.00003	0.00002	0.00000
NO2	0.00011	0.00008	0.00001
*N2	0.10201	0.10368	0.11144
N2O	0.00001	0.00000	0.00000
*O	0.00884	0.00679	0.00010
*OH	0.04232	0.03515	0.00196
*O2	0.16222	0.16626	0.19266
AL2O3(a)	0.00000	0.00000	0.05195
AL2O3(L)	0.04689	0.04891	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1160.3 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000
FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7351	99.000
P, BAR	79.998	46.106	0.80806
T, K	3370.76	3180.05	1919.62
RHO, KG/CU M	7.8098 0	4.8160 0	1.4558-1
H, KJ/KG	0.00000	-545.81	-3565.11
U, KJ/KG	-1024.33	-1503.17	-4120.18
G, KJ/KG	-32620.8	-31321.0	-22142.4
S, KJ/(KG)(K)	9.6776	9.6776	9.6776
M, (1/n)	27.361	27.618	28.754
MW, MOL WT	27.023	27.259	28.339
(dLV/dLP)t	-1.02105	-1.01684	-1.00119
(dLV/dLT)p	1.3664	1.3130	1.0303
Cp, KJ/(KG)(K)	3.9525	3.7115	1.8680
GAMMAs	1.1396	1.1402	1.1949
SON VEL,M/SEC	1080.4	1044.8	814.4
MACH NUMBER	0.000	1.000	3.279

PERFORMANCE PARAMETERS

Ae/At	1.0000	12.944
CSTAR, M/SEC	1589.9	1589.9
CF	0.6572	1.6796
Ivac, M/SEC	1961.1	2878.1
Isp, M/SEC	1044.8	2670.2

MASS FRACTIONS

ALCL	0.00011	0.00005	0.00000
ALCL2	0.00010	0.00005	0.00000
ALCL3	0.00034	0.00024	0.00000
*ALO	0.00002	0.00001	0.00000
ALOCL	0.00065	0.00037	0.00000
ALOCL2	0.00004	0.00002	0.00000
ALOH	0.00016	0.00007	0.00000
ALOHCL	0.00030	0.00013	0.00000
ALOHCL2	0.00374	0.00249	0.00002
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00017	0.00007	0.00000
AL(OH)2CL	0.00265	0.00165	0.00001
AL(OH)3	0.00157	0.00096	0.00000
*CO	0.01384	0.01076	0.00010
*CO2	0.06595	0.07079	0.08754
*CL	0.05663	0.05340	0.01532
CLO	0.00220	0.00169	0.00013
CL2	0.00140	0.00125	0.00107
*H	0.00022	0.00016	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.22105	0.22656	0.27005
HNO	0.00001	0.00001	0.00000
HNO2	0.00001	0.00001	0.00000
HOCL	0.00070	0.00054	0.00007
HO2	0.00040	0.00027	0.00000
*H2	0.00111	0.00086	0.00001
H2O	0.24279	0.24868	0.26531
H2O2	0.00004	0.00003	0.00000
*NO	0.02256	0.01897	0.00220
NOCL	0.00004	0.00002	0.00000
NO2	0.00012	0.00008	0.00001
*N2	0.10188	0.10358	0.11145
N2O	0.00001	0.00000	0.00000
*O	0.00855	0.00655	0.00009
*OH	0.04183	0.03470	0.00189
*O2	0.16217	0.16627	0.19279
AL2O3(a)	0.00000	0.00000	0.05194
AL2O3(L)	0.04655	0.04870	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1305.3 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000
FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT

Pinf/P	1.0000	1.7354	99.000
P, BAR	89.998	51.859	0.90907
T, K	3381.90	3189.15	1918.90
RHO, KG/CU M	8.7682 0	5.4072 0	1.6386-1
H, KJ/KG	0.00000	-547.07	-3568.40
U, KJ/KG	-1026.41	-1506.13	-4123.18
G, KJ/KG	-32607.6	-31296.3	-22070.1
S, KJ/(KG)(K)	9.6418	9.6418	9.6418
M, (1/n)	27.395	27.648	28.759
MW, MOL WT	27.059	27.289	28.343
(dLV/dLP)t	-1.02068	-1.01651	-1.00116
(dLV/dLT)p	1.3570	1.3045	1.0294
Cp, KJ/(KG)(K)	3.8928	3.6568	1.8594
GAMMAs	1.1401	1.1408	1.1956
SON VEL,M/SEC	1081.8	1046.0	814.4
MACH NUMBER	0.000	1.000	3.280

PERFORMANCE PARAMETERS

Ae/At	1.0000	12.921
CSTAR, M/SEC	1591.2	1591.2
CF	0.6574	1.6789
Ivac, M/SEC	1962.9	2879.1
Isp, M/SEC	1046.0	2671.5

MASS FRACTIONS

ALCL	0.00011	0.00005	0.00000
ALCL2	0.00010	0.00005	0.00000
ALCL3	0.00037	0.00026	0.00000
*ALO	0.00002	0.00001	0.00000
ALOCL	0.00064	0.00036	0.00000
ALOCL2	0.00004	0.00002	0.00000
ALOH	0.00016	0.00007	0.00000
ALOHCL	0.00031	0.00014	0.00000
ALOHCL2	0.00402	0.00268	0.00002
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00017	0.00007	0.00000
AL(OH)2CL	0.00285	0.00178	0.00001
AL(OH)3	0.00170	0.00103	0.00000
*CO	0.01356	0.01050	0.00009
*CO2	0.06639	0.07119	0.08755
*CL	0.05570	0.05250	0.01486
CLO	0.00229	0.00176	0.00013
CL2	0.00148	0.00133	0.00114
*H	0.00021	0.00015	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.22155	0.22714	0.27044
HNO	0.00001	0.00001	0.00000
HNO2	0.00002	0.00001	0.00000
HOCL	0.00075	0.00058	0.00007
HO2	0.00042	0.00028	0.00000
*H2	0.00108	0.00083	0.00001
H2O	0.24314	0.24898	0.26525
H2O2	0.00005	0.00003	0.00000
*NO	0.02278	0.01915	0.00219
NOCL	0.00004	0.00003	0.00000
NO2	0.00012	0.00009	0.00001
*N2	0.10177	0.10349	0.11145
N2O	0.00001	0.00000	0.00000
*O	0.00830	0.00635	0.00008
*OH	0.04140	0.03429	0.00183
*O2	0.16212	0.16628	0.19290
AL2O3(a)	0.00000	0.00000	0.05194

AL2O3(L) 0.04624 0.04850 0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1450.3 PSIA
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	AL	0.1100000	0.000	0.000
FUEL	C2H5OH	0.1220000	0.000	0.000
FUEL	C3H8O,2propanol	0.0410000	0.000	0.000
FUEL	HNCO	0.0270000	0.000	0.000
FUEL	NH4CLO4(I)	0.7000000	0.000	0.000
OXIDANT	NH4CLO4(I)	1.0000000	0.000	0.000

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 0.659207 PHI,EQ.RATIO= 0.222309

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7358	99.000
P, BAR	99.998	57.610	1.0101
T, K	3391.77	3197.21	1918.27
RHO, KG/CU M	9.7251 0	5.9975 0	1.8215-1
H, KJ/KG	0.00000	-548.17	-3571.28
U, KJ/KG	-1028.24	-1508.73	-4125.80
G, KJ/KG	-32594.4	-31272.9	-22005.5
S, KJ/(KG)(K)	9.6098	9.6098	9.6098
M, (1/n)	27.426	27.675	28.762
MW, MOL WT	27.092	27.316	28.347
(dLV/dLP)t	-1.02036	-1.01622	-1.00114
(dLV/dLT)p	1.3486	1.2971	1.0286
Cp, KJ/(KG)(K)	3.8406	3.6089	1.8520
GAMMAs	1.1405	1.1414	1.1962
SON VEL,M/SEC	1082.9	1047.1	814.4
MACH NUMBER	0.000	1.000	3.281

PERFORMANCE PARAMETERS

Ae/At	1.0000	12.900
CSTAR, M/SEC	1592.4	1592.4
CF	0.6575	1.6783
Ivac, M/SEC	1964.5	2880.0
Isp, M/SEC	1047.1	2672.6

MASS FRACTIONS

ALCL	0.00010	0.00005	0.00000
ALCL2	0.00011	0.00005	0.00000
ALCL3	0.00039	0.00027	0.00000
*ALO	0.00002	0.00001	0.00000
ALOCL	0.00063	0.00036	0.00000
ALOCL2	0.00004	0.00002	0.00000
ALOH	0.00015	0.00006	0.00000
ALOHCL	0.00031	0.00014	0.00000
ALOHCL2	0.00429	0.00286	0.00002
ALO2	0.00002	0.00001	0.00000
AL(OH)2	0.00018	0.00007	0.00000
AL(OH)2CL	0.00305	0.00190	0.00001

AL(OH)3	0.00182	0.00110	0.00000
*CO	0.01330	0.01027	0.00009
*CO2	0.06679	0.07155	0.08756
*CL	0.05486	0.05170	0.01447
CLO	0.00237	0.00182	0.00014
CL2	0.00155	0.00140	0.00121
*H	0.00020	0.00014	0.00000
HALO2	0.00004	0.00002	0.00000
HCL	0.22198	0.22765	0.27077
HNO	0.00001	0.00001	0.00000
HNO2	0.00002	0.00001	0.00000
HOCL	0.00079	0.00061	0.00007
HO2	0.00044	0.00029	0.00000
*H2	0.00105	0.00081	0.00001
H2O	0.24345	0.24924	0.26521
H2O2	0.00005	0.00003	0.00000
*NO	0.02298	0.01931	0.00219
NOCL	0.00004	0.00003	0.00000
NO2	0.00013	0.00010	0.00001
*N2	0.10168	0.10341	0.11145
N2O	0.00001	0.00000	0.00000
*O	0.00808	0.00617	0.00008
*OH	0.04101	0.03392	0.00178
*O2	0.16208	0.16629	0.19299
AL2O3(a)	0.00000	0.00000	0.05194
AL2O3(L)	0.04593	0.04830	0.00000

 * THERMODYNAMIC PROPERTIES FITTED TO 20000.K

NOTE. WEIGHT FRACTION OF FUEL IN TOTAL FUELS AND OF OXIDANT IN TOTAL OXIDANTS