
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

CEA analysis performed on Mon 22-Dec-2025 03:47:26

Problem Type: "Rocket" (Finite Area Combustor)

prob case = _____9942 ro equilibrium ions fac

!Contraction Ratio:
ac/at=4

Pressure (10 values):
p,atm= 10, 20, 30, 40, 50, 60, 70, 80, 90, 100
Chamber/Exit Pressure Ratio (1 value):
pi/p= 50

Oxidizer/Fuel Wt. ratio (29 values):
o/f = 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1, 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 2, 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7,

You selected the following fuels and oxidizers:

reac
fuel RP-1 wt%=100.0000
oxid O2(L) 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
Transport properties calculated
output transport

Input prepared by this script:/var/www/sites/cearun/cgi-bin/CEARUN/prepareInputFile.cgi

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.000000
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7934
P, BAR	10.133	9.7365	5.6497
T, K	973.90	971.81	924.31
RHO, KG/CU M	2.6768 0	2.5737 0	1.5839 0
H, KJ/KG	-1541.40	-1541.40	-1741.36
U, KJ/KG	-1919.93	-1919.70	-2098.05
G, KJ/KG	-11419.2	-11413.1	-11130.5
S, KJ/(KG)(K)	10.1425	10.1580	10.1580
M, (1/n)	21.392	21.359	21.546
MW, MOL WT	11.253	11.235	11.229
(dLV/dLP)t	-1.11272	-1.11290	-1.10983
(dLV/dLT)p	2.3757	2.3804	2.3850
Cp, KJ/(KG)(K)	9.9376	9.9814	10.0723
GAMMAS	1.1211	1.1212	1.1212
SON VEL,M/SEC	651.4	651.3	632.4
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.31506 0.00000 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	17.1496	0.0000	7.8873
CONDUCTIVITY	7.8944	0.0000	NaN
PRANDTL NUMBER	0.6844	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2870	0.0000	5.7887
CONDUCTIVITY	2.1762	0.0000	NaN
PRANDTL NUMBER	0.6207	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1011.6	1011.6
CF	0.0002	0.6252
Ivac, M/SEC	1843648.5	1196.4
Isp, M/SEC	0.2	632.4

MASS FRACTIONS

CH4	0.23176	0.23059	0.23019
*CO	0.05914	0.05907	0.04579
*CO2	0.04182	0.04189	0.04376
C2H6	0.00004	0.00004	0.00002
*H2	0.04603	0.04632	0.04564
H2O	0.11539	0.11538	0.12238
C(gr)	0.50582	0.50671	0.51220

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

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50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

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REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.000000
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0126	1.7443
P, BAR	20.265	20.013	11.618
T, K	1010.65	1009.98	959.92
RHO, KG/CU M	5.3023 0	5.2373 0	3.2225 0
H, KJ/KG	-1541.40	-1541.40	-1743.29
U, KJ/KG	-1923.59	-1923.53	-2103.83
G, KJ/KG	-11523.4	-11521.5	-11228.8
S, KJ/(KG)(K)	9.8768	9.8815	9.8815
M, (1/n)	21.986	21.975	22.137
MW, MOL WT	11.584	11.577	11.556
(dLV/dLP)t	-1.10838	-1.10848	-1.10567

(dLV/dLT)p	2.2839	2.2857	2.2935
Cp, KJ/(KG)(K)	9.1645	9.1785	9.2855
GAMMAS	1.1196	1.1197	1.1199
SON VEL,M/SEC	654.2	654.1	635.4
MACH NUMBER	0.000	NaN	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.32307	0.00000	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	15.4693	0.0000	7.7133
CONDUCTIVITY	7.4912	0.0000	NaN
PRANDTL NUMBER	0.6671	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2521	0.0000	5.6369
CONDUCTIVITY	2.1576	0.0000	NaN
PRANDTL NUMBER	0.6367	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	989.7	989.7
CF	NaN	0.6421
Ivac, M/SEC	NaN	1202.8
Isp, M/SEC	NaN	635.4

MASS FRACTIONS

CH4	0.25203	0.25167	0.25039
*CO	0.05980	0.05980	0.04703
*CO2	0.04085	0.04086	0.04268
C2H6	0.00007	0.00007	0.00004
*H2	0.04088	0.04098	0.04055
H2O	0.11576	0.11575	0.12247
C(gr)	0.49060	0.49087	0.49683

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

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CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.000000
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7921
P, BAR	30.398	29.209	16.962
T, K	1032.44	1030.29	978.91
RHO, KG/CU M	7.9153 0	7.6093 0	4.6813 0
H, KJ/KG	-1541.40	-1541.40	-1744.14
U, KJ/KG	-1925.43	-1925.26	-2106.46
G, KJ/KG	-11581.6	-11576.0	-11278.3
S, KJ/(KG)(K)	9.7247	9.7395	9.7395
M, (1/n)	22.353	22.316	22.464
MW, MOL WT	11.784	11.764	11.734
(dLV/dLP)t	-1.10497	-1.10533	-1.10271
(dLV/dLT)p	2.2225	2.2288	2.2384
Cp, KJ/(KG)(K)	8.7102	8.7547	8.8674
GAMMAS	1.1185	1.1187	1.1191
SON VEL,M/SEC	655.4	655.3	636.8
MACH NUMBER	0.000	NaN	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.32766 0.00000 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	14.5163	0.0000	7.5249
CONDUCTIVITY	7.2379	0.0000	NaN
PRANDTL NUMBER	0.6572	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2364	0.0000	5.5648
CONDUCTIVITY	2.1483	0.0000	NaN
PRANDTL NUMBER	0.6461	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1019.7	1019.7
CF	NaN	0.6244
Ivac, M/SEC	NaN	1205.8
Isp, M/SEC	NaN	636.8

MASS FRACTIONS

CH4	0.26378	0.26263	0.26092
*CO	0.05971	0.05974	0.04733
*CO2	0.04048	0.04051	0.04227
C2H6	0.00010	0.00010	0.00006
*H2	0.03789	0.03818	0.03788
H2O	0.11612	0.11607	0.12262
C(gr)	0.48192	0.48276	0.48891

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

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REQUIREMENTS FOR THE POINT 4 (EQLBRM)

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REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.000000
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7917
P, BAR	40.530	38.946	22.621
T, K	1047.96	1045.81	993.44
RHO, KG/CU M	1.0522 1	1.0115 1	6.2219 0
H, KJ/KG	-1541.40	-1541.40	-1744.70
U, KJ/KG	-1926.60	-1926.44	-2108.28
G, KJ/KG	-11621.0	-11615.7	-11314.5
S, KJ/(KG)(K)	9.6183	9.6330	9.6330
M, (1/n)	22.620	22.583	22.719
MW, MOL WT	11.929	11.909	11.872
(dLV/dLP)t	-1.10217	-1.10257	-1.10013
(dLV/dLT)p	2.1760	2.1826	2.1936

Cp, KJ/(KG)(K)	8.3907	8.4348	8.5502
GAMMAS	1.1176	1.1178	1.1184
SON VEL,M/SEC	656.1	656.0	637.7
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.33087	0.00000	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.8579	0.0000	7.5559
CONDUCTIVITY	7.0514	0.0000	NaN
PRANDTL NUMBER	0.6503	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2274	0.0000	5.4979
CONDUCTIVITY	2.1427	0.0000	NaN
PRANDTL NUMBER	0.6528	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1021.6	1021.6
CF	0.0007	0.6242
Ivac, M/SEC	556145.2	1207.8
Isp, M/SEC	0.7	637.7

MASS FRACTIONS

CH4	0.27201	0.27087	0.26886
*CO	0.05942	0.05947	0.04737
*CO2	0.04032	0.04034	0.04203
C2H4	0.00001	0.00001	0.00000
C2H6	0.00013	0.00012	0.00008
*H2	0.03578	0.03607	0.03587
H2O	0.11644	0.11639	0.12279
C(gr)	0.47591	0.47673	0.48300

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.000000
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7913
P, BAR	50.663	48.682	28.283
T, K	1060.01	1057.86	1004.74
RHO, KG/CU M	1.3125 1	1.2616 1	7.7598 0
H, KJ/KG	-1541.40	-1541.40	-1745.09
U, KJ/KG	-1927.41	-1927.27	-2109.57
G, KJ/KG	-11650.4	-11645.2	-11341.5
S, KJ/(KG)(K)	9.5367	9.5512	9.5512
M, (1/n)	22.832	22.794	22.920
MW, MOL WT	12.042	12.022	11.981
(dLV/dLP)t	-1.09980	-1.10023	-1.09793
(dLV/dLT)p	2.1385	2.1453	2.1574
Cp, KJ/(KG)(K)	8.1459	8.1894	8.3061
GAMMAS	1.1169	1.1170	1.1177
SON VEL,M/SEC	656.6	656.5	638.3
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.33333 0.00000 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.3590	0.0000	7.6601
CONDUCTIVITY	6.9034	0.0000	NaN
PRANDTL NUMBER	0.6450	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2217	0.0000	5.4124
CONDUCTIVITY	2.1389	0.0000	NaN
PRANDTL NUMBER	0.6579	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1022.9	1022.9
CF	0.0007	0.6240
Ivac, M/SEC	533023.4	1209.3
Isp, M/SEC	0.7	638.3

MASS FRACTIONS

CH4	0.27831	0.27719	0.27495
*CO	0.05905	0.05912	0.04730
*CO2	0.04024	0.04025	0.04189
C2H4	0.00001	0.00001	0.00000
C2H6	0.00016	0.00015	0.00010
*H2	0.03415	0.03444	0.03431
H2O	0.11674	0.11669	0.12295
C(gr)	0.47134	0.47215	0.47850

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.000000
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7909
P, BAR	60.795	58.419	33.946
T, K	1069.84	1067.69	1013.97
RHO, KG/CU M	1.5725 1	1.5115 1	9.2960 0
H, KJ/KG	-1541.40	-1541.40	-1745.38
U, KJ/KG	-1928.02	-1927.89	-2110.55
G, KJ/KG	-11673.3	-11668.4	-11362.8
S, KJ/(KG)(K)	9.4705	9.4849	9.4849
M, (1/n)	23.007	22.969	23.087
MW, MOL WT	12.135	12.115	12.070
(dLV/dLP)t	-1.09773	-1.09819	-1.09602

(dLV/dLT)p	2.1070	2.1140	2.1269
Cp, KJ/(KG)(K)	7.9485	7.9914	8.1083
GAMMAS	1.1162	1.1164	1.1172
SON VEL,M/SEC	656.9	656.9	638.7
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.33530	0.00000	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	12.9595	0.0000	7.4217
CONDUCTIVITY	6.7806	0.0000	NaN
PRANDTL NUMBER	0.6409	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2179	0.0000	7.3114
CONDUCTIVITY	2.1361	0.0000	NaN
PRANDTL NUMBER	0.6621	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1023.9	1023.9
CF	0.0007	0.6238
Ivac, M/SEC	508289.3	1210.4
Isp, M/SEC	0.8	638.7

MASS FRACTIONS

*C	0.00000	0.00000	0.00024
CH4	0.28340	0.28229	0.27988
*CO	0.05865	0.05874	0.04715
*CO2	0.04021	0.04022	0.04180
C2H4	0.00001	0.00001	0.00000
C2H6	0.00018	0.00017	0.00011
*H2	0.03284	0.03312	0.03305
H2O	0.11702	0.11696	0.12311
*O	0.00000	0.00000	0.00010
C(gr)	0.46769	0.46848	0.47488

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

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REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.000000

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.33333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7906
P, BAR	70.927	68.155	39.610
T, K	1078.13	1075.98	1021.77
RHO, KG/CU M	1.8323 1	1.7612 1	1.0831 1
H, KJ/KG	-1541.40	-1541.40	-1745.60
U, KJ/KG	-1928.50	-1928.38	-2111.32
G, KJ/KG	-11692.0	-11687.2	-11380.2
S, KJ/(KG)(K)	9.4150	9.4293	9.4293

M, (1/n)	23.157	23.118	23.230
MW, MOL WT	12.214	12.194	12.145
(dLV/dLP)t	-1.09591	-1.09639	-1.09433
(dLV/dLT)p	2.0799	2.0870	2.1006
Cp, KJ/(KG)(K)	7.7836	7.8261	7.9427
GAMMAS	1.1156	1.1158	1.1167
SON VEL,M/SEC	657.2	657.1	639.1
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.33696 0.00000 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	12.6280	0.0000	8.9079
CONDUCTIVITY	6.6755	0.0000	NaN
PRANDTL NUMBER	0.6374	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2151	0.0000	4.8507
CONDUCTIVITY	2.1340	0.0000	NaN
PRANDTL NUMBER	0.6656	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1024.7	1024.7
CF	0.0008	0.6236
Ivac, M/SEC	484720.8	1211.3
Isp, M/SEC	0.8	639.1

MASS FRACTIONS

CH4	0.28765	0.28655	0.28401
*CO	0.05825	0.05836	0.04698
*CO2	0.04022	0.04021	0.04175
C2H4	0.00001	0.00001	0.00000
C2H6	0.00021	0.00020	0.00013
*H2	0.03174	0.03202	0.03200
H2O	0.11728	0.11721	0.12326
C(gr)	0.46466	0.46544	0.47186

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.000000

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7904
P, BAR	81.060	77.892	45.276
T, K	1085.29	1083.15	1028.51
RHO, KG/CU M	2.0919 1	2.0108 1	1.2365 1
H, KJ/KG	-1541.40	-1541.40	-1745.77
U, KJ/KG	-1928.89	-1928.77	-2111.94
G, KJ/KG	-11707.5	-11702.9	-11394.7
S, KJ/(KG)(K)	9.3672	9.3814	9.3814

M, (1/n)	23.288	23.249	23.354
MW, MOL WT	12.283	12.263	12.211
(dLV/dLP)t	-1.09428	-1.09477	-1.09281
(dLV/dLT)p	2.0561	2.0632	2.0774
Cp, KJ/(KG)(K)	7.6426	7.6845	7.8007
GAMMAS	1.1151	1.1153	1.1163
SON VEL,M/SEC	657.3	657.3	639.3
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.33837	0.00000	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	12.3455	0.0000	11.4383
CONDUCTIVITY	6.5837	0.0000	NaN
PRANDTL NUMBER	0.6345	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2131	0.0000	4.3086
CONDUCTIVITY	2.1324	0.0000	NaN
PRANDTL NUMBER	0.6685	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1025.4	1025.4
CF	0.0008	0.6235
Ivac, M/SEC	463032.3	1212.1
Isp, M/SEC	0.8	639.3

MASS FRACTIONS

CH4	0.29129	0.29021	0.28756
*CO	0.05785	0.05798	0.04679
*CO2	0.04024	0.04023	0.04172
C2H4	0.00001	0.00001	0.00000
C2H6	0.00023	0.00022	0.00014
*H2	0.03079	0.03107	0.03109
H2O	0.11751	0.11744	0.12341
C(gr)	0.46208	0.46284	0.46929

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE

REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.000000

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7901
P, BAR	91.192	87.628	50.942
T, K	1091.59	1089.46	1034.45
RHO, KG/CU M	2.3515 1	2.2602 1	1.3898 1
H, KJ/KG	-1541.40	-1541.40	-1745.91
U, KJ/KG	-1929.20	-1929.10	-2112.46
G, KJ/KG	-11720.7	-11716.3	-11407.1
S, KJ/(KG)(K)	9.3252	9.3394	9.3394
M, (1/n)	23.404	23.364	23.465
MW, MOL WT	12.344	12.323	12.269
(dLV/dLP)t	-1.09279	-1.09330	-1.09142
(dLV/dLT)p	2.0349	2.0421	2.0567
Cp, KJ/(KG)(K)	7.5196	7.5611	7.6766
GAMMAS	1.1146	1.1148	1.1159
SON VEL,M/SEC	657.5	657.4	639.5
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.33961 0.00000 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	12.1001	0.0000	7.2082
CONDUCTIVITY	6.5021	0.0000	NaN
PRANDTL NUMBER	0.6320	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2116	0.0000	6.9998
CONDUCTIVITY	2.1312	0.0000	NaN
PRANDTL NUMBER	0.6711	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1026.0	1026.0
CF	0.0009	0.6233
Ivac, M/SEC	443272.3	1212.7

Isp, M/SEC 0.9 639.5

MASS FRACTIONS

*e-	0.00000	0.00000	0.00001
*C	0.00000	0.00000	0.00005
CH4	0.29447	0.29340	0.29065
*CO	0.05746	0.05760	0.04659
*CO2	0.04027	0.04026	0.04171
C2H4	0.00001	0.00001	0.00001
C2H6	0.00025	0.00024	0.00016
*H2	0.02996	0.03024	0.03029
H2O	0.11774	0.11766	0.12355
*O	0.00000	0.00000	0.00002
C(gr)	0.45983	0.46059	0.46704

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.000000

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.20000 %FUEL= 83.333333 R,EQ.RATIO=17.028331 PHI,EQ.RATIO=17.028331

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7899
P, BAR	101.33	97.365	56.610
T, K	1097.20	1095.08	1039.75
RHO, KG/CU M	2.6110 1	2.5096 1	1.5430 1
H, KJ/KG	-1541.40	-1541.40	-1746.03

U, KJ/KG	-1929.47	-1929.37	-2112.90
G, KJ/KG	-11732.1	-11727.8	-11417.8
S, KJ/(KG)(K)	9.2879	9.3020	9.3020
M, (1/n)	23.508	23.468	23.564
MW, MOL WT	12.398	12.377	12.322
(dLV/dLP)t	-1.09143	-1.09195	-1.09015
(dLV/dLT)p	2.0157	2.0230	2.0381
Cp, KJ/(KG)(K)	7.4109	7.4519	7.5667
GAMMAS	1.1142	1.1144	1.1155
SON VEL,M/SEC	657.6	657.5	639.7
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.34070	0.00000	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	11.8838	0.0000	11.1513
CONDUCTIVITY	6.4288	0.0000	NaN
PRANDTL NUMBER	0.6298	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	4.2105	0.0000	4.2903
CONDUCTIVITY	2.1302	0.0000	NaN
PRANDTL NUMBER	0.6734	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1026.5	1026.5
CF	0.0009	0.6232
Ivac, M/SEC	425326.2	1213.2
Isp, M/SEC	0.9	639.7

MASS FRACTIONS

CH4	0.29728	0.29622	0.29340
*CO	0.05709	0.05723	0.04638
*CO2	0.04031	0.04029	0.04171
C2H4	0.00001	0.00001	0.00001
C2H6	0.00027	0.00027	0.00017
*H2	0.02922	0.02950	0.02958
H2O	0.11795	0.11787	0.12369
C(gr)	0.45786	0.45860	0.46506

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.000000

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7944
P, BAR	10.133	9.7365	5.6468
T, K	1047.84	1045.50	994.65
RHO, KG/CU M	2.2730 0	2.1858 0	1.3463 0
H, KJ/KG	-1454.03	-1454.03	-1689.53
U, KJ/KG	-1899.80	-1899.47	-2108.95
G, KJ/KG	-12803.3	-12795.7	-12479.5
S, KJ/(KG)(K)	10.8310	10.8480	10.8480
M, (1/n)	19.544	19.515	19.717
MW, MOL WT	11.156	11.138	11.090
(dLV/dLP)t	-1.12260	-1.12248	-1.12002
(dLV/dLT)p	2.5148	2.5168	2.5441
Cp, KJ/(KG)(K)	11.4919	11.5338	11.8930
GAMMAS	1.1255	1.1255	1.1229
SON VEL,M/SEC	708.3	708.1	686.3
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.35383 0.00000 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	19.7939	0.0000	8.8153
CONDUCTIVITY	10.1415	0.0000	NaN
PRANDTL NUMBER	0.6906	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.9167	0.0000	4.8075
CONDUCTIVITY	2.4127	0.0000	NaN
PRANDTL NUMBER	0.5744	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1096.7	1096.7
CF	0.0001	0.6258
Ivac, M/SEC	2765229.4	1297.4
Isp, M/SEC	0.2	686.3

MASS FRACTIONS

CH4	0.15288	0.15171	0.14865
*CO	0.15783	0.15784	0.13270
*CO2	0.06159	0.06174	0.06968
C2H6	0.00003	0.00002	0.00002
*H2	0.05768	0.05798	0.05767
H2O	0.10791	0.10779	0.11745
C(gr)	0.46208	0.46292	0.47383

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.000000
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7945
P, BAR	20.265	19.473	11.293
T, K	1089.60	1087.14	1033.10
RHO, KG/CU M	4.4917 0	4.3190 0	2.6601 0
H, KJ/KG	-1454.03	-1454.03	-1692.43

U, KJ/KG	-1905.20	-1904.90	-2116.96
G, KJ/KG	-12938.5	-12930.5	-12598.5
S, KJ/(KG)(K)	10.5401	10.5566	10.5566
M, (1/n)	20.080	20.048	20.233
MW, MOL WT	11.488	11.468	11.407
(dLV/dLP)t	-1.12334	-1.12336	-1.12111
(dLV/dLT)p	2.4665	2.4700	2.5021
Cp, KJ/(KG)(K)	10.7321	10.7772	11.1508
GAMMAS	1.1254	1.1254	1.1231
SON VEL,M/SEC	712.5	712.3	690.5
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.36294	0.00000	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	17.9237	0.0000	8.6800
CONDUCTIVITY	9.6995	0.0000	NaN
PRANDTL NUMBER	0.6707	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8939	0.0000	4.7409
CONDUCTIVITY	2.3928	0.0000	NaN
PRANDTL NUMBER	0.5906	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1103.3	1103.3
CF	0.0000	0.6258
Ivac, M/SEC	*****	1305.3
Isp, M/SEC	0.0	690.5

MASS FRACTIONS

CH4	0.17364	0.17244	0.16869
*CO	0.15724	0.15730	0.13325
*CO2	0.05948	0.05958	0.06693
C2H4	0.00001	0.00001	0.00000
C2H6	0.00005	0.00005	0.00003
*H2	0.05222	0.05253	0.05242
H2O	0.11002	0.10989	0.11934
C(gr)	0.44735	0.44820	0.45932

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.000000
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7944
P, BAR	30.398	29.209	16.940
T, K	1114.90	1112.39	1056.45
RHO, KG/CU M	6.6953 0	6.4375 0	3.9646 0
H, KJ/KG	-1454.03	-1454.03	-1693.94
U, KJ/KG	-1908.04	-1907.77	-2121.23
G, KJ/KG	-13019.5	-13011.5	-12670.2
S, KJ/(KG)(K)	10.3736	10.3898	10.3898
M, (1/n)	20.418	20.384	20.557
MW, MOL WT	11.695	11.675	11.604
(dLV/dLP)t	-1.12268	-1.12278	-1.12071
(dLV/dLT)p	2.4276	2.4318	2.4663
Cp, KJ/(KG)(K)	10.2678	10.3138	10.6891
GAMMAS	1.1249	1.1250	1.1229
SON VEL,M/SEC	714.6	714.5	692.7
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.36831 0.00000 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	16.8402	0.0000	14.5070
CONDUCTIVITY	9.4102	0.0000	NaN
PRANDTL NUMBER	0.6591	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8846	0.0000	4.0690
CONDUCTIVITY	2.3821	0.0000	NaN
PRANDTL NUMBER	0.6006	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1106.9	1106.9
CF	0.0000	0.6258
Ivac, M/SEC	*****	1309.5
Isp, M/SEC	0.0	692.7

MASS FRACTIONS

CH4	0.18599	0.18477	0.18063
*CO	0.15632	0.15643	0.13310
*CO2	0.05862	0.05870	0.06570
C2H4	0.00001	0.00001	0.00000
C2H6	0.00007	0.00007	0.00004
*H2	0.04896	0.04929	0.04929
H2O	0.11131	0.11118	0.12045
C(gr)	0.43871	0.43956	0.45078

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.000000
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7943
P, BAR	40.530	38.946	22.589
T, K	1133.20	1130.64	1073.36
RHO, KG/CU M	8.8907 0	8.5479 0	5.2639 0

H, KJ/KG	-1454.03	-1454.03	-1694.91
U, KJ/KG	-1909.90	-1909.65	-2124.04
G, KJ/KG	-13077.3	-13069.3	-12721.7
S, KJ/(KG)(K)	10.2571	10.2732	10.2732

M, (1/n)	20.668	20.633	20.797
MW, MOL WT	11.848	11.826	11.749
(dLV/dLP)t	-1.12172	-1.12188	-1.11995
(dLV/dLT)p	2.3955	2.4002	2.4363
Cp, KJ/(KG)(K)	9.9336	9.9801	10.3535
GAMMAS	1.1244	1.1245	1.1227
SON VEL,M/SEC	716.0	715.8	694.1
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.37213	0.00000	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	16.0841	0.0000	14.1603
CONDUCTIVITY	9.1937	0.0000	NaN
PRANDTL NUMBER	0.6510	0.0000	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8799	0.0000	4.0468
CONDUCTIVITY	2.3750	0.0000	NaN
PRANDTL NUMBER	0.6079	0.0000	NaN

PERFORMANCE PARAMETERS

Ae/At	0.00000	1.0000
CSTAR, M/SEC	1109.3	1109.3
CF	0.0000	0.6257
Ivac, M/SEC	*****	1312.4
Isp, M/SEC	0.0	694.1

MASS FRACTIONS

CH4	0.19478	0.19356	0.18914
*CO	0.15537	0.15552	0.13275
*CO2	0.05820	0.05825	0.06499
C2H4	0.00001	0.00001	0.00001
C2H6	0.00010	0.00009	0.00006
*H2	0.04664	0.04696	0.04706
H2O	0.11227	0.11213	0.12126
C(gr)	0.43263	0.43347	0.44474

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE

REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012601

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0257	1.7457	50.000
P, BAR	50.663	49.394	29.022	1.0132
T, K	1147.56	1145.32	1088.29	805.81
RHO, KG/CU M	1.1081 1	1.0820 1	6.7392 0	3.3728-1
H, KJ/KG	-1454.03	-1459.89	-1695.70	-2908.50
U, KJ/KG	-1911.25	-1916.39	-2126.34	-3208.92
G, KJ/KG	-13122.1	-13110.9	-12766.6	-11105.8
S, KJ/(KG)(K)	10.1678	10.1728	10.1728	10.1728
M, (1/n)	20.868	20.860	21.012	22.302
MW, MOL WT	11.969	11.960	11.878	11.739
(dLV/dLP)t	-1.12070	-1.12073	-1.11896	-1.09775
(dLV/dLT)p	2.3682	2.3709	2.4072	2.3731
Cp, KJ/(KG)(K)	9.6734	9.6979	10.0579	10.2232
GAMMAS	1.1240	1.1240	1.1223	1.1206
SON VEL,M/SEC	716.9	716.3	695.2	580.2
MACH NUMBER	0.000	0.151	1.000	2.940

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.37508 0.37459 0.36143 0.28716

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	15.5073	15.5639	16.4941	16.6799
CONDUCTIVITY	9.0201	9.0345	9.1663	7.4376
PRANDTL NUMBER	0.6448	0.6453	0.6504	0.6440

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8773	3.8768	3.8514	3.6257
CONDUCTIVITY	2.3699	2.3680	2.2802	1.7444
PRANDTL NUMBER	0.6136	0.6133	0.6105	0.5969

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1447
CSTAR, M/SEC	1067.9	1067.9	1067.9

CF	0.1014	0.6510	1.5972
Ivac, M/SEC	4325.3	1314.7	1881.7
Isp, M/SEC	108.3	695.2	1705.6

MASS FRACTIONS

CH4	0.20159	0.20109	0.19656	0.18864
*CO	0.15444	0.15397	0.13225	0.02851
*CO2	0.05797	0.05813	0.06449	0.08440
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00012	0.00011	0.00007	0.00000
*H2	0.04484	0.04495	0.04511	0.04148
H2O	0.11305	0.11322	0.12198	0.17241
C(gr)	0.42797	0.42851	0.43952	0.48456

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012596
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0257	1.7455	50.000
P, BAR	60.795	59.274	34.830	1.2159
T, K	1159.39	1157.12	1099.27	812.82
RHO, KG/CU M	1.3267 1	1.2955 1	8.0682 0	4.0363-1
H, KJ/KG	-1454.03	-1459.90	-1696.22	-2912.24
U, KJ/KG	-1912.28	-1917.44	-2127.91	-3213.49
G, KJ/KG	-13158.6	-13147.3	-12799.3	-11122.1
S, KJ/(KG)(K)	10.0954	10.1004	10.1004	10.1004
M, (1/n)	21.036	21.028	21.172	22.435
MW, MOL WT	12.069	12.060	11.974	11.814

(dLV/dLP)t	-1.11968	-1.11973	-1.11806	-1.09709
(dLV/dLT)p	2.3445	2.3473	2.3843	2.3551
Cp, KJ/(KG)(K)	9.4608	9.4852	9.8416	10.0427
GAMMAS	1.1235	1.1235	1.1221	1.1206
SON VEL,M/SEC	717.5	717.0	696.0	581.0
MACH NUMBER	0.000	0.151	1.000	2.939

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.37750	0.37700	0.36372	0.28884
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	15.0433	15.0989	16.0108	16.3245
CONDUCTIVITY	8.8751	8.8896	9.0238	7.3637
PRANDTL NUMBER	0.6399	0.6403	0.6453	0.6403

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8758	3.8753	3.8484	3.6167
CONDUCTIVITY	2.3661	2.3642	2.2757	1.7384
PRANDTL NUMBER	0.6184	0.6180	0.6151	0.6009

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1463
CSTAR, M/SEC	1069.2	1069.2	1069.2
CF	0.1013	0.6509	1.5972
Ivac, M/SEC	4330.7	1316.2	1884.2
Isp, M/SEC	108.4	696.0	1707.8

MASS FRACTIONS

CH4	0.20714	0.20664	0.20195	0.19295
*CO	0.15356	0.15310	0.13178	0.02891
*CO2	0.05785	0.05801	0.06420	0.08392
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00014	0.00014	0.00009	0.00001
*H2	0.04336	0.04347	0.04369	0.04038
H2O	0.11372	0.11388	0.12253	0.17254
C(gr)	0.42421	0.42474	0.43575	0.48129

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE

REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012594

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0257	1.7453	50.000
P, BAR	70.927	69.153	40.639	1.4185
T, K	1169.46	1167.17	1108.63	818.80
RHO, KG/CU M	1.5450 1	1.5087 1	9.3953 0	4.6983-1
H, KJ/KG	-1454.03	-1459.91	-1696.64	-2915.32
U, KJ/KG	-1913.11	-1918.28	-2129.18	-3217.25
G, KJ/KG	-13189.2	-13177.8	-12826.8	-11135.8
S, KJ/(KG)(K)	10.0347	10.0396	10.0396	10.0396
M, (1/n)	21.180	21.172	21.310	22.548
MW, MOL WT	12.155	12.146	12.056	11.878
(dLV/dLP)t	-1.11870	-1.11875	-1.11718	-1.09646
(dLV/dLT)p	2.3235	2.3263	2.3639	2.3390
Cp, KJ/(KG)(K)	9.2816	9.3057	9.6585	9.8880
GAMMAS	1.1231	1.1231	1.1218	1.1205
SON VEL,M/SEC	718.1	717.5	696.6	581.6
MACH NUMBER	0.000	0.151	1.000	2.939

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.37953 0.37903 0.36566 0.29026

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	14.6569	14.7114	15.6070	16.0234
CONDUCTIVITY	8.7504	8.7651	8.9010	7.2992
PRANDTL NUMBER	0.6357	0.6362	0.6411	0.6372

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8751	3.8745	3.8463	3.6094
CONDUCTIVITY	2.3631	2.3611	2.2721	1.7335
PRANDTL NUMBER	0.6224	0.6220	0.6190	0.6044

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1480
CSTAR, M/SEC	1070.3	1070.3	1070.3
CF	0.1013	0.6508	1.5973
Ivac, M/SEC	4335.1	1317.5	1886.2
Isp, M/SEC	108.4	696.6	1709.6

MASS FRACTIONS

CH4	0.21182	0.21131	0.20650	0.19660
*CO	0.15271	0.15228	0.13129	0.02924

*CO2	0.05780	0.05795	0.06400	0.08353
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00016	0.00016	0.00010	0.00001
*H2	0.04212	0.04223	0.04250	0.03945
H2O	0.11430	0.11446	0.12301	0.17265
C(gr)	0.42106	0.42159	0.43260	0.47852

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012591

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0257	1.7452	50.000
P, BAR	81.060	79.032	46.449	1.6212
T, K	1178.21	1175.91	1116.77	824.01
RHO, KG/CU M	1.7631 1	1.7217 1	1.0721 1	5.3591-1
H, KJ/KG	-1454.03	-1459.92	-1696.98	-2917.92
U, KJ/KG	-1913.79	-1918.97	-2130.23	-3220.43
G, KJ/KG	-13215.5	-13204.1	-12850.5	-11147.5
S, KJ/(KG)(K)	9.9824	9.9873	9.9873	9.9873
M, (1/n)	21.308	21.299	21.432	22.648
MW, MOL WT	12.230	12.221	12.128	11.934
(dLV/dLP)t	-1.11775	-1.11782	-1.11632	-1.09586
(dLV/dLT)p	2.3045	2.3074	2.3455	2.3243
Cp, KJ/(KG)(K)	9.1269	9.1508	9.5000	9.7526
GAMMAS	1.1227	1.1227	1.1215	1.1205
SON VEL,M/SEC	718.5	717.9	697.1	582.2
MACH NUMBER	0.000	0.151	1.000	2.939

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.38129 0.38079 0.36733 0.29149

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	14.3266	14.3803	15.2612	15.7623
CONDUCTIVITY	8.6409	8.6558	8.7929	7.2418
PRANDTL NUMBER	0.6322	0.6326	0.6376	0.6345

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8748	3.8741	3.8449	3.6034
CONDUCTIVITY	2.3607	2.3587	2.2691	1.7293
PRANDTL NUMBER	0.6258	0.6254	0.6224	0.6074

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1497
CSTAR, M/SEC	1071.2	1071.2	1071.2
CF	0.1013	0.6507	1.5973
Ivac, M/SEC	4338.7	1318.6	1887.9
Isp, M/SEC	108.5	697.1	1711.1

MASS FRACTIONS

CH4	0.21585	0.21535	0.21042	0.19976
*CO	0.15191	0.15149	0.13081	0.02950
*CO2	0.05779	0.05794	0.06386	0.08322
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00018	0.00018	0.00011	0.00001
*H2	0.04104	0.04115	0.04146	0.03864
H2O	0.11482	0.11497	0.12343	0.17274
C(gr)	0.41837	0.41889	0.42989	0.47613

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012591
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7934
P, BAR	91.192	87.628	50.848
T, K	1185.97	1183.34	1122.31
RHO, KG/CU M	1.9810 1	1.9044 1	1.1724 1
H, KJ/KG	-1454.03	-1454.03	-1697.20
U, KJ/KG	-1914.36	-1914.17	-2130.91
G, KJ/KG	-13238.5	-13230.7	-12866.5
S, KJ/(KG)(K)	9.9366	9.9521	9.9521
M, (1/n)	21.421	21.383	21.515
MW, MOL WT	12.297	12.274	12.177
(dLV/dLP)t	-1.11685	-1.11716	-1.11570
(dLV/dLT)p	2.2874	2.2932	2.3327
Cp, KJ/(KG)(K)	8.9911	9.0370	9.3928
GAMMAS	1.1224	1.1225	1.1213
SON VEL,M/SEC	718.8	718.7	697.4
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.38283 0.38079 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	14.0391	14.3803	6.0142
CONDUCTIVITY	8.5434	8.6558	NaN
PRANDTL NUMBER	0.6291	0.6326	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8748	3.8741	5.8054
CONDUCTIVITY	2.3587	2.3587	NaN
PRANDTL NUMBER	0.6289	0.6254	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1101.5	1101.5
CF	0.0002	0.6331
Ivac, M/SEC	1857529.8	1319.3
Isp, M/SEC	0.2	697.4

MASS FRACTIONS

CH4	0.21939	0.21819	0.21307
*CO	0.15115	0.15141	0.13045
*CO2	0.05782	0.05781	0.06378
C2H4	0.00003	0.00003	0.00001
C2H6	0.00020	0.00019	0.00012
*H2	0.04010	0.04042	0.04076
H2O	0.11529	0.11513	0.12372
*O	0.00000	0.00000	0.00001

C(gr) 0.41602 0.41682 0.42808

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012588

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.30000 %FUEL= 76.923077 R,EQ.RATIO=11.352221 PHI,EQ.RATIO=11.352221

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0256	1.7448	50.000
P, BAR	101.33	98.792	58.071	2.0265
T, K	1192.92	1190.58	1130.47	832.77
RHO, KG/CU M	2.1988 1	2.1471 1	1.3369 1	6.6775-1
H, KJ/KG	-1454.03	-1459.93	-1697.50	-2922.11
U, KJ/KG	-1914.84	-1920.04	-2131.87	-3225.59
G, KJ/KG	-13258.9	-13247.5	-12889.8	-11167.1
S, KJ/(KG)(K)	9.8958	9.9006	9.9006	9.9006
M, (1/n)	21.524	21.514	21.639	22.816
MW, MOL WT	12.357	12.347	12.250	12.028
(dLV/dLP)t	-1.11599	-1.11607	-1.11472	-1.09473
(dLV/dLT)p	2.2716	2.2746	2.3134	2.2985
Cp, KJ/(KG)(K)	8.8702	8.8938	9.2359	9.5237
GAMMAS	1.1220	1.1220	1.1210	1.1204
SON VEL,M/SEC	719.0	718.5	697.8	583.1
MACH NUMBER	0.000	0.151	1.000	2.939

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.38421 0.38371 0.37013 0.29356

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.7850	13.8371	14.6923	15.3260
CONDUCTIVITY	8.4554	8.4704	8.6092	7.1427
PRANDTL NUMBER	0.6264	0.6268	0.6317	0.6299

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.8750	3.8742	3.8432	3.5941
CONDUCTIVITY	2.3570	2.3550	2.2646	1.7225
PRANDTL NUMBER	0.6317	0.6313	0.6281	0.6125

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1531
CSTAR, M/SEC	1072.6	1072.6	1072.6
CF	0.1013	0.6505	1.5975
Ivac, M/SEC	4344.6	1320.3	1890.6
Isp, M/SEC	108.6	697.8	1713.5

MASS FRACTIONS

CH4	0.22254	0.22204	0.21695	0.20502
*CO	0.15042	0.15002	0.12987	0.02992
*CO2	0.05786	0.05799	0.06370	0.08271
C2H4	0.00003	0.00003	0.00001	0.00000
C2H6	0.00022	0.00021	0.00014	0.00001
*H2	0.03925	0.03936	0.03973	0.03730
H2O	0.11573	0.11587	0.12416	0.17289
C(gr)	0.41395	0.41446	0.42543	0.47215

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012588
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7976
P, BAR	10.133	9.7365	5.6367
T, K	1104.26	1101.77	1047.00
RHO, KG/CU M	2.0168 0	1.9397 0	1.1963 0
H, KJ/KG	-1379.14	-1379.14	-1644.96
U, KJ/KG	-1881.56	-1881.11	-2116.15
G, KJ/KG	-13936.5	-13928.2	-13570.1
S, KJ/(KG)(K)	11.3717	11.3899	11.3899
M, (1/n)	18.275	18.250	18.475
MW, MOL WT	11.378	11.361	11.308
(dLV/dLP)t	-1.11714	-1.11681	-1.11681
(dLV/dLT)p	2.4544	2.4542	2.5304
Cp, KJ/(KG)(K)	11.6574	11.6909	12.5006
GAMMAS	1.1338	1.1337	1.1283
SON VEL,M/SEC	754.7	754.4	729.1
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.38342	0.38371	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	17.7780	13.8371	9.9331
CONDUCTIVITY	9.8289	8.4704	NaN
PRANDTL NUMBER	0.6935	0.6268	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5089	3.8742	3.9874
CONDUCTIVITY	2.4917	2.3550	NaN
PRANDTL NUMBER	0.5399	0.6313	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1147.2	1147.2
CF	0.0001	0.6356
Ivac, M/SEC	5669128.8	1375.4
Isp, M/SEC	0.1	729.1

MASS FRACTIONS

CH4	0.10465	0.10360	0.10027
*CO	0.27782	0.27801	0.24501
*CO2	0.06589	0.06602	0.07929
C2H6	0.00002	0.00002	0.00001
*H2	0.06418	0.06447	0.06415
H2O	0.08909	0.08886	0.09921
C(gr)	0.39836	0.39903	0.41205

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012588

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7984
P, BAR	20.265	19.473	11.269
T, K	1149.14	1146.49	1087.94
RHO, KG/CU M	3.9746 0	3.8223 0	2.3575 0
H, KJ/KG	-1379.14	-1379.14	-1649.08
U, KJ/KG	-1889.01	-1888.60	-2127.07
G, KJ/KG	-14088.9	-14079.8	-13701.2
S, KJ/(KG)(K)	11.0602	11.0779	11.0779
M, (1/n)	18.739	18.711	18.924
MW, MOL WT	11.693	11.674	11.606
(dLV/dLP)t	-1.12186	-1.12164	-1.12159
(dLV/dLT)p	2.4451	2.4463	2.5235
Cp, KJ/(KG)(K)	11.0339	11.0717	11.8447
GAMMAS	1.1345	1.1345	1.1294
SON VEL,M/SEC	760.6	760.2	734.8
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.39332 0.38371 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	16.5399	13.8371	13.8683
CONDUCTIVITY	9.6474	8.4704	NaN
PRANDTL NUMBER	0.6743	0.6268	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5049	3.8742	3.6834
CONDUCTIVITY	2.4834	2.3550	NaN
PRANDTL NUMBER	0.5551	0.6313	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1155.4	1155.4
CF	0.0000	0.6359
Ivac, M/SEC	*****	1385.3
Isp, M/SEC	0.0	734.8

MASS FRACTIONS

CH4	0.12363	0.12250	0.11848
*CO	0.27416	0.27439	0.24267
*CO2	0.06403	0.06411	0.07639
C2H4	0.00001	0.00001	0.00000
C2H6	0.00003	0.00003	0.00002
*H2	0.05897	0.05928	0.05913
H2O	0.09296	0.09274	0.10310
C(gr)	0.38621	0.38693	0.40021

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012671
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7503	50.000
P, BAR	30.398	29.632	17.368	0.60795
T, K	1176.68	1174.30	1114.83	833.47
RHO, KG/CU M	5.9148 0	5.7761 0	3.6031 0	1.8107-1
H, KJ/KG	-1379.14	-1385.77	-1651.45	-3003.40
U, KJ/KG	-1893.07	-1898.79	-2133.46	-3339.17
G, KJ/KG	-14183.5	-14170.7	-13788.8	-12077.5
S, KJ/(KG)(K)	10.8817	10.8872	10.8872	10.8872
M, (1/n)	19.037	19.032	19.230	20.639
MW, MOL WT	11.895	11.887	11.810	11.523
(dLV/dLP)t	-1.12366	-1.12363	-1.12357	-1.10315
(dLV/dLT)p	2.4292	2.4319	2.5074	2.5251
Cp, KJ/(KG)(K)	10.6385	10.6700	11.3966	12.3688
GAMMAS	1.1346	1.1345	1.1299	1.1167
SON VEL,M/SEC	763.6	762.9	738.0	612.3
MACH NUMBER	0.000	0.151	1.000	2.943

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.39924 0.39872 0.38522 0.31390

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	15.7526	15.8141	17.2882	21.4295
CONDUCTIVITY	9.4869	9.5036	9.9241	9.9110
PRANDTL NUMBER	0.6629	0.6635	0.6711	0.6787

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5049	3.5046	3.4926	3.4373
CONDUCTIVITY	2.4779	2.4759	2.3917	1.9544
PRANDTL NUMBER	0.5647	0.5644	0.5625	0.5521

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1478
CSTAR, M/SEC	1128.9	1128.9	1128.9
CF	0.1019	0.6537	1.5966
Ivac, M/SEC	4572.8	1391.1	1988.7
Isp, M/SEC	115.1	738.0	1802.4

MASS FRACTIONS

CH4	0.13525	0.13478	0.13041	0.11354
*CO	0.27160	0.27097	0.24085	0.07400
*CO2	0.06330	0.06359	0.07498	0.13454
C2H4	0.00001	0.00001	0.00001	0.00000
C2H6	0.00005	0.00005	0.00003	0.00000
*H2	0.05579	0.05589	0.05587	0.05357
H2O	0.09520	0.09537	0.10541	0.16397

C(gr) 0.37878 0.37933 0.39243 0.46038

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012671
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7503	50.000
P, BAR	40.530	39.510	23.155	0.81060
T, K	1196.77	1194.33	1133.24	844.84
RHO, KG/CU M	7.8448 0	7.6608 0	4.7786 0	2.4037-1
H, KJ/KG	-1379.14	-1385.80	-1652.92	-3011.48
U, KJ/KG	-1895.79	-1901.55	-2137.48	-3348.71
G, KJ/KG	-14252.5	-14239.5	-13849.2	-12103.9
S, KJ/(KG)(K)	10.7568	10.7623	10.7623	10.7623
M, (1/n)	19.260	19.254	19.445	20.830
MW, MOL WT	12.046	12.037	11.953	11.635
(dLV/dLP)t	-1.12446	-1.12445	-1.12441	-1.10425
(dLV/dLT)p	2.4133	2.4161	2.4916	2.5219
Cp, KJ/(KG)(K)	10.3476	10.3788	11.0858	12.1459
GAMMA _s	1.1344	1.1343	1.1300	1.1170
SON VEL,M/SEC	765.6	764.9	740.0	613.8

MACH NUMBER	0.000	0.151	1.000	2.944
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TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.40349	0.40296	0.38920	0.31659
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	15.1773	15.2380	16.6631	20.8349
CONDUCTIVITY	9.3519	9.3693	9.7856	9.8198
PRANDTL NUMBER	0.6548	0.6554	0.6627	0.6717

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5061	3.5056	3.4914	3.4234
CONDUCTIVITY	2.4740	2.4720	2.3863	1.9426
PRANDTL NUMBER	0.5718	0.5715	0.5694	0.5579

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1417
CSTAR, M/SEC	1131.9	1131.9	1131.9
CF	0.1019	0.6538	1.5963
Ivac, M/SEC	4584.8	1394.8	1993.5
Isp, M/SEC	115.4	740.0	1806.8

MASS FRACTIONS

CH4	0.14368	0.14319	0.13852	0.12024
*CO	0.26954	0.26893	0.23944	0.07475
*CO2	0.06296	0.06323	0.07424	0.13225
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00007	0.00007	0.00004	0.00000
*H2	0.05349	0.05360	0.05366	0.05173
H2O	0.09680	0.09697	0.10693	0.16536
C(gr)	0.37343	0.37398	0.38715	0.45567

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012671
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7504	50.000
P, BAR	50.663	49.387	28.944	1.0132
T, K	1212.64	1210.15	1147.81	853.84
RHO, KG/CU M	9.7680 0	9.5388 0	5.9498 0	2.9946-1
H, KJ/KG	-1379.14	-1385.83	-1654.00	-3017.58
U, KJ/KG	-1897.80	-1903.58	-2140.47	-3355.94
G, KJ/KG	-14307.0	-14293.7	-13896.9	-12124.9
S, KJ/(KG)(K)	10.6609	10.6663	10.6663	10.6663
M, (1/n)	19.440	19.434	19.618	20.981
MW, MOL WT	12.168	12.158	12.068	11.725
(dLV/dLP)t	-1.12480	-1.12481	-1.12479	-1.10490
(dLV/dLT)p	2.3983	2.4012	2.4766	2.5165
Cp, KJ/(KG)(K)	10.1175	10.1484	10.8390	11.9599
GAMMAS	1.1342	1.1341	1.1300	1.1172
SON VEL,M/SEC	767.0	766.3	741.4	614.8
MACH NUMBER	0.000	0.151	1.000	2.944

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.40681 0.40628 0.39232 0.31871

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	14.7256	14.7854	16.1703	20.3571
CONDUCTIVITY	9.2365	9.2541	9.6662	9.7379
PRANDTL NUMBER	0.6486	0.6491	0.6563	0.6663

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5077	3.5071	3.4912	3.4132
CONDUCTIVITY	2.4711	2.4690	2.3823	1.9335
PRANDTL NUMBER	0.5775	0.5771	0.5749	0.5626

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1377
CSTAR, M/SEC	1134.1	1134.1	1134.1
CF	0.1019	0.6538	1.5962
Ivac, M/SEC	4593.9	1397.6	1997.1
Isp, M/SEC	115.6	741.4	1810.2

MASS FRACTIONS

CH4	0.15030	0.14980	0.14490	0.12550
*CO	0.26777	0.26718	0.23821	0.07531
*CO2	0.06281	0.06307	0.07377	0.13057
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00009	0.00008	0.00005	0.00000
*H2	0.05168	0.05179	0.05193	0.05029
H2O	0.09806	0.09823	0.10811	0.16638
C(gr)	0.36926	0.36981	0.38302	0.45195

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012670
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7503	50.000
P, BAR	60.795	59.265	34.733	1.2159
T, K	1225.79	1223.26	1159.90	861.30
RHO, KG/CU M	1.1686 1	1.1412 1	7.1177 0	3.5838-1
H, KJ/KG	-1379.14	-1385.85	-1654.84	-3022.46
U, KJ/KG	-1899.37	-1905.18	-2142.82	-3361.74
G, KJ/KG	-14351.9	-14338.5	-13936.5	-12142.4

S, KJ/(KG)(K)	10.5832	10.5886	10.5886	10.5886
M, (1/n)	19.591	19.585	19.763	21.107
MW, MOL WT	12.269	12.260	12.164	11.800
(dLV/dLP)t	-1.12490	-1.12491	-1.12492	-1.10529
(dLV/dLT)p	2.3843	2.3874	2.4627	2.5103
Cp, KJ/(KG)(K)	9.9273	9.9579	10.6344	11.8001
GAMMAS	1.1340	1.1339	1.1300	1.1174
SON VEL,M/SEC	768.1	767.4	742.6	615.7
MACH NUMBER	0.000	0.151	1.000	2.944

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.40954	0.40900	0.39488	0.32045
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	14.3548	14.4137	15.7645	19.9575
CONDUCTIVITY	9.1357	9.1536	9.5615	9.6641
PRANDTL NUMBER	0.6435	0.6440	0.6511	0.6618

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5094	3.5089	3.4915	3.4054
CONDUCTIVITY	2.4687	2.4667	2.3791	1.9261
PRANDTL NUMBER	0.5822	0.5818	0.5795	0.5666

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1349
CSTAR, M/SEC	1135.9	1135.9	1135.9
CF	0.1019	0.6537	1.5961
Ivac, M/SEC	4601.0	1399.7	2000.1
Isp, M/SEC	115.8	742.6	1812.9

MASS FRACTIONS

CH4	0.15574	0.15524	0.15015	0.12984
*CO	0.26621	0.26564	0.23710	0.07573
*CO2	0.06277	0.06301	0.07346	0.12927
C2H4	0.00003	0.00003	0.00001	0.00000
C2H6	0.00010	0.00010	0.00006	0.00000
*H2	0.05019	0.05030	0.05050	0.04911
H2O	0.09910	0.09927	0.10907	0.16717
C(gr)	0.36584	0.36640	0.37964	0.44887

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE

REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012670
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.7987
P, BAR	70.927	68.155	39.432
T, K	1237.02	1234.11	1168.39
RHO, KG/CU M	1.3601 1	1.3077 1	8.0638 0
H, KJ/KG	-1379.14	-1379.14	-1655.40
U, KJ/KG	-1900.65	-1900.32	-2144.40
G, KJ/KG	-14390.2	-14380.3	-13964.3
S, KJ/(KG)(K)	10.5180	10.5349	10.5349
M, (1/n)	19.722	19.688	19.866
MW, MOL WT	12.357	12.334	12.233
(dLV/dLP)t	-1.12484	-1.12487	-1.12492
(dLV/dLT)p	2.3714	2.3749	2.4521
Cp, KJ/(KG)(K)	9.7653	9.8073	10.4908
GAMMAS	1.1337	1.1338	1.1299
SON VEL,M/SEC	768.9	768.7	743.3
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.41185 0.40900 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	14.0409	14.4137	5.2275
CONDUCTIVITY	9.0463	9.1536	NaN
PRANDTL NUMBER	0.6392	0.6440	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5113	3.5089	4.8922
CONDUCTIVITY	2.4668	2.4667	NaN
PRANDTL NUMBER	0.5862	0.5818	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1168.5	1168.5

CF	0.0003	0.6361
Ivac, M/SEC	1657784.5	1401.2
Isp, M/SEC	0.3	743.3

MASS FRACTIONS

CH4	0.16037	0.15917	0.15382
*CO	0.26479	0.26517	0.23627
*CO2	0.06278	0.06277	0.07329
C2H4	0.00003	0.00003	0.00002
C2H6	0.00012	0.00011	0.00007
*H2	0.04893	0.04926	0.04950
H2O	0.10000	0.09977	0.10975
C(gr)	0.36297	0.36371	0.37729

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012667
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7502	50.000
P, BAR	81.060	79.021	46.314	1.6212
T, K	1246.84	1244.26	1179.27	873.26
RHO, KG/CU M	1.5512 1	1.5147 1	9.4467 0	4.7584-1
H, KJ/KG	-1379.14	-1385.88	-1656.08	-3029.94
U, KJ/KG	-1901.71	-1907.55	-2146.34	-3370.64
G, KJ/KG	-14423.5	-14409.8	-13999.8	-12170.5
S, KJ/(KG)(K)	10.4619	10.4672	10.4672	10.4672

M, (1/n)	19.838	19.831	20.000	21.311
MW, MOL WT	12.435	12.425	12.321	11.921
(dLV/dLP)t	-1.12469	-1.12473	-1.12479	-1.10566
(dLV/dLT)p	2.3594	2.3626	2.4376	2.4971
Cp, KJ/(KG)(K)	9.6244	9.6544	10.3076	11.5344
GAMMAS	1.1334	1.1334	1.1298	1.1176
SON VEL,M/SEC	769.6	768.9	744.2	617.1
MACH NUMBER	0.000	0.151	1.000	2.945

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.41386	0.41331	0.39894	0.32323
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.7694	13.8267	15.1219	19.3127
CONDUCTIVITY	8.9659	8.9841	9.3843	9.5355
PRANDTL NUMBER	0.6356	0.6361	0.6429	0.6547

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5131	3.5124	3.4929	3.3938
CONDUCTIVITY	2.4653	2.4632	2.3744	1.9146
PRANDTL NUMBER	0.5898	0.5894	0.5869	0.5730

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1314
CSTAR, M/SEC	1138.6	1138.6	1138.6
CF	0.1019	0.6537	1.5959
Ivac, M/SEC	4611.9	1403.0	2004.5
Isp, M/SEC	116.0	744.2	1817.0

MASS FRACTIONS

CH4	0.16438	0.16387	0.15849	0.13676
*CO	0.26350	0.26296	0.23515	0.07636
*CO2	0.06284	0.06307	0.07312	0.12734
C2H4	0.00004	0.00004	0.00002	0.00000
C2H6	0.00014	0.00013	0.00008	0.00000
*H2	0.04783	0.04794	0.04822	0.04724
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.10079	0.10095	0.11061	0.16835
C(gr)	0.36048	0.36104	0.37431	0.44395

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012665

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7502	50.000
P, BAR	91.192	88.898	52.105	1.8239
T, K	1255.56	1252.96	1187.31	878.23
RHO, KG/CU M	1.7421 1	1.7011 1	1.0609 1	5.3441-1
H, KJ/KG	-1379.14	-1385.89	-1656.56	-3032.92
U, KJ/KG	-1902.62	-1908.48	-2147.71	-3374.20
G, KJ/KG	-14452.9	-14439.2	-14025.9	-12182.2
S, KJ/(KG)(K)	10.4127	10.4179	10.4179	10.4179
M, (1/n)	19.942	19.935	20.099	21.396
MW, MOL WT	12.504	12.494	12.386	11.971
(dLV/dLP)t	-1.12449	-1.12453	-1.12462	-1.10571
(dLV/dLT)p	2.3482	2.3515	2.4262	2.4905
Cp, KJ/(KG)(K)	9.4999	9.5296	10.1728	11.4212
GAMMAS	1.1332	1.1331	1.1296	1.1177
SON VEL,M/SEC	770.2	769.5	744.9	617.6
MACH NUMBER	0.000	0.151	1.000	2.945

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.41563 0.41508 0.40061 0.32438

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.5305	13.5871	14.8590	19.0446
CONDUCTIVITY	8.8929	8.9112	9.3078	9.4787
PRANDTL NUMBER	0.6324	0.6329	0.6395	0.6517

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5149	3.5142	3.4938	3.3893
CONDUCTIVITY	2.4640	2.4619	2.3725	1.9099
PRANDTL NUMBER	0.5929	0.5925	0.5899	0.5757

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000	8.1304
CSTAR, M/SEC	1139.6	1139.6	1139.6
CF	0.1019	0.6536	1.5959
Ivac, M/SEC	4616.2	1404.3	2006.3
Isp, M/SEC	116.1	744.9	1818.7

MASS FRACTIONS

CH4	0.16793	0.16741	0.16192	0.13961
*CO	0.26230	0.26178	0.23427	0.07660
*CO2	0.06292	0.06314	0.07303	0.12659
C2H4	0.00004	0.00004	0.00002	0.00000
C2H6	0.00015	0.00015	0.00009	0.00001
*H2	0.04685	0.04697	0.04729	0.04647
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.10149	0.10165	0.11124	0.16881
C(gr)	0.35830	0.35886	0.37213	0.44192

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012664

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.40000 %FUEL= 71.428571 R,EQ.RATIO= 8.514166 PHI,EQ.RATIO= 8.514166

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7501	50.000
P, BAR	101.33	98.776	57.897	2.0265
T, K	1263.41	1260.79	1194.55	882.71
RHO, KG/CU M	1.9327 1	1.8873 1	1.1769 1	5.9289-1
H, KJ/KG	-1379.14	-1385.90	-1656.97	-3035.54
U, KJ/KG	-1903.41	-1909.27	-2148.91	-3377.34
G, KJ/KG	-14479.3	-14465.5	-14049.3	-12192.8
S, KJ/(KG)(K)	10.3689	10.3741	10.3741	10.3741
M, (1/n)	20.037	20.029	20.190	21.473
MW, MOL WT	12.566	12.556	12.445	12.017
(dLV/dLP)t	-1.12424	-1.12429	-1.12441	-1.10572
(dLV/dLT)p	2.3377	2.3410	2.4156	2.4840
Cp, KJ/(KG)(K)	9.3884	9.4179	10.0519	11.3179
GAMMAS	1.1329	1.1328	1.1295	1.1178
SON VEL,M/SEC	770.7	770.0	745.4	618.1
MACH NUMBER	0.000	0.151	1.000	2.945

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.41722 0.41667 0.40211 0.32541

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.3175	13.3734	14.6242	18.8030
CONDUCTIVITY	8.8260	8.8443	9.2376	9.4260
PRANDTL NUMBER	0.6295	0.6300	0.6366	0.6491

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.5167	3.5159	3.4948	3.3855
CONDUCTIVITY	2.4629	2.4608	2.3710	1.9058
PRANDTL NUMBER	0.5957	0.5953	0.5927	0.5781

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1296
CSTAR, M/SEC	1140.5	1140.5	1140.5
CF	0.1019	0.6536	1.5958
Ivac, M/SEC	4619.9	1405.4	2007.9
Isp, M/SEC	116.2	745.4	1820.1

MASS FRACTIONS

CH4 0.17110 0.17058 0.16499 0.14216

*CO	0.26118	0.26067	0.23345	0.07679
*CO2	0.06302	0.06323	0.07298	0.12594
C2H4	0.00005	0.00004	0.00002	0.00000
C2H6	0.00017	0.00016	0.00010	0.00001
*H2	0.04598	0.04609	0.04645	0.04579
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.10213	0.10228	0.11181	0.16921
C(gr)	0.35636	0.35692	0.37019	0.44010

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012664
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8027
P, BAR	10.133	9.7365	5.6208
T, K	1153.17	1150.57	1090.44
RHO, KG/CU M	1.8341 0	1.7642 0	1.0899 0
H, KJ/KG	-1314.24	-1314.24	-1607.32
U, KJ/KG	-1866.69	-1866.13	-2123.06
G, KJ/KG	-14933.1	-14924.5	-14506.3
S, KJ/(KG)(K)	11.8100	11.8291	11.8291
M, (1/n)	17.356	17.334	17.580
MW, MOL WT	11.751	11.735	11.694
(dLV/dLP)t	-1.10248	-1.10200	-1.10549
(dLV/dLT)p	2.2613	2.2592	2.3892

Cp, KJ/(KG)(K)	10.6893	10.7078	11.9649
GAMMAS	1.1451	1.1450	1.1366
SON VEL,M/SEC	795.4	794.9	765.6
MACH NUMBER	0.000	NaN	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.40671	0.41667	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	14.2406	13.3734	4.6882
CONDUCTIVITY	8.4241	8.8443	NaN
PRANDTL NUMBER	0.6875	0.6300	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.1713	3.5159	4.5058
CONDUCTIVITY	2.4982	2.4608	NaN
PRANDTL NUMBER	0.5163	0.5953	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1199.2	1199.2
CF	NaN	0.6385
Ivac, M/SEC	NaN	1439.2
Isp, M/SEC	NaN	765.6

MASS FRACTIONS

*C	0.00000	0.00000	0.00034
CH4	0.07302	0.07213	0.06972
*CO	0.40082	0.40123	0.36387
*CO2	0.05958	0.05962	0.07624
C2H4	0.00001	0.00001	0.00000
C2H6	0.00001	0.00001	0.00001
*H2	0.06770	0.06796	0.06740
H2O	0.06876	0.06846	0.07888
*O	0.00000	0.00000	0.00026
C(gr)	0.33010	0.33058	0.34387

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012751
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7554	50.000
P, BAR	20.265	19.752	11.544	0.40530
T, K	1200.08	1197.58	1134.76	853.69
RHO, KG/CU M	3.6063 0	3.5219 0	2.2006 0	1.1135-1
H, KJ/KG	-1314.24	-1321.53	-1612.81	-3076.27
U, KJ/KG	-1876.17	-1882.36	-2137.40	-3440.25
G, KJ/KG	-15093.2	-15078.8	-14648.5	-12883.1
S, KJ/(KG)(K)	11.4816	11.4876	11.4876	11.4876
M, (1/n)	17.757	17.755	17.985	19.501
MW, MOL WT	12.042	12.035	11.979	11.669
(dLV/dLP)t	-1.11013	-1.11009	-1.11304	-1.10021
(dLV/dLT)p	2.2883	2.2912	2.4132	2.5907
Cp, KJ/(KG)(K)	10.3160	10.3518	11.4781	14.1910
GAMMAS	1.1462	1.1460	1.1383	1.1129
SON VEL,M/SEC	802.5	801.7	772.8	636.5
MACH NUMBER	0.000	0.151	1.000	2.950

TRANSPORT PROPERTIES (GASES ONLY) CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.41721 0.41665 0.40249 0.33379

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.7415	13.7931	15.4336	22.0662
CONDUCTIVITY	8.5357	8.5490	9.0964	10.3157
PRANDTL NUMBER	0.6717	0.6722	0.6829	0.7140

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.1799	3.1794	3.1692	3.1724
CONDUCTIVITY	2.5041	2.5017	2.4125	2.0380
PRANDTL NUMBER	0.5298	0.5295	0.5287	0.5196

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1351
CSTAR, M/SEC	1176.7	1176.7	1176.7

CF	0.1026	0.6567	1.5954
Ivac, M/SEC	4766.8	1451.6	2071.1
Isp, M/SEC	120.7	772.7	1877.2

MASS FRACTIONS

CH4	0.08954	0.08915	0.08605	0.06825
*CO	0.39355	0.39285	0.35754	0.14219
*CO2	0.05905	0.05940	0.07452	0.17381
C2H4	0.00001	0.00001	0.00001	0.00000
C2H6	0.00002	0.00002	0.00001	0.00000
*H2	0.06298	0.06306	0.06268	0.06076
H2O	0.07387	0.07403	0.08436	0.14158
C(gr)	0.32098	0.32147	0.33482	0.41341

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012751
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8043
P, BAR	30.398	29.209	16.847
T, K	1229.12	1226.21	1159.40
RHO, KG/CU M	5.3591 0	5.1542 0	3.1843 0
H, KJ/KG	-1314.24	-1314.24	-1615.54
U, KJ/KG	-1881.46	-1880.95	-2144.62

G, KJ/KG	-15194.9	-15184.6	-14730.2
S, KJ/(KG)(K)	11.2931	11.3116	11.3116
M, (1/n)	18.017	17.991	18.220
MW, MOL WT	12.234	12.215	12.148
(dLV/dLP)t	-1.11390	-1.11356	-1.11638
(dLV/dLT)p	2.2949	2.2945	2.4171
Cp, KJ/(KG)(K)	10.0552	10.0821	11.1830
GAMMAS	1.1465	1.1465	1.1390
SON VEL,M/SEC	806.4	806.1	776.3
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.42355	0.41665	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.3376	13.7931	4.5696
CONDUCTIVITY	8.5370	8.5490	NaN
PRANDTL NUMBER	0.6617	0.6722	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.1862	3.1794	4.3340
CONDUCTIVITY	2.5059	2.5017	NaN
PRANDTL NUMBER	0.5385	0.5295	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1214.2	1214.2
CF	0.0005	0.6393
Ivac, M/SEC	1032706.6	1457.8
Isp, M/SEC	0.5	776.3

MASS FRACTIONS

CH4	0.09997	0.09892	0.09531
*CO	0.38908	0.38953	0.35410
*CO2	0.05895	0.05895	0.07383
C2H4	0.00002	0.00002	0.00001
C2H6	0.00004	0.00003	0.00002
*H2	0.06002	0.06032	0.06004
H2O	0.07682	0.07653	0.08714
*O	0.00000	0.00000	0.00001
C(gr)	0.31509	0.31569	0.32954

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012757
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7562	50.000
P, BAR	40.530	39.503	23.079	0.81060
T, K	1250.42	1247.75	1180.62	881.12
RHO, KG/CU M	7.1003 0	6.9338 0	4.3324 0	2.2029-1
H, KJ/KG	-1314.24	-1321.65	-1617.72	-3100.70
U, KJ/KG	-1885.06	-1891.36	-2150.42	-3468.67
G, KJ/KG	-15270.3	-15255.1	-14801.6	-12940.0
S, KJ/(KG)(K)	11.1611	11.1669	11.1669	11.1669
M, (1/n)	18.214	18.210	18.428	19.909
MW, MOL WT	12.380	12.372	12.297	11.910
(dLV/dLP)t	-1.11619	-1.11617	-1.11875	-1.10574
(dLV/dLT)p	2.2951	2.2982	2.4155	2.6139
Cp, KJ/(KG)(K)	9.8536	9.8883	10.9188	13.6835
GAMMAS	1.1466	1.1464	1.1394	1.1146
SON VEL,M/SEC	809.0	808.2	779.1	640.4
MACH NUMBER	0.000	0.151	1.000	2.952

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.42814 0.42756 0.41268 0.34051

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	13.0113	13.0637	14.6078	21.2434
CONDUCTIVITY	8.5113	8.5267	9.0706	10.4000
PRANDTL NUMBER	0.6545	0.6551	0.6646	0.6955

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.1914	3.1907	3.1764	3.1533
CONDUCTIVITY	2.5067	2.5042	2.4115	2.0163

PRANDTL NUMBER 0.5451 0.5448 0.5436 0.5325

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1060
CSTAR, M/SEC	1185.7	1185.7	1185.7
CF	0.1026	0.6571	1.5942
Ivac, M/SEC	4803.2	1462.8	2084.9
Isp, M/SEC	121.7	779.1	1890.2

MASS FRACTIONS

CH4	0.10768	0.10724	0.10334	0.08216
*CO	0.38575	0.38510	0.35112	0.14185
*CO2	0.05901	0.05933	0.07340	0.16623
C2H4	0.00003	0.00002	0.00001	0.00000
C2H6	0.00005	0.00005	0.00003	0.00000
*H2	0.05785	0.05794	0.05777	0.05654
H2O	0.07891	0.07907	0.08941	0.14801
C(gr)	0.31072	0.31124	0.32492	0.40521

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012758
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7563	50.000
P, BAR	50.663	49.379	28.846	1.0132
T, K	1267.33	1264.60	1196.05	890.33
RHO, KG/CU M	8.8337 0	8.6264 0	5.3898 0	2.7441-1
H, KJ/KG	-1314.24	-1321.68	-1619.20	-3108.32
U, KJ/KG	-1887.76	-1894.09	-2154.39	-3477.56
G, KJ/KG	-15330.5	-15315.0	-14854.0	-12960.2
S, KJ/(KG)(K)	11.0597	11.0654	11.0654	11.0654
M, (1/n)	18.373	18.369	18.581	20.048
MW, MOL WT	12.499	12.490	12.409	11.994
(dLV/dLP)t	-1.11772	-1.11771	-1.12019	-1.10723
(dLV/dLT)p	2.2927	2.2959	2.4116	2.6167
Cp, KJ/(KG)(K)	9.6888	9.7231	10.7225	13.4965
GAMMAS	1.1465	1.1464	1.1396	1.1150
SON VEL,M/SEC	810.9	810.1	781.0	641.7
MACH NUMBER	0.000	0.151	1.000	2.952

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.43174 0.43115 0.41604 0.34272

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	12.7394	12.7916	14.2979	20.9046
CONDUCTIVITY	8.4771	8.4930	9.0328	10.3922
PRANDTL NUMBER	0.6488	0.6494	0.6585	0.6894

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.1959	3.1952	3.1795	3.1476
CONDUCTIVITY	2.5070	2.5045	2.4108	2.0088
PRANDTL NUMBER	0.5504	0.5500	0.5487	0.5370

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0978
CSTAR, M/SEC	1188.4	1188.4	1188.4
CF	0.1026	0.6571	1.5939
Ivac, M/SEC	4814.4	1466.3	2089.2
Isp, M/SEC	122.0	781.0	1894.2

MASS FRACTIONS

CH4	0.11381	0.11336	0.10918	0.08688
*CO	0.38304	0.38241	0.34890	0.14177
*CO2	0.05915	0.05945	0.07318	0.16398
C2H4	0.00003	0.00003	0.00001	0.00000
C2H6	0.00006	0.00006	0.00004	0.00000
*H2	0.05612	0.05622	0.05612	0.05515
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.08054	0.08070	0.09101	0.14990
C(gr)	0.30724	0.30777	0.32154	0.40233

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012758
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7564	50.000
P, BAR	60.795	59.255	34.614	1.2159
T, K	1281.39	1278.62	1208.88	898.00
RHO, KG/CU M	1.0561 1	1.0313 1	6.4435 0	3.2838-1
H, KJ/KG	-1314.24	-1321.71	-1620.36	-3114.45
U, KJ/KG	-1889.89	-1896.26	-2157.55	-3484.72
G, KJ/KG	-15380.6	-15365.0	-14897.7	-12977.4
S, KJ/(KG)(K)	10.9775	10.9832	10.9832	10.9832
M, (1/n)	18.508	18.503	18.711	20.165
MW, MOL WT	12.599	12.590	12.503	12.065
(dLV/dLP)t	-1.11880	-1.11881	-1.12121	-1.10832
(dLV/dLT)p	2.2890	2.2923	2.4068	2.6173
Cp, KJ/(KG)(K)	9.5494	9.5833	10.5573	13.3353
GAMMAS	1.1464	1.1462	1.1397	1.1154
SON VEL,M/SEC	812.3	811.5	782.5	642.7
MACH NUMBER	0.000	0.151	1.000	2.953

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.43471 0.43411 0.41882 0.34455

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	12.5068	12.5587	14.0323	20.6049
CONDUCTIVITY	8.4403	8.4566	8.9920	10.3738
PRANDTL NUMBER	0.6441	0.6447	0.6536	0.6844

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.1999	3.1991	3.1824	3.1431
CONDUCTIVITY	2.5071	2.5046	2.4101	2.0026
PRANDTL NUMBER	0.5548	0.5545	0.5530	0.5408

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0916
CSTAR, M/SEC	1190.6	1190.6	1190.6
CF	0.1026	0.6572	1.5937
Ivac, M/SEC	4823.3	1469.0	2092.6
Isp, M/SEC	122.2	782.5	1897.5

MASS FRACTIONS

CH4	0.11890	0.11844	0.11404	0.09081
*CO	0.38074	0.38012	0.34702	0.14170
*CO2	0.05932	0.05962	0.07307	0.16222
C2H4	0.00004	0.00004	0.00002	0.00000
C2H6	0.00007	0.00007	0.00005	0.00000
*H2	0.05469	0.05479	0.05475	0.05399
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.08188	0.08204	0.09231	0.15138
C(gr)	0.30435	0.30488	0.31873	0.39989

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012758

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7564	50.000
P, BAR	70.927	69.130	40.382	1.4185
T, K	1293.44	1290.63	1219.90	904.59
RHO, KG/CU M	1.2284 1	1.1996 1	7.4942 0	3.8221-1
H, KJ/KG	-1314.24	-1321.73	-1621.31	-3119.55
U, KJ/KG	-1891.64	-1898.03	-2160.15	-3490.70
G, KJ/KG	-15423.7	-15407.8	-14935.4	-12992.3
S, KJ/(KG)(K)	10.9084	10.9141	10.9141	10.9141

M, (1/n)	18.626	18.620	18.824	20.265
MW, MOL WT	12.686	12.677	12.585	12.126
(dLV/dLP)t	-1.11960	-1.11961	-1.12195	-1.10916
(dLV/dLT)p	2.2848	2.2881	2.4014	2.6165
Cp, KJ/(KG)(K)	9.4286	9.4621	10.4144	13.1933
GAMMAS	1.1462	1.1461	1.1398	1.1158
SON VEL,M/SEC	813.5	812.7	783.7	643.5
MACH NUMBER	0.000	0.151	1.000	2.953

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.43723 0.43663 0.42118 0.34611

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	12.3040	12.3556	13.8002	20.3368
CONDUCTIVITY	8.4034	8.4200	8.9509	10.3501
PRANDTL NUMBER	0.6402	0.6407	0.6494	0.6801

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.2035	3.2027	3.1850	3.1395
CONDUCTIVITY	2.5071	2.5047	2.4095	1.9972
PRANDTL NUMBER	0.5587	0.5583	0.5567	0.5441

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0867
CSTAR, M/SEC	1192.5	1192.5	1192.5
CF	0.1026	0.6572	1.5935
Ivac, M/SEC	4830.7	1471.3	2095.5
Isp, M/SEC	122.4	783.7	1900.2

MASS FRACTIONS

CH4	0.12326	0.12279	0.11820	0.09418
*CO	0.37871	0.37811	0.34538	0.14164
*CO2	0.05951	0.05980	0.07302	0.16079
C2H4	0.00004	0.00004	0.00002	0.00000

C2H6	0.00009	0.00009	0.00005	0.00000
*H2	0.05346	0.05356	0.05358	0.05301
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.08302	0.08318	0.09341	0.15260
C(gr)	0.30188	0.30242	0.31633	0.39778

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012757

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7564	50.000
P, BAR	81.060	79.006	46.150	1.6212
T, K	1304.00	1301.16	1229.55	910.36
RHO, KG/CU M	1.4003 1	1.3674 1	8.5426 0	4.3593-1
H, KJ/KG	-1314.24	-1321.75	-1622.11	-3123.91
U, KJ/KG	-1893.11	-1899.53	-2162.35	-3495.81
G, KJ/KG	-15461.4	-15445.4	-14968.5	-13005.5
S, KJ/(KG)(K)	10.8490	10.8546	10.8546	10.8546

M, (1/n)	18.730	18.724	18.923	20.353
MW, MOL WT	12.764	12.754	12.657	12.181
(dLV/dLP)t	-1.12019	-1.12021	-1.12251	-1.10981
(dLV/dLT)p	2.2802	2.2835	2.3959	2.6148
Cp, KJ/(KG)(K)	9.3219	9.3551	10.2886	13.0661
GAMMAS	1.1460	1.1459	1.1398	1.1160
SON VEL,M/SEC	814.5	813.7	784.7	644.2
MACH NUMBER	0.000	0.151	1.000	2.953

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.43943	0.43883	0.42324	0.34747
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	12.1243	12.1755	13.5942	20.0945
CONDUCTIVITY	8.3672	8.3840	8.9106	10.3236
PRANDTL NUMBER	0.6368	0.6373	0.6457	0.6763

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.2068	3.2059	3.1875	3.1365
CONDUCTIVITY	2.5072	2.5047	2.4090	1.9926
PRANDTL NUMBER	0.5621	0.5617	0.5600	0.5469

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0828
CSTAR, M/SEC	1194.0	1194.0	1194.0
CF	0.1026	0.6572	1.5933
Ivac, M/SEC	4837.0	1473.2	2097.9
Isp, M/SEC	122.6	784.7	1902.5

MASS FRACTIONS

CH4	0.12708	0.12660	0.12185	0.09714
*CO	0.37691	0.37632	0.34390	0.14158
*CO2	0.05971	0.05999	0.07302	0.15958
C2H4	0.00005	0.00005	0.00002	0.00000
C2H6	0.00010	0.00010	0.00006	0.00000
*H2	0.05239	0.05249	0.05256	0.05215
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.08402	0.08417	0.09436	0.15362
C(gr)	0.29973	0.30027	0.31423	0.39592

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012756

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7564	50.000
P, BAR	91.192	88.882	51.919	1.8238
T, K	1313.41	1310.54	1238.16	915.50
RHO, KG/CU M	1.5719 1	1.5350 1	9.5890 0	4.8955-1
H, KJ/KG	-1314.24	-1321.77	-1622.80	-3127.71
U, KJ/KG	-1894.38	-1900.81	-2164.24	-3500.27
G, KJ/KG	-15494.9	-15478.8	-14998.0	-13017.4
S, KJ/(KG)(K)	10.7968	10.8024	10.8024	10.8024
M, (1/n)	18.824	18.818	19.013	20.432
MW, MOL WT	12.833	12.823	12.722	12.230
(dLV/dLP)t	-1.12064	-1.12066	-1.12292	-1.11033
(dLV/dLT)p	2.2755	2.2789	2.3904	2.6126
Cp, KJ/(KG)(K)	9.2264	9.2593	10.1761	12.9510
GAMMAS	1.1458	1.1457	1.1398	1.1163
SON VEL,M/SEC	815.3	814.5	785.6	644.9
MACH NUMBER	0.000	0.151	1.000	2.953

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.44138 0.44077 0.42506 0.34868

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	11.9631	12.0140	13.4093	19.8737
CONDUCTIVITY	8.3322	8.3492	8.8716	10.2958
PRANDTL NUMBER	0.6337	0.6342	0.6425	0.6730

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.2098	3.2090	3.1898	3.1340
CONDUCTIVITY	2.5072	2.5047	2.4085	1.9885

PRANDTL NUMBER 0.5651 0.5647 0.5630 0.5495

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0795
CSTAR, M/SEC	1195.4	1195.4	1195.4
CF	0.1026	0.6572	1.5932
Ivac, M/SEC	4842.5	1474.8	2100.1
Isp, M/SEC	122.7	785.6	1904.5

MASS FRACTIONS

CH4	0.13046	0.12998	0.12508	0.09977
*CO	0.37526	0.37468	0.34256	0.14152
*CO2	0.05992	0.06019	0.07304	0.15855
C2H4	0.00005	0.00005	0.00003	0.00000
C2H6	0.00011	0.00011	0.00007	0.00000
*H2	0.05143	0.05154	0.05165	0.05139
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.08491	0.08506	0.09520	0.15450
C(gr)	0.29783	0.29837	0.31236	0.39426

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012755

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.50000 %FUEL= 66.666667 R,EQ.RATIO= 6.811333 PHI,EQ.RATIO= 6.811333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7564	50.000
P, BAR	101.33	98.758	57.688	2.0265
T, K	1321.89	1319.00	1245.93	920.15
RHO, KG/CU M	1.7432 1	1.7023 1	1.0634 1	5.4309-1
H, KJ/KG	-1314.24	-1321.78	-1623.39	-3131.07
U, KJ/KG	-1895.49	-1901.94	-2165.90	-3504.21
G, KJ/KG	-15525.1	-15508.9	-15024.6	-13028.2
S, KJ/(KG)(K)	10.7504	10.7560	10.7560	10.7560
M, (1/n)	18.909	18.903	19.095	20.503
MW, MOL WT	12.897	12.886	12.782	12.274
(dLV/dLP)t	-1.12098	-1.12101	-1.12324	-1.11075
(dLV/dLT)p	2.2708	2.2742	2.3849	2.6100
Cp, KJ/(KG)(K)	9.1401	9.1726	10.0745	12.8455
GAMMAS	1.1456	1.1455	1.1397	1.1165
SON VEL,M/SEC	816.0	815.2	786.3	645.4
MACH NUMBER	0.000	0.151	1.000	2.953

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.44313	0.44252	0.42670	0.34976
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	11.8171	11.8676	13.2417	19.6708
CONDUCTIVITY	8.2985	8.3156	8.8340	10.2675
PRANDTL NUMBER	0.6310	0.6315	0.6396	0.6701

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	3.2126	3.2118	3.1920	3.1318
CONDUCTIVITY	2.5072	2.5047	2.4081	1.9848
PRANDTL NUMBER	0.5678	0.5674	0.5656	0.5519

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0767
CSTAR, M/SEC	1196.6	1196.6	1196.6
CF	0.1026	0.6572	1.5931
Ivac, M/SEC	4847.3	1476.3	2102.0
Isp, M/SEC	122.8	786.3	1906.2

MASS FRACTIONS

CH4	0.13351	0.13302	0.12800	0.10215
*CO	0.37375	0.37318	0.34133	0.14147
*CO2	0.06013	0.06040	0.07309	0.15765
C2H4	0.00006	0.00006	0.00003	0.00000
C2H6	0.00013	0.00012	0.00008	0.00000
*H2	0.05057	0.05068	0.05083	0.05071
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.08571	0.08585	0.09596	0.15527
C(gr)	0.29612	0.29666	0.31069	0.39275

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012838
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7610	50.000
P, BAR	10.133	9.8742	5.7538	0.20265
T, K	1200.36	1197.78	1131.69	855.84
RHO, KG/CU M	1.6924 0	1.6528 0	1.0347 0	5.2763-2
H, KJ/KG	-1257.45	-1265.27	-1576.49	-3119.05
U, KJ/KG	-1856.16	-1862.70	-2132.55	-3503.13
G, KJ/KG	-15868.3	-15852.4	-15358.7	-13541.9
S, KJ/(KG)(K)	12.1721	12.1784	12.1784	12.1784
M, (1/n)	16.670	16.670	16.921	18.527
MW, MOL WT	12.201	12.197	12.176	11.949
(dLV/dLP)t	-1.08305	-1.08305	-1.08989	-1.09187
(dLV/dLT)p	2.0002	2.0032	2.1730	2.5994
Cp, KJ/(KG)(K)	9.0418	9.0791	10.6232	15.9019
GAMMAS	1.1596	1.1593	1.1475	1.1096
SON VEL,M/SEC	833.2	832.2	798.8	652.8
MACH NUMBER	0.000	0.150	1.000	2.956

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.42642 0.42584 0.41075 0.34386

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.7611	10.7966	12.3850	19.0771
CONDUCTIVITY	6.8266	6.8340	7.3884	8.8740
PRANDTL NUMBER	0.6722	0.6728	0.6885	0.7392

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9099	2.9093	2.8983	2.9161
CONDUCTIVITY	2.4793	2.4763	2.3775	2.0345
PRANDTL NUMBER	0.5005	0.5003	0.5007	0.4928

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1186
CSTAR, M/SEC	1210.4	1210.4	1210.4
CF	0.1033	0.6600	1.5942
Ivac, M/SEC	4903.6	1494.9	2128.6
Isp, M/SEC	125.0	798.8	1929.6

MASS FRACTIONS

CH4	0.05102	0.05076	0.04968	0.03714
*CO	0.51771	0.51703	0.47889	0.22815
*CO2	0.04778	0.04815	0.06582	0.19997
C2H4	0.00001	0.00001	0.00000	0.00000
C2H6	0.00001	0.00001	0.00000	0.00000
*H2	0.06946	0.06951	0.06866	0.06605
H2O	0.05015	0.05029	0.06035	0.11179
C(gr)	0.26386	0.26425	0.27659	0.35689

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012850
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7621	50.000
P, BAR	20.265	19.748	11.500	0.40530
T, K	1248.27	1245.53	1175.38	881.69
RHO, KG/CU M	3.3226 0	3.2448 0	2.0314 0	1.0428-1
H, KJ/KG	-1257.45	-1265.42	-1582.74	-3148.62
U, KJ/KG	-1867.36	-1874.03	-2148.86	-3537.28
G, KJ/KG	-16024.3	-16007.5	-15494.6	-13584.3
S, KJ/(KG)(K)	11.8298	11.8360	11.8360	11.8360
M, (1/n)	17.017	17.016	17.262	18.862
MW, MOL WT	12.467	12.461	12.427	12.131
(dLV/dLP)t	-1.09280	-1.09279	-1.09888	-1.09899
(dLV/dLT)p	2.0599	2.0630	2.2239	2.6434
Cp, KJ/(KG)(K)	8.9740	9.0100	10.4162	15.4267
GAMMAS	1.1604	1.1601	1.1492	1.1120
SON VEL,M/SEC	841.3	840.3	806.6	657.4
MACH NUMBER	0.000	0.150	1.000	2.958

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.43727 0.43666 0.42092 0.35074

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.8145	10.8539	12.4184	19.5059
CONDUCTIVITY	7.1435	7.1533	7.7276	9.4251
PRANDTL NUMBER	0.6620	0.6626	0.6764	0.7259

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9248	2.9241	2.9102	2.9101
CONDUCTIVITY	2.4973	2.4943	2.3920	2.0279
PRANDTL NUMBER	0.5121	0.5119	0.5121	0.5033

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0789
CSTAR, M/SEC	1221.1	1221.1	1221.1
CF	0.1034	0.6605	1.5927
Ivac, M/SEC	4947.2	1508.5	2144.7
Isp, M/SEC	126.2	806.6	1944.8

MASS FRACTIONS

CH4	0.06503	0.06472	0.06293	0.04721
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*CO	0.50716	0.50649	0.46920	0.22356
*CO2	0.04900	0.04935	0.06606	0.19266
C2H4	0.00001	0.00001	0.00001	0.00000
C2H6	0.00002	0.00002	0.00001	0.00000
*H2	0.06529	0.06535	0.06465	0.06252
H2O	0.05594	0.05608	0.06639	0.12073
C(gr)	0.25755	0.25797	0.27075	0.35331

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012855
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7627	50.000
P, BAR	30.398	29.622	17.245	0.60795
T, K	1278.17	1275.32	1202.60	897.70
RHO, KG/CU M	4.9324 0	4.8168 0	3.0155 0	1.5536-1
H, KJ/KG	-1257.45	-1265.51	-1586.28	-3165.66
U, KJ/KG	-1873.73	-1880.47	-2158.17	-3556.97
G, KJ/KG	-16126.4	-16109.1	-15583.5	-13614.1
S, KJ/(KG)(K)	11.6330	11.6391	11.6391	11.6391
M, (1/n)	17.244	17.243	17.484	19.074

MW, MOL WT	12.647	12.640	12.595	12.253
(dLV/dLP)t	-1.09808	-1.09807	-1.10374	-1.10293
(dLV/dLT)p	2.0871	2.0902	2.2459	2.6637
Cp, KJ/(KG)(K)	8.8807	8.9160	10.2439	15.1120
GAMMAS	1.1607	1.1604	1.1500	1.1133
SON VEL,M/SEC	845.7	844.7	811.0	660.0
MACH NUMBER	0.000	0.150	1.000	2.960

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.44389	0.44327	0.42710	0.35489
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.7266	10.7675	12.2978	19.5234
CONDUCTIVITY	7.2726	7.2837	7.8625	9.6698
PRANDTL NUMBER	0.6547	0.6553	0.6680	0.7165

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9345	2.9337	2.9180	2.9063
CONDUCTIVITY	2.5058	2.5027	2.3985	2.0219
PRANDTL NUMBER	0.5198	0.5196	0.5196	0.5101

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0573
CSTAR, M/SEC	1227.3	1227.3	1227.3
CF	0.1034	0.6608	1.5918
Ivac, M/SEC	4972.1	1516.2	2153.9
Isp, M/SEC	126.9	811.0	1953.6

MASS FRACTIONS

CH4	0.07416	0.07382	0.07156	0.05381
*CO	0.50092	0.50026	0.46355	0.22123
*CO2	0.04977	0.05010	0.06626	0.18849
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00003	0.00002	0.00002	0.00000
*H2	0.06261	0.06268	0.06209	0.06031
H2O	0.05933	0.05947	0.06986	0.12565
C(gr)	0.25316	0.25361	0.26666	0.35052

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE

REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012857
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7630	50.000
P, BAR	40.530	39.495	22.989	0.81060
T, K	1300.22	1297.29	1222.67	909.47
RHO, KG/CU M	6.5300 0	6.3768 0	3.9919 0	2.0616-1
H, KJ/KG	-1257.45	-1265.57	-1588.72	-3177.57
U, KJ/KG	-1878.12	-1884.92	-2164.61	-3570.77
G, KJ/KG	-16203.4	-16185.7	-15650.7	-13637.4
S, KJ/(KG)(K)	11.4950	11.5011	11.5011	11.5011
M, (1/n)	17.418	17.415	17.652	19.232
MW, MOL WT	12.786	12.779	12.725	12.347
(dLV/dLP)t	-1.10156	-1.10155	-1.10692	-1.10556
(dLV/dLT)p	2.1024	2.1055	2.2576	2.6748
Cp, KJ/(KG)(K)	8.7918	8.8266	10.1000	14.8703
GAMMAS	1.1607	1.1604	1.1504	1.1142
SON VEL,M/SEC	848.8	847.8	814.0	661.9
MACH NUMBER	0.000	0.150	1.000	2.961

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.44871 0.44807 0.43160 0.35789

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.6159	10.6576	12.1556	19.4359
CONDUCTIVITY	7.3386	7.3505	7.9293	9.8059
PRANDTL NUMBER	0.6491	0.6497	0.6616	0.7094

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9419	2.9411	2.9241	2.9036
CONDUCTIVITY	2.5109	2.5078	2.4024	2.0167
PRANDTL NUMBER	0.5257	0.5255	0.5253	0.5153

PERFORMANCE PARAMETERS

Ae/At 4.0000 1.0000 8.0428

CSTAR, M/SEC	1231.5	1231.5	1231.5
CF	0.1034	0.6609	1.5913
Ivac, M/SEC	4989.4	1521.5	2160.3
Isp, M/SEC	127.4	814.0	1959.7

MASS FRACTIONS

CH4	0.08103	0.08066	0.07804	0.05879
*CO	0.49639	0.49576	0.45950	0.21970
*CO2	0.05038	0.05070	0.06646	0.18561
C2H4	0.00003	0.00003	0.00001	0.00000
C2H6	0.00003	0.00003	0.00002	0.00000
*H2	0.06061	0.06069	0.06019	0.05869
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.06174	0.06188	0.07230	0.12899
C(gr)	0.24978	0.25024	0.26348	0.34823

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012858
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

INJECTOR COMB END THROAT EXIT

Pinj/P	1.0000	1.0262	1.7632	50.000
P, BAR	50.663	49.369	28.733	1.0132
T, K	1317.79	1314.80	1238.66	918.84
RHO, KG/CU M	8.1190 0	7.9285 0	4.9631 0	2.5675-1
H, KJ/KG	-1257.45	-1265.61	-1590.56	-3186.70
U, KJ/KG	-1881.45	-1888.29	-2169.50	-3581.34
G, KJ/KG	-16265.6	-16247.6	-15705.0	-13656.8
S, KJ/(KG)(K)	11.3889	11.3949	11.3949	11.3949

M, (1/n)	17.559	17.556	17.789	19.358
MW, MOL WT	12.900	12.892	12.831	12.424
(dLV/dLP)t	-1.10407	-1.10407	-1.10921	-1.10748
(dLV/dLT)p	2.1118	2.1151	2.2643	2.6814
Cp, KJ/(KG)(K)	8.7108	8.7450	9.9767	14.6717
GAMMAS	1.1606	1.1604	1.1507	1.1148
SON VEL,M/SEC	851.0	850.0	816.2	663.3
MACH NUMBER	0.000	0.150	1.000	2.961

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.45250	0.45185	0.43515	0.36024
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.5051	10.5471	12.0158	19.3141
CONDUCTIVITY	7.3752	7.3878	7.9646	9.8897
PRANDTL NUMBER	0.6445	0.6451	0.6565	0.7035

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9479	2.9471	2.9291	2.9017
CONDUCTIVITY	2.5144	2.5113	2.4050	2.0123
PRANDTL NUMBER	0.5305	0.5303	0.5300	0.5194

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0322	
CSTAR, M/SEC	1234.8	1234.8	1234.8	
CF	0.1034	0.6610	1.5908	
Ivac, M/SEC	5002.6	1525.5	2165.2	
Isp, M/SEC	127.7	816.2	1964.3	

MASS FRACTIONS

CH4	0.08657	0.08618	0.08326	0.06281
*CO	0.49281	0.49218	0.45631	0.21857
*CO2	0.05090	0.05121	0.06666	0.18344
C2H4	0.00004	0.00004	0.00002	0.00000
C2H6	0.00004	0.00004	0.00003	0.00000
*H2	0.05900	0.05909	0.05866	0.05740
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.06361	0.06376	0.07419	0.13149
C(gr)	0.24702	0.24749	0.26088	0.34629

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012858
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7633	50.000
P, BAR	60.795	59.243	34.478	1.2159
T, K	1332.44	1329.40	1252.01	926.65
RHO, KG/CU M	9.7016 0	9.4738 0	5.9301 0	3.0718-1
H, KJ/KG	-1257.45	-1265.65	-1592.02	-3194.07
U, KJ/KG	-1884.10	-1890.98	-2173.42	-3589.89
G, KJ/KG	-16317.8	-16299.6	-15750.8	-13673.4
S, KJ/(KG)(K)	11.3028	11.3088	11.3088	11.3088
M, (1/n)	17.679	17.676	17.905	19.465
MW, MOL WT	12.998	12.989	12.922	12.490
(dLV/dLP)t	-1.10598	-1.10599	-1.11095	-1.10896
(dLV/dLT)p	2.1180	2.1212	2.2682	2.6853
Cp, KJ/(KG)(K)	8.6371	8.6710	9.8688	14.5022
GAMMAS	1.1605	1.1602	1.1509	1.1154
SON VEL,M/SEC	852.8	851.8	818.0	664.4
MACH NUMBER	0.000	0.150	1.000	2.962

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.45564 0.45499 0.43808 0.36219

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.3996	10.4418	11.8841	19.1814
CONDUCTIVITY	7.3959	7.4090	7.9830	9.9438

PRANDTL NUMBER	0.6407	0.6412	0.6522	0.6987
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WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9531	2.9522	2.9334	2.9002
CONDUCTIVITY	2.5170	2.5139	2.4070	2.0085
PRANDTL NUMBER	0.5346	0.5343	0.5339	0.5230

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0239
CSTAR, M/SEC	1237.4	1237.4	1237.4
CF	0.1035	0.6611	1.5905
Ivac, M/SEC	5013.1	1528.8	2169.2
Isp, M/SEC	128.0	818.0	1968.1

MASS FRACTIONS

CH4	0.09122	0.09081	0.08764	0.06620
*CO	0.48981	0.48920	0.45365	0.21767
*CO2	0.05136	0.05167	0.06687	0.18172
C2H4	0.00004	0.00004	0.00002	0.00000
C2H6	0.00005	0.00005	0.00003	0.00000
*H2	0.05766	0.05775	0.05739	0.05632
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.06516	0.06530	0.07572	0.13347
C(gr)	0.24468	0.24516	0.25867	0.34461

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012858

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7634	50.000
P, BAR	70.927	69.116	40.222	1.4185
T, K	1345.04	1341.96	1263.49	933.36
RHO, KG/CU M	1.1279 1	1.1014 1	6.8940 0	3.5748-1
H, KJ/KG	-1257.45	-1265.67	-1593.22	-3200.23
U, KJ/KG	-1886.29	-1893.20	-2176.66	-3597.05
G, KJ/KG	-16363.0	-16344.6	-15790.4	-13688.0
S, KJ/(KG)(K)	11.2305	11.2365	11.2365	11.2365
M, (1/n)	17.784	17.780	18.006	19.557
MW, MOL WT	13.083	13.074	13.002	12.547
(dLV/dLP)t	-1.10750	-1.10751	-1.11233	-1.11014
(dLV/dLT)p	2.1220	2.1253	2.2703	2.6875
Cp, KJ/(KG)(K)	8.5699	8.6035	9.7729	14.3538
GAMMAS	1.1603	1.1601	1.1510	1.1158
SON VEL,M/SEC	854.2	853.2	819.5	665.4
MACH NUMBER	0.000	0.150	1.000	2.962

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.45832 0.45766 0.44058 0.36385

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.3008	10.3430	11.7615	19.0473
CONDUCTIVITY	7.4071	7.4205	7.9914	9.9796
PRANDTL NUMBER	0.6374	0.6379	0.6484	0.6944

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9577	2.9567	2.9373	2.8990
CONDUCTIVITY	2.5190	2.5160	2.4085	2.0051
PRANDTL NUMBER	0.5381	0.5378	0.5373	0.5260

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0172
CSTAR, M/SEC	1239.5	1239.5	1239.5
CF	0.1035	0.6611	1.5903
Ivac, M/SEC	5021.9	1531.4	2172.5
Isp, M/SEC	128.2	819.5	1971.2

MASS FRACTIONS

CH4	0.09523	0.09481	0.09142	0.06913
*CO	0.48723	0.48663	0.45137	0.21693
*CO2	0.05179	0.05209	0.06708	0.18030
C2H4	0.00005	0.00005	0.00002	0.00000
C2H6	0.00006	0.00006	0.00004	0.00000

*H2	0.05650	0.05659	0.05629	0.05540
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.06647	0.06661	0.07702	0.13511
C(gr)	0.24265	0.24314	0.25675	0.34312

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012858

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7634	50.000
P, BAR	81.060	78.990	45.967	1.6212
T, K	1356.10	1352.98	1273.57	939.26
RHO, KG/CU M	1.2852 1	1.2550 1	7.8553 0	4.0767-1
H, KJ/KG	-1257.45	-1265.70	-1594.23	-3205.52
U, KJ/KG	-1888.15	-1895.09	-2179.41	-3603.19
G, KJ/KG	-16402.8	-16384.2	-15825.4	-13701.0
S, KJ/(KG)(K)	11.1683	11.1742	11.1742	11.1742
M, (1/n)	17.877	17.874	18.096	19.638
MW, MOL WT	13.160	13.150	13.072	12.598
(dLV/dLP)t	-1.10874	-1.10875	-1.11345	-1.11111
(dLV/dLT)p	2.1246	2.1279	2.2712	2.6886

Cp, KJ/(KG)(K)	8.5083	8.5416	9.6865	14.2215
GAMMAS	1.1601	1.1599	1.1511	1.1162
SON VEL,M/SEC	855.4	854.4	820.7	666.2
MACH NUMBER	0.000	0.150	1.000	2.963

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.46066	0.46000	0.44277	0.36530
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.2085	10.2508	11.6474	18.9155
CONDUCTIVITY	7.4121	7.4258	7.9934	10.0033
PRANDTL NUMBER	0.6345	0.6350	0.6452	0.6907

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9617	2.9608	2.9407	2.8980
CONDUCTIVITY	2.5206	2.5176	2.4097	2.0021
PRANDTL NUMBER	0.5413	0.5410	0.5403	0.5288

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0117
CSTAR, M/SEC	1241.4	1241.4	1241.4
CF	0.1034	0.6611	1.5900
Ivac, M/SEC	5029.4	1533.7	2175.3
Isp, M/SEC	128.4	820.7	1973.9

MASS FRACTIONS

CH4	0.09876	0.09834	0.09475	0.07172
*CO	0.48494	0.48435	0.44936	0.21630
*CO2	0.05218	0.05248	0.06728	0.17910
C2H4	0.00006	0.00006	0.00003	0.00000
C2H6	0.00007	0.00007	0.00005	0.00000
*H2	0.05548	0.05557	0.05532	0.05459
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.06762	0.06775	0.07814	0.13650
C(gr)	0.24086	0.24136	0.25505	0.34178

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012858

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7635	50.000
P, BAR	91.192	88.864	51.713	1.8238
T, K	1365.97	1362.82	1282.58	944.52
RHO, KG/CU M	1.4422 1	1.4083 1	8.8142 0	4.5776-1
H, KJ/KG	-1257.45	-1265.72	-1595.11	-3210.14
U, KJ/KG	-1889.76	-1896.72	-2181.80	-3608.57
G, KJ/KG	-16438.4	-16419.7	-15856.8	-13712.8
S, KJ/(KG)(K)	11.1136	11.1195	11.1195	11.1195
M, (1/n)	17.962	17.958	18.176	19.711
MW, MOL WT	13.228	13.219	13.136	12.644
(dLV/dLP)t	-1.10976	-1.10978	-1.11437	-1.11191
(dLV/dLT)p	2.1263	2.1296	2.2714	2.6889
Cp, KJ/(KG)(K)	8.4515	8.4845	9.6079	14.1019
GAMMAS	1.1599	1.1597	1.1511	1.1165
SON VEL,M/SEC	856.4	855.4	821.8	667.0
MACH NUMBER	0.000	0.150	1.000	2.963

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.46274 0.46207 0.44472 0.36658

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.1224	10.1645	11.5412	18.7879
CONDUCTIVITY	7.4130	7.4270	7.9912	10.0186
PRANDTL NUMBER	0.6319	0.6324	0.6423	0.6874

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9654	2.9645	2.9439	2.8972
CONDUCTIVITY	2.5220	2.5190	2.4107	1.9993
PRANDTL NUMBER	0.5441	0.5438	0.5431	0.5312

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0070
CSTAR, M/SEC	1243.0	1243.0	1243.0
CF	0.1034	0.6611	1.5899
Ivac, M/SEC	5035.9	1535.7	2177.8
Isp, M/SEC	128.6	821.8	1976.2

MASS FRACTIONS

CH4	0.10192	0.10148	0.09773	0.07404
*CO	0.48289	0.48231	0.44756	0.21575
*CO2	0.05256	0.05284	0.06748	0.17807
C2H4	0.00007	0.00006	0.00003	0.00000
C2H6	0.00008	0.00008	0.00005	0.00000
*H2	0.05457	0.05467	0.05446	0.05388
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.06863	0.06877	0.07914	0.13770
C(gr)	0.23926	0.23976	0.25353	0.34056

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012857
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.60000 %FUEL= 62.500000 R,EQ.RATIO= 5.676110 PHI,EQ.RATIO= 5.676110

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7635	50.000
P, BAR	101.33	98.738	57.458	2.0265
T, K	1374.89	1371.71	1290.71	949.28
RHO, KG/CU M	1.5989 1	1.5613 1	9.7713 0	5.0777-1
H, KJ/KG	-1257.45	-1265.74	-1595.88	-3214.23
U, KJ/KG	-1891.18	-1898.15	-2183.91	-3613.33
G, KJ/KG	-16470.6	-16451.8	-15885.2	-13723.6
S, KJ/(KG)(K)	11.0650	11.0709	11.0709	11.0709
M, (1/n)	18.039	18.034	18.250	19.777
MW, MOL WT	13.291	13.282	13.195	12.686
(dLV/dLP)t	-1.11063	-1.11064	-1.11515	-1.11260
(dLV/dLT)p	2.1272	2.1306	2.2711	2.6886
Cp, KJ/(KG)(K)	8.3988	8.4315	9.5358	13.9926
GAMMAS	1.1597	1.1595	1.1511	1.1168
SON VEL,M/SEC	857.3	856.3	822.7	667.6
MACH NUMBER	0.000	0.150	1.000	2.963

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.46461	0.46393	0.44647	0.36774
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	10.0417	10.0838	11.4421	18.6651
CONDUCTIVITY	7.4112	7.4253	7.9862	10.0279
PRANDTL NUMBER	0.6295	0.6300	0.6397	0.6845

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.9688	2.9678	2.9468	2.8966
CONDUCTIVITY	2.5232	2.5202	2.4116	1.9968
PRANDTL NUMBER	0.5467	0.5463	0.5455	0.5334

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0029
CSTAR, M/SEC	1244.4	1244.4	1244.4
CF	0.1034	0.6611	1.5897
Ivac, M/SEC	5041.7	1537.5	2180.0
Isp, M/SEC	128.7	822.7	1978.3

MASS FRACTIONS

CH4	0.10477	0.10433	0.10043	0.07614
*CO	0.48102	0.48045	0.44592	0.21526
*CO2	0.05291	0.05319	0.06768	0.17716
C2H4	0.00007	0.00007	0.00003	0.00000
C2H6	0.00009	0.00009	0.00006	0.00000
*H2	0.05375	0.05385	0.05368	0.05323
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.06954	0.06968	0.08002	0.13876
C(gr)	0.23782	0.23832	0.25215	0.33944

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012967
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7695	50.000
P, BAR	10.133	9.8716	5.7262	0.20265
T, K	1250.31	1247.43	1170.81	878.07
RHO, KG/CU M	1.5745 0	1.5376 0	9.6516-1	5.0156-2
H, KJ/KG	-1207.34	-1215.83	-1551.84	-3180.16
U, KJ/KG	-1850.87	-1857.84	-2145.14	-3584.20
G, KJ/KG	-16804.5	-16785.4	-16165.1	-14139.6
S, KJ/(KG)(K)	12.4746	12.4813	12.4813	12.4813
M, (1/n)	16.154	16.155	16.408	18.070
MW, MOL WT	12.698	12.694	12.699	12.523
(dLV/dLP)t	-1.06222	-1.06226	-1.07194	-1.09002
(dLV/dLT)p	1.7238	1.7267	1.9222	2.6214
Cp, KJ/(KG)(K)	7.1543	7.1876	8.8802	16.7052
GAMMAS	1.1786	1.1782	1.1613	1.1102
SON VEL,M/SEC	870.9	869.7	830.1	669.7
MACH NUMBER	0.000	0.150	1.000	2.966

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.44464 0.44399 0.42647 0.35601

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	7.8616	7.8874	9.3225	15.3660
CONDUCTIVITY	5.4042	5.4090	5.9407	7.4678
PRANDTL NUMBER	0.6468	0.6474	0.6692	0.7325

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7099	2.7091	2.6926	2.6914
CONDUCTIVITY	2.4586	2.4549	2.3370	1.9779
PRANDTL NUMBER	0.4901	0.4900	0.4914	0.4844

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0412
CSTAR, M/SEC	1248.6	1248.6	1248.6
CF	0.1043	0.6648	1.5909
Ivac, M/SEC	5059.0	1544.8	2189.8
Isp, M/SEC	130.3	830.1	1986.4

MASS FRACTIONS

CH4	0.03506	0.03488	0.03513	0.02626
*CO	0.62388	0.62328	0.58583	0.31673
*CO2	0.03428	0.03460	0.05214	0.20397
C2H4	0.00001	0.00001	0.00000	0.00000
*H2	0.07007	0.07010	0.06895	0.06572
H2O	0.03432	0.03444	0.04417	0.09294
C(gr)	0.20238	0.20268	0.21378	0.29437

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012970
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7702	50.000
P, BAR	20.265	19.743	11.448	0.40530
T, K	1297.81	1294.76	1214.70	904.21
RHO, KG/CU M	3.0900 0	3.0174 0	1.8936 0	9.9048-2
H, KJ/KG	-1207.34	-1215.99	-1558.69	-3213.45
U, KJ/KG	-1863.18	-1870.29	-2163.24	-3622.64
G, KJ/KG	-16938.1	-16918.3	-16290.0	-14179.3
S, KJ/(KG)(K)	12.1211	12.1276	12.1276	12.1276
M, (1/n)	16.453	16.453	16.706	18.373
MW, MOL WT	12.938	12.933	12.925	12.682
(dLV/dLP)t	-1.07326	-1.07328	-1.08210	-1.09717
(dLV/dLT)p	1.8088	1.8118	1.9976	2.6651
Cp, KJ/(KG)(K)	7.3726	7.4052	8.9559	16.1945
GAMMAS	1.1779	1.1775	1.1623	1.1127
SON VEL,M/SEC	878.9	877.7	838.3	674.8
MACH NUMBER	0.000	0.150	1.000	2.968

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.45548 0.45479 0.43678 0.36325

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.2442	8.2735	9.7081	16.3042
CONDUCTIVITY	5.8251	5.8319	6.3889	8.1628
PRANDTL NUMBER	0.6446	0.6452	0.6637	0.7255

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7270	2.7262	2.7079	2.6933
CONDUCTIVITY	2.4848	2.4811	2.3608	1.9816
PRANDTL NUMBER	0.4999	0.4997	0.5010	0.4937

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0006
CSTAR, M/SEC	1260.3	1260.3	1260.3
CF	0.1043	0.6651	1.5893
Ivac, M/SEC	5106.7	1559.5	2207.3
Isp, M/SEC	131.5	838.3	2003.0

MASS FRACTIONS

CH4	0.04674	0.04651	0.04614	0.03425
*CO	0.61101	0.61041	0.57323	0.30820
*CO2	0.03710	0.03742	0.05434	0.19908
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00001	0.00001	0.00001	0.00000
*H2	0.06646	0.06651	0.06548	0.06265

H2O	0.04029	0.04041	0.05048	0.10243
C(gr)	0.19836	0.19871	0.21033	0.29338

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012972
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7706	50.000
P, BAR	30.398	29.615	17.168	0.60795
T, K	1327.79	1324.64	1242.24	920.42
RHO, KG/CU M	4.5850 0	4.4773 0	2.8093 0	1.4749-1
H, KJ/KG	-1207.34	-1216.09	-1562.66	-3232.81
U, KJ/KG	-1870.32	-1877.52	-2173.76	-3645.00
G, KJ/KG	-17031.1	-17010.8	-16374.8	-14207.7
S, KJ/(KG)(K)	11.9174	11.9238	11.9238	11.9238

M, (1/n)	16.652	16.651	16.902	18.566
MW, MOL WT	13.104	13.098	13.080	12.790
(dLV/dLP)t	-1.07959	-1.07961	-1.08788	-1.10130
(dLV/dLT)p	1.8527	1.8557	2.0355	2.6871
Cp, KJ/(KG)(K)	7.4422	7.4743	8.9420	15.8661
GAMMAS	1.1774	1.1771	1.1629	1.1142
SON VEL,M/SEC	883.5	882.4	843.0	677.7
MACH NUMBER	0.000	0.150	1.000	2.970

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.46217 0.46148 0.44312 0.36761

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.3700	8.4010	9.8162	16.6561
CONDUCTIVITY	6.0330	6.0408	6.6061	8.5160
PRANDTL NUMBER	0.6412	0.6418	0.6584	0.7190

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7379	2.7370	2.7177	2.6942
CONDUCTIVITY	2.4980	2.4943	2.3727	1.9815
PRANDTL NUMBER	0.5066	0.5064	0.5075	0.4998

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9777
CSTAR, M/SEC	1267.1	1267.1	1267.1
CF	0.1044	0.6653	1.5884
Ivac, M/SEC	5134.2	1567.9	2217.5
Isp, M/SEC	132.2	843.0	2012.7

MASS FRACTIONS

CH4	0.05460	0.05433	0.05351	0.03963
*CO	0.60342	0.60283	0.56593	0.30365
*CO2	0.03870	0.03901	0.05554	0.19606
C2H4	0.00003	0.00002	0.00001	0.00000
C2H6	0.00002	0.00002	0.00001	0.00000
*H2	0.06409	0.06414	0.06321	0.06070
H2O	0.04385	0.04398	0.05419	0.10783
C(gr)	0.19528	0.19566	0.20760	0.29213

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012972
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7709	50.000
P, BAR	40.530	39.486	22.887	0.81060
T, K	1350.05	1346.82	1262.63	932.34
RHO, KG/CU M	6.0676 0	5.9250 0	3.7173 0	1.9565-1
H, KJ/KG	-1207.34	-1216.15	-1565.43	-3246.44
U, KJ/KG	-1875.32	-1882.59	-2181.13	-3660.75
G, KJ/KG	-17103.4	-17082.7	-16440.1	-14230.1
S, KJ/(KG)(K)	11.7744	11.7807	11.7807	11.7807
M, (1/n)	16.804	16.803	17.051	18.710
MW, MOL WT	13.235	13.228	13.202	12.875
(dLV/dLP)t	-1.08395	-1.08396	-1.09184	-1.10415
(dLV/dLT)p	1.8806	1.8836	2.0591	2.7003
Cp, KJ/(KG)(K)	7.4655	7.4972	8.9063	15.6177
GAMMAS	1.1771	1.1768	1.1632	1.1152
SON VEL,M/SEC	886.7	885.6	846.3	679.7
MACH NUMBER	0.000	0.150	1.000	2.971

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.46708 0.46637 0.44774 0.37078

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.4148	8.4467	9.8401	16.8114
CONDUCTIVITY	6.1604	6.1690	6.7370	8.7367
PRANDTL NUMBER	0.6380	0.6386	0.6540	0.7135

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7461	2.7452	2.7250	2.6948
CONDUCTIVITY	2.5065	2.5028	2.3803	1.9805
PRANDTL NUMBER	0.5117	0.5115	0.5126	0.5045

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9620
CSTAR, M/SEC	1271.9	1271.9	1271.9
CF	0.1044	0.6654	1.5878
Ivac, M/SEC	5153.5	1573.8	2224.6
Isp, M/SEC	132.7	846.3	2019.5

MASS FRACTIONS

CH4	0.06063	0.06033	0.05915	0.04376
*CO	0.59797	0.59739	0.56074	0.30060
*CO2	0.03985	0.04015	0.05639	0.19389
C2H4	0.00003	0.00003	0.00002	0.00000
C2H6	0.00002	0.00002	0.00001	0.00000
*H2	0.06228	0.06234	0.06150	0.05924

HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.04642	0.04655	0.05682	0.11157
C(gr)	0.19278	0.19317	0.20537	0.29093

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012972
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7710	50.000
P, BAR	50.663	49.358	28.606	1.0132
T, K	1367.88	1364.59	1278.93	941.84
RHO, KG/CU M	7.5413 0	7.3641 0	4.6197 0	2.4360-1
H, KJ/KG	-1207.34	-1216.20	-1567.55	-3256.93
U, KJ/KG	-1879.14	-1886.45	-2186.77	-3672.87
G, KJ/KG	-17162.8	-17141.9	-16493.6	-14248.9
S, KJ/(KG)(K)	11.6644	11.6707	11.6707	11.6707

M, (1/n)	16.930	16.928	17.173	18.827
MW, MOL WT	13.343	13.336	13.303	12.945
(dLV/dLP)t	-1.08721	-1.08722	-1.09479	-1.10629
(dLV/dLT)p	1.9002	1.9032	2.0753	2.7089
Cp, KJ/(KG)(K)	7.4689	7.5004	8.8643	15.4155

GAMMAS	1.1768	1.1765	1.1634	1.1160
SON VEL,M/SEC	889.1	888.0	848.8	681.3
MACH NUMBER	0.000	0.150	1.000	2.972

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.47097	0.47025	0.45141	0.37326
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.4246	8.4572	9.8295	16.8774
CONDUCTIVITY	6.2472	6.2564	6.8246	8.8890
PRANDTL NUMBER	0.6351	0.6357	0.6502	0.7087

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7528	2.7518	2.7309	2.6953
CONDUCTIVITY	2.5125	2.5089	2.3858	1.9792
PRANDTL NUMBER	0.5160	0.5158	0.5167	0.5083

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9502
CSTAR, M/SEC	1275.5	1275.5	1275.5
CF	0.1044	0.6654	1.5873
Ivac, M/SEC	5168.2	1578.3	2230.1
Isp, M/SEC	133.1	848.8	2024.6

MASS FRACTIONS

CH4	0.06555	0.06523	0.06374	0.04714
*CO	0.59369	0.59311	0.55669	0.29832
*CO2	0.04076	0.04105	0.05707	0.19222
C2H4	0.00004	0.00004	0.00002	0.00000
C2H6	0.00003	0.00003	0.00002	0.00000
*H2	0.06082	0.06088	0.06011	0.05807
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.04843	0.04856	0.05887	0.11440
C(gr)	0.19067	0.19108	0.20347	0.28984

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE

REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012972
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7711	50.000
P, BAR	60.795	59.229	34.326	1.2159
T, K	1382.80	1379.46	1292.57	949.77
RHO, KG/CU M	9.0084 0	8.7966 0	5.5180 0	2.9139-1
H, KJ/KG	-1207.34	-1216.24	-1569.24	-3265.43
U, KJ/KG	-1882.21	-1889.56	-2191.32	-3682.71
G, KJ/KG	-17213.4	-17192.3	-16539.0	-14265.1
S, KJ/(KG)(K)	11.5751	11.5814	11.5814	11.5814
M, (1/n)	17.036	17.034	17.276	18.925
MW, MOL WT	13.437	13.429	13.389	13.006
(dLV/dLP)t	-1.08978	-1.08979	-1.09711	-1.10797
(dLV/dLT)p	1.9148	1.9178	2.0871	2.7148
Cp, KJ/(KG)(K)	7.4624	7.4936	8.8210	15.2439
GAMMAS	1.1765	1.1762	1.1635	1.1166
SON VEL,M/SEC	891.0	889.9	850.8	682.6
MACH NUMBER	0.000	0.150	1.000	2.972

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.47420 0.47348 0.45444 0.37532

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.4171	8.4501	9.8024	16.8964
CONDUCTIVITY	6.3100	6.3196	6.8869	9.0005
PRANDTL NUMBER	0.6326	0.6331	0.6468	0.7046

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7584	2.7574	2.7359	2.6958
CONDUCTIVITY	2.5171	2.5135	2.3900	1.9779
PRANDTL NUMBER	0.5197	0.5194	0.5202	0.5116

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9409
CSTAR, M/SEC	1278.4	1278.4	1278.4
CF	0.1044	0.6655	1.5870
Ivac, M/SEC	5180.1	1582.0	2234.5

Isp, M/SEC 133.4 850.8 2028.8

MASS FRACTIONS

CH4	0.06972	0.06939	0.06764	0.05001
*CO	0.59014	0.58957	0.55336	0.29651
*CO2	0.04152	0.04181	0.05764	0.19086
C2H4	0.00005	0.00005	0.00002	0.00000
C2H6	0.00004	0.00004	0.00002	0.00000
*H2	0.05958	0.05965	0.05894	0.05710
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.05008	0.05021	0.06055	0.11668
C(gr)	0.18884	0.18926	0.20182	0.28883

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012971

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7712	50.000
P, BAR	70.927	69.101	40.045	1.4185
T, K	1395.67	1392.28	1304.33	956.59

RHO, KG/CU M	1.0470	1.0224	1.64128	0.33904
H, KJ/KG	-1207.34	-1216.28	-1570.65	-3272.57
U, KJ/KG	-1884.77	-1892.16	-2195.11	-3690.97
G, KJ/KG	-17257.6	-17236.3	-16578.7	-14279.4
S, KJ/(KG)(K)	11.5001	11.5063	11.5063	11.5063

M, (1/n)	17.130	17.127	17.367	19.009
MW, MOL WT	13.520	13.512	13.466	13.059
(dLV/dLP)t	-1.09188	-1.09188	-1.09899	-1.10935
(dLV/dLT)p	1.9260	1.9291	2.0960	2.7189
Cp, KJ/(KG)(K)	7.4507	7.4816	8.7782	15.0942
GAMMAS	1.1762	1.1759	1.1636	1.1172
SON VEL,M/SEC	892.6	891.5	852.4	683.7
MACH NUMBER	0.000	0.150	1.000	2.973

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.47697	0.47624	0.45705	0.37707
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.4002	8.4334	9.7673	16.8884
CONDUCTIVITY	6.3574	6.3674	6.9329	9.0854
PRANDTL NUMBER	0.6302	0.6308	0.6439	0.7009

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7633	2.7623	2.7403	2.6962
CONDUCTIVITY	2.5208	2.5171	2.3933	1.9765
PRANDTL NUMBER	0.5229	0.5226	0.5233	0.5144

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9333
CSTAR, M/SEC	1280.9	1280.9	1280.9
CF	0.1044	0.6655	1.5867
Ivac, M/SEC	5190.1	1585.0	2238.2
Isp, M/SEC	133.7	852.4	2032.3

MASS FRACTIONS

CH4	0.07335	0.07300	0.07103	0.05252
*CO	0.58710	0.58654	0.55052	0.29501
*CO2	0.04218	0.04247	0.05813	0.18973
C2H4	0.00006	0.00006	0.00003	0.00000
C2H6	0.00005	0.00005	0.00003	0.00000
*H2	0.05851	0.05858	0.05793	0.05626
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.05149	0.05162	0.06197	0.11857
C(gr)	0.18723	0.18766	0.20036	0.28791

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012970
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7712	50.000
P, BAR	81.060	78.972	45.765	1.6212
T, K	1407.00	1403.57	1314.67	962.59
RHO, KG/CU M	1.1927 1	1.1647 1	7.3048 0	3.8657-1
H, KJ/KG	-1207.34	-1216.31	-1571.85	-3278.70
U, KJ/KG	-1886.96	-1894.37	-2198.35	-3698.08
G, KJ/KG	-17296.9	-17275.4	-16613.9	-14292.3
S, KJ/(KG)(K)	11.4354	11.4416	11.4416	11.4416
M, (1/n)	17.213	17.211	17.448	19.084
MW, MOL WT	13.594	13.585	13.534	13.106
(dLV/dLP)t	-1.09363	-1.09364	-1.10057	-1.11050
(dLV/dLT)p	1.9349	1.9381	2.1029	2.7218
Cp, KJ/(KG)(K)	7.4359	7.4667	8.7367	14.9611
GAMMAS	1.1759	1.1756	1.1636	1.1176
SON VEL,M/SEC	893.9	892.8	853.8	684.6
MACH NUMBER	0.000	0.150	1.000	2.973

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.47940 0.47866 0.45932 0.37860

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.3780	8.4114	9.7280	16.8640
CONDUCTIVITY	6.3941	6.4044	6.9679	9.1519
PRANDTL NUMBER	0.6281	0.6287	0.6413	0.6976

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7677	2.7666	2.7442	2.6967
CONDUCTIVITY	2.5238	2.5202	2.3961	1.9752
PRANDTL NUMBER	0.5257	0.5255	0.5261	0.5169

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9269
CSTAR, M/SEC	1283.0	1283.0	1283.0
CF	0.1043	0.6655	1.5864
Ivac, M/SEC	5198.6	1587.6	2241.4
Isp, M/SEC	133.9	853.8	2035.4

MASS FRACTIONS

CH4	0.07657	0.07621	0.07403	0.05475
*CO	0.58444	0.58388	0.54803	0.29374
*CO2	0.04277	0.04305	0.05858	0.18876
C2H4	0.00007	0.00007	0.00003	0.00000
C2H6	0.00005	0.00005	0.00003	0.00000
*H2	0.05756	0.05763	0.05703	0.05552
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.05272	0.05285	0.06320	0.12018
C(gr)	0.18579	0.18622	0.19904	0.28705

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012970
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7713	50.000
P, BAR	91.192	88.844	51.485	1.8238
T, K	1417.12	1413.66	1323.92	967.94
RHO, KG/CU M	1.3381 1	1.3066 1	8.1945 0	4.3401-1
H, KJ/KG	-1207.34	-1216.33	-1572.90	-3284.08
U, KJ/KG	-1888.85	-1896.29	-2201.18	-3704.31
G, KJ/KG	-17332.3	-17310.7	-16645.6	-14304.0
S, KJ/(KG)(K)	11.3787	11.3848	11.3848	11.3848
M, (1/n)	17.289	17.286	17.520	19.151
MW, MOL WT	13.661	13.653	13.596	13.149
(dLV/dLP)t	-1.09513	-1.09514	-1.10191	-1.11149
(dLV/dLT)p	1.9422	1.9453	2.1083	2.7238
Cp, KJ/(KG)(K)	7.4196	7.4501	8.6969	14.8410
GAMMAS	1.1756	1.1753	1.1637	1.1180
SON VEL,M/SEC	895.1	894.0	855.0	685.4
MACH NUMBER	0.000	0.150	1.000	2.973

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.48155	0.48081	0.46135	0.37996
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.3528	8.3864	9.6869	16.8293
CONDUCTIVITY	6.4232	6.4337	6.9950	9.2049
PRANDTL NUMBER	0.6262	0.6267	0.6389	0.6947

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7716	2.7705	2.7478	2.6971
CONDUCTIVITY	2.5263	2.5227	2.3984	1.9739
PRANDTL NUMBER	0.5283	0.5280	0.5286	0.5192

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9214
CSTAR, M/SEC	1284.8	1284.8	1284.8
CF	0.1043	0.6655	1.5862
Ivac, M/SEC	5206.0	1589.8	2244.2
Isp, M/SEC	134.1	855.0	2038.0

MASS FRACTIONS

CH4	0.07946	0.07910	0.07673	0.05675
*CO	0.58205	0.58151	0.54582	0.29263
*CO2	0.04331	0.04359	0.05899	0.18792
CH2CO,ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00008	0.00007	0.00004	0.00000
C2H6	0.00006	0.00006	0.00004	0.00000
*H2	0.05671	0.05678	0.05623	0.05486
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.05382	0.05394	0.06429	0.12159
C(gr)	0.18448	0.18492	0.19785	0.28626

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012970

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.70000 %FUEL= 58.823529 R,EQ.RATIO= 4.865238 PHI,EQ.RATIO= 4.865238

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0130	1.7713
P, BAR	101.33	100.03	57.205
T, K	1426.29	1425.17	1332.30
RHO, KG/CU M	1.4831 1	1.4646 1	9.0821 0
H, KJ/KG	-1207.34	-1207.34	-1573.81
U, KJ/KG	-1890.53	-1890.33	-2203.67
G, KJ/KG	-17364.5	-17360.6	-16674.4
S, KJ/(KG)(K)	11.3281	11.3343	11.3343

M, (1/n)	17.358	17.350	17.587
MW, MOL WT	13.723	13.715	13.653
(dLV/dLP)t	-1.09643	-1.09627	-1.10307
(dLV/dLT)p	1.9481	1.9474	2.1127
Cp, KJ/(KG)(K)	7.4023	7.4046	8.6588
GAMMA	1.1753	1.1753	1.1636

SON VEL,M/SEC	896.1	896.0	856.1
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.48350	0.48081	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.3260	8.3864	6.7512
CONDUCTIVITY	6.4466	6.4337	NaN
PRANDTL NUMBER	0.6244	0.6267	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.7752	2.7705	3.0797
CONDUCTIVITY	2.5285	2.5227	NaN
PRANDTL NUMBER	0.5307	0.5280	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1286.5	1286.5
CF	0.0002	0.6655
Ivac, M/SEC	3501726.0	1591.8
Isp, M/SEC	0.2	856.1

MASS FRACTIONS

*C	0.00000	0.00000	0.00117
CH4	0.08209	0.08177	0.07919
*CO	0.57990	0.58016	0.54382
*CO2	0.04380	0.04374	0.05936
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00009	0.00008	0.00004
C2H6	0.00007	0.00007	0.00004
*H2	0.05593	0.05603	0.05550
HCHO,formaldehy	0.00001	0.00001	0.00001
H2O	0.05480	0.05468	0.06527
*O	0.00000	0.00000	0.00053
C(gr)	0.18329	0.18344	0.19676

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012970

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8290
P, BAR	10.133	9.7365	5.5400
T, K	1307.51	1305.11	1210.58
RHO, KG/CU M	1.4704 0	1.4144 0	8.8107-1
H, KJ/KG	-1162.80	-1162.80	-1533.61
U, KJ/KG	-1851.88	-1851.19	-2162.39
G, KJ/KG	-17806.1	-17803.0	-16968.4
S, KJ/(KG)(K)	12.7290	12.7500	12.7500

M, (1/n)	15.777	15.763	16.008
MW, MOL WT	13.227	13.216	13.247
(dLV/dLP)t	-1.04270	-1.04207	-1.05364
(dLV/dLT)p	1.4727	1.4670	1.6699
Cp, KJ/(KG)(K)	5.3938	5.3675	7.0382
GAMMAS	1.2037	1.2040	1.1795
SON VEL,M/SEC	910.7	910.4	861.2
MACH NUMBER	0.000	0.001	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.46310 0.48081 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.6522	8.3864	3.2767
CONDUCTIVITY	4.2814	6.4337	NaN
PRANDTL NUMBER	0.6114	0.6267	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.5567	2.7705	3.1206
CONDUCTIVITY	2.4491	2.5227	NaN
PRANDTL NUMBER	0.4834	0.5280	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1318.3	1318.3
CF	0.0006	0.6532
Ivac, M/SEC	821749.5	1591.3
Isp, M/SEC	0.8	861.2

MASS FRACTIONS

CH4	0.02326	0.02278	0.02422
*CO	0.71661	0.71738	0.68244
*CO2	0.02181	0.02158	0.03780
C2H4	0.00001	0.00001	0.00000
*H2	0.06985	0.07001	0.06862
H2O	0.02169	0.02138	0.03057
C(gr)	0.14677	0.14686	0.15634

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013119
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7802	50.000
P, BAR	20.265	19.737	11.384	0.40530
T, K	1352.35	1348.92	1255.15	922.90
RHO, KG/CU M	2.8888 0	2.8208 0	1.7754 0	9.5001-2
H, KJ/KG	-1162.80	-1172.16	-1540.64	-3274.02
U, KJ/KG	-1864.30	-1871.86	-2181.83	-3700.65
G, KJ/KG	-17886.6	-17862.7	-17070.9	-14693.3

S, KJ/(KG)(K)	12.3665	12.3732	12.3732	12.3732
M, (1/n)	16.029	16.029	16.276	17.986
MW, MOL WT	13.439	13.435	13.456	13.282
(dLV/dLP)t	-1.05405	-1.05409	-1.06477	-1.09451
(dLV/dLT)p	1.5706	1.5732	1.7665	2.6537
Cp, KJ/(KG)(K)	5.8048	5.8312	7.3712	16.5020
GAMMAS	1.1996	1.1991	1.1785	1.1145
SON VEL,M/SEC	917.3	916.0	869.3	689.6
MACH NUMBER	0.000	0.149	1.000	2.980

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.47334	0.47257	0.45138	0.37289
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.1738	6.1953	7.4770	13.3702
CONDUCTIVITY	4.7212	4.7253	5.2342	6.9479
PRANDTL NUMBER	0.6190	0.6196	0.6448	0.7176

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.5733	2.5723	2.5494	2.5189
CONDUCTIVITY	2.4782	2.4737	2.3304	1.9216
PRANDTL NUMBER	0.4915	0.4914	0.4938	0.4888

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9059
CSTAR, M/SEC	1296.1	1296.1	1296.1
CF	0.1055	0.6707	1.5855
Ivac, M/SEC	5252.3	1606.9	2262.5
Isp, M/SEC	136.8	869.3	2054.9

MASS FRACTIONS

CH4	0.03282	0.03266	0.03358	0.02580
*CO	0.70296	0.70246	0.66749	0.39098
*CO2	0.02561	0.02586	0.04173	0.19764
C2H4	0.00002	0.00002	0.00001	0.00000
C2H6	0.00001	0.00001	0.00000	0.00000
*H2	0.06681	0.06684	0.06555	0.06189
H2O	0.02735	0.02746	0.03697	0.08717
C(gr)	0.14441	0.14468	0.15467	0.23652

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013111
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7801	50.000
P, BAR	30.398	29.606	17.076	0.60795
T, K	1381.31	1377.79	1282.43	939.30
RHO, KG/CU M	4.2877 0	4.1867 0	2.6341 0	1.4140-1
H, KJ/KG	-1162.80	-1172.25	-1544.72	-3295.23
U, KJ/KG	-1871.75	-1879.40	-2193.00	-3725.19
G, KJ/KG	-17955.7	-17931.6	-17144.1	-14720.8
S, KJ/(KG)(K)	12.1572	12.1639	12.1639	12.1639
M, (1/n)	16.200	16.200	16.448	18.164
MW, MOL WT	13.591	13.586	13.598	13.379
(dLV/dLP)t	-1.06092	-1.06094	-1.07113	-1.09871
(dLV/dLT)p	1.6251	1.6277	1.8166	2.6775
Cp, KJ/(KG)(K)	5.9977	6.0242	7.4999	16.1890
GAMMAS	1.1977	1.1973	1.1783	1.1161
SON VEL,M/SEC	921.5	920.1	874.0	692.7
MACH NUMBER	0.000	0.149	1.000	2.981

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.47984 0.47906 0.45770 0.37742

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.4171	6.4401	7.7176	13.8979
CONDUCTIVITY	4.9619	4.9668	5.4892	7.3435
PRANDTL NUMBER	0.6206	0.6212	0.6435	0.7143

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.5839	2.5829	2.5596	2.5224
CONDUCTIVITY	2.4938	2.4894	2.3460	1.9263
PRANDTL NUMBER	0.4972	0.4971	0.4994	0.4942

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8841
CSTAR, M/SEC	1303.3	1303.3	1303.3
CF	0.1055	0.6706	1.5846
Ivac, M/SEC	5281.5	1615.7	2273.4
Isp, M/SEC	137.5	874.0	2065.2

MASS FRACTIONS

CH4	0.03948	0.03928	0.03982	0.03020
*CO	0.69474	0.69424	0.65905	0.38445
*CO2	0.02779	0.02805	0.04380	0.19605
C2H4	0.00003	0.00003	0.00001	0.00000
C2H6	0.00001	0.00001	0.00001	0.00000
*H2	0.06475	0.06478	0.06356	0.06017
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.03085	0.03096	0.04070	0.09267
C(gr)	0.14234	0.14264	0.15304	0.23646

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013107
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7801	50.000
P, BAR	40.530	39.475	22.769	0.81060
T, K	1403.06	1399.47	1302.75	951.37
RHO, KG/CU M	5.6745 0	5.5408 0	3.4852 0	1.8750-1
H, KJ/KG	-1162.80	-1172.32	-1547.64	-3310.26
U, KJ/KG	-1877.05	-1884.77	-2200.93	-3742.58

G, KJ/KG	-18013.9	-17989.5	-17202.6	-14742.7
S, KJ/(KG)(K)	12.0102	12.0168	12.0168	12.0168
M, (1/n)	16.333	16.332	16.580	18.297
MW, MOL WT	13.712	13.707	13.711	13.456
(dLV/dLP)t	-1.06579	-1.06581	-1.07560	-1.10167
(dLV/dLT)p	1.6617	1.6643	1.8496	2.6927
Cp, KJ/(KG)(K)	6.1106	6.1371	7.5643	15.9521
GAMMAS	1.1965	1.1961	1.1781	1.1172
SON VEL,M/SEC	924.4	923.1	877.3	695.0
MACH NUMBER	0.000	0.149	1.000	2.982

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.48466	0.48387	0.46235	0.38071
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.5567	6.5806	7.8469	14.1992
CONDUCTIVITY	5.1209	5.1265	5.6550	7.6054
PRANDTL NUMBER	0.6205	0.6211	0.6416	0.7108

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.5920	2.5910	2.5673	2.5249
CONDUCTIVITY	2.5042	2.4998	2.3562	1.9287
PRANDTL NUMBER	0.5017	0.5015	0.5038	0.4984

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8687
CSTAR, M/SEC	1308.4	1308.4	1308.4
CF	0.1054	0.6705	1.5839
Ivac, M/SEC	5302.2	1622.0	2281.0
Isp, M/SEC	138.0	877.3	2072.4

MASS FRACTIONS

CH4	0.04469	0.04446	0.04467	0.03363
*CO	0.68880	0.68830	0.65304	0.38000
*CO2	0.02933	0.02959	0.04524	0.19482
C2H4	0.00004	0.00004	0.00002	0.00000
C2H6	0.00002	0.00002	0.00001	0.00000
*H2	0.06315	0.06319	0.06204	0.05887
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.03341	0.03352	0.04339	0.09654
C(gr)	0.14056	0.14087	0.15159	0.23614

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013103

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7800	50.000
P, BAR	50.663	49.345	28.461	1.0132
T, K	1420.62	1416.97	1319.07	960.99
RHO, KG/CU M	7.0526 0	6.8864 0	4.3309 0	2.3339-1
H, KJ/KG	-1162.80	-1172.37	-1549.89	-3321.89
U, KJ/KG	-1881.16	-1888.92	-2207.07	-3756.03
G, KJ/KG	-18063.8	-18039.3	-17251.5	-14761.1
S, KJ/(KG)(K)	11.8970	11.9035	11.9035	11.9035
M, (1/n)	16.443	16.442	16.689	18.405
MW, MOL WT	13.814	13.808	13.806	13.521
(dLV/dLP)t	-1.06954	-1.06955	-1.07902	-1.10392
(dLV/dLT)p	1.6885	1.6912	1.8736	2.7031
Cp, KJ/(KG)(K)	6.1838	6.2103	7.5988	15.7592
GAMMAS	1.1956	1.1952	1.1780	1.1180
SON VEL,M/SEC	926.8	925.4	879.9	696.7
MACH NUMBER	0.000	0.149	1.000	2.983

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.48851 0.48771 0.46605 0.38330

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.6448	6.6694	7.9225	14.3876
CONDUCTIVITY	5.2361	5.2422	5.7737	7.7952
PRANDTL NUMBER	0.6199	0.6205	0.6395	0.7075

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.5986	2.5975	2.5734	2.5269
CONDUCTIVITY	2.5117	2.5074	2.3638	1.9300

PRANDTL NUMBER 0.5054 0.5052 0.5074 0.5019

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8570
CSTAR, M/SEC	1312.3	1312.3	1312.3
CF	0.1054	0.6705	1.5835
Ivac, M/SEC	5318.0	1626.8	2286.9
Isp, M/SEC	138.3	879.9	2078.0

MASS FRACTIONS

CH4	0.04900	0.04875	0.04868	0.03647
*CO	0.68412	0.68362	0.64836	0.37665
*CO2	0.03053	0.03079	0.04634	0.19382
C2H4	0.00005	0.00005	0.00002	0.00000
C2H6	0.00002	0.00002	0.00001	0.00000
*H2	0.06184	0.06189	0.06080	0.05783
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.03543	0.03554	0.04549	0.09952
C(gr)	0.13899	0.13932	0.15029	0.23572

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013101
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7800	50.000
P, BAR	60.795	59.214	34.154	1.2159

T, K	1435.40	1431.70	1332.77	969.02
RHO, KG/CU M	8.4240 0	8.2255 0	5.1723 0	2.7912-1
H, KJ/KG	-1162.80	-1172.41	-1551.72	-3331.35
U, KJ/KG	-1884.49	-1892.30	-2212.05	-3766.97
G, KJ/KG	-18107.7	-18083.0	-17293.8	-14777.0
S, KJ/(KG)(K)	11.8050	11.8116	11.8116	11.8116

M, (1/n)	16.537	16.536	16.781	18.495
MW, MOL WT	13.903	13.897	13.888	13.576
(dLV/dLP)t	-1.07256	-1.07257	-1.08176	-1.10573
(dLV/dLT)p	1.7094	1.7121	1.8919	2.7108
Cp, KJ/(KG)(K)	6.2342	6.2607	7.6169	15.5955
GAMMAS	1.1949	1.1945	1.1779	1.1187
SON VEL,M/SEC	928.6	927.3	881.9	698.1
MACH NUMBER	0.000	0.150	1.000	2.983

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.49174	0.49093	0.46913	0.38545
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.7034	6.7285	7.9681	14.5109
CONDUCTIVITY	5.3245	5.3309	5.8635	7.9407
PRANDTL NUMBER	0.6191	0.6196	0.6375	0.7044

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.6041	2.6030	2.5787	2.5286
CONDUCTIVITY	2.5176	2.5133	2.3696	1.9307
PRANDTL NUMBER	0.5086	0.5085	0.5105	0.5048

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8476
CSTAR, M/SEC	1315.5	1315.5	1315.5
CF	0.1054	0.6704	1.5831
Ivac, M/SEC	5330.9	1630.7	2291.7
Isp, M/SEC	138.6	881.9	2082.6

MASS FRACTIONS

CH4	0.05269	0.05243	0.05211	0.03890
*CO	0.68025	0.67975	0.64451	0.37397
*CO2	0.03153	0.03178	0.04725	0.19298
C2H4	0.00006	0.00006	0.00003	0.00000
C2H6	0.00003	0.00003	0.00002	0.00000
*H2	0.06072	0.06077	0.05974	0.05695
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.03711	0.03722	0.04723	0.10192
C(gr)	0.13760	0.13795	0.14911	0.23528

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013098
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7800	50.000
P, BAR	70.927	69.083	39.847	1.4185
T, K	1448.19	1444.45	1344.60	975.93
RHO, KG/CU M	9.7901 0	9.5593 0	6.0103 0	3.2470-1
H, KJ/KG	-1162.80	-1172.45	-1553.25	-3339.32
U, KJ/KG	-1887.28	-1895.13	-2216.24	-3776.19
G, KJ/KG	-18146.8	-18121.9	-17331.1	-14791.1
S, KJ/(KG)(K)	11.7277	11.7342	11.7342	11.7342
M, (1/n)	16.620	16.619	16.863	18.574
MW, MOL WT	13.982	13.975	13.961	13.626
(dLV/dLP)t	-1.07507	-1.07507	-1.08403	-1.10723
(dLV/dLT)p	1.7261	1.7288	1.9065	2.7165
Cp, KJ/(KG)(K)	6.2701	6.2966	7.6253	15.4526
GAMMAS	1.1943	1.1939	1.1778	1.1192
SON VEL,M/SEC	930.2	928.9	883.7	699.3
MACH NUMBER	0.000	0.150	1.000	2.984

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.49451	0.49369	0.47177	0.38728
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.7435	6.7690	7.9954	14.5934
CONDUCTIVITY	5.3948	5.4016	5.9343	8.0562
PRANDTL NUMBER	0.6181	0.6187	0.6356	0.7015

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.6089	2.6079	2.5832	2.5301
CONDUCTIVITY	2.5223	2.5180	2.3744	1.9312
PRANDTL NUMBER	0.5115	0.5113	0.5133	0.5074

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8398
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CSTAR, M/SEC	1318.2	1318.2	1318.2
CF	0.1054	0.6704	1.5828
Ivac, M/SEC	5341.8	1633.9	2295.8
Isp, M/SEC	138.9	883.7	2086.4

MASS FRACTIONS

CH4	0.05594	0.05566	0.05511	0.04103
*CO	0.67693	0.67644	0.64124	0.37174
*CO2	0.03238	0.03263	0.04802	0.19227
CH2CO,ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00007	0.00007	0.00003	0.00000
C2H6	0.00003	0.00003	0.00002	0.00000
*H2	0.05974	0.05980	0.05882	0.05619
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.03854	0.03866	0.04870	0.10394
C(gr)	0.13634	0.13670	0.14805	0.23483

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013096
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7800	50.000

P, BAR	81.060	78.953	45.540	1.6212
T, K	1459.50	1455.72	1355.04	982.01
RHO, KG/CU M	1.1152 1	1.0889 1	6.8454 0	3.7017-1
H, KJ/KG	-1162.80	-1172.48	-1554.57	-3346.19
U, KJ/KG	-1889.69	-1897.56	-2219.83	-3784.14
G, KJ/KG	-18182.1	-18157.1	-17364.6	-14803.8
S, KJ/(KG)(K)	11.6611	11.6675	11.6675	11.6675

M, (1/n)	16.695	16.693	16.935	18.643
MW, MOL WT	14.054	14.046	14.026	13.670
(dLV/dLP)t	-1.07720	-1.07721	-1.08596	-1.10850
(dLV/dLT)p	1.7400	1.7427	1.9184	2.7209
Cp, KJ/(KG)(K)	6.2964	6.3228	7.6274	15.3255
GAMMAS	1.1937	1.1934	1.1778	1.1197
SON VEL,M/SEC	931.5	930.2	885.2	700.3
MACH NUMBER	0.000	0.150	1.000	2.984

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.49694	0.49612	0.47409	0.38887
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.7712	6.7970	8.0107	14.6486
CONDUCTIVITY	5.4523	5.4594	5.9916	8.1506
PRANDTL NUMBER	0.6172	0.6177	0.6339	0.6989

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.6132	2.6121	2.5872	2.5314
CONDUCTIVITY	2.5262	2.5220	2.3783	1.9314
PRANDTL NUMBER	0.5141	0.5139	0.5157	0.5097

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8332
CSTAR, M/SEC	1320.5	1320.5	1320.5
CF	0.1054	0.6703	1.5825
Ivac, M/SEC	5351.1	1636.7	2299.3
Isp, M/SEC	139.1	885.2	2089.7

MASS FRACTIONS

CH4	0.05883	0.05854	0.05780	0.04294
*CO	0.67403	0.67354	0.63838	0.36985
*CO2	0.03312	0.03337	0.04869	0.19165
CH2CO,ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00008	0.00008	0.00003	0.00000
C2H6	0.00004	0.00004	0.00002	0.00000
*H2	0.05887	0.05893	0.05800	0.05551
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.03980	0.03991	0.04999	0.10567
C(gr)	0.13520	0.13557	0.14708	0.23439

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013094
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7799	50.000
P, BAR	91.192	88.822	51.234	1.8238
T, K	1469.64	1465.82	1364.39	987.44
RHO, KG/CU M	1.2510 1	1.2215 1	7.6782 0	4.1554-1
H, KJ/KG	-1162.80	-1172.51	-1555.71	-3352.22
U, KJ/KG	-1891.79	-1899.69	-2222.98	-3791.13
G, KJ/KG	-18214.3	-18189.2	-17394.9	-14815.4
S, KJ/(KG)(K)	11.6025	11.6090	11.6090	11.6090
M, (1/n)	16.762	16.760	17.001	18.706
MW, MOL WT	14.119	14.111	14.086	13.710
(dLV/dLP)t	-1.07905	-1.07906	-1.08762	-1.10959
(dLV/dLT)p	1.7516	1.7544	1.9283	2.7243
Cp, KJ/(KG)(K)	6.3158	6.3421	7.6255	15.2108
GAMMAS	1.1932	1.1929	1.1777	1.1202
SON VEL,M/SEC	932.6	931.4	886.5	701.2
MACH NUMBER	0.000	0.150	1.000	2.984

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.49912 0.49829 0.47616 0.39030

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.7903	6.8163	8.0179	14.6847
CONDUCTIVITY	5.5003	5.5077	6.0390	8.2291

PRANDTL NUMBER	0.6162	0.6167	0.6322	0.6965
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WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.6171	2.6160	2.5908	2.5326
CONDUCTIVITY	2.5295	2.5253	2.3817	1.9314
PRANDTL NUMBER	0.5164	0.5162	0.5180	0.5118

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8275
CSTAR, M/SEC	1322.5	1322.5	1322.5
CF	0.1053	0.6703	1.5823
Ivac, M/SEC	5359.2	1639.2	2302.3
Isp, M/SEC	139.3	886.5	2092.6

MASS FRACTIONS

CH4	0.06146	0.06115	0.06022	0.04466
*CO	0.67144	0.67095	0.63585	0.36819
*CO2	0.03379	0.03404	0.04929	0.19110
CH2CO,ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00009	0.00008	0.00004	0.00000
C2H6	0.00005	0.00004	0.00003	0.00000
*H2	0.05808	0.05815	0.05726	0.05491
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.04092	0.04103	0.05112	0.10718
C(gr)	0.13416	0.13453	0.14618	0.23396

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM
COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013092
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.80000 %FUEL= 55.555556 R,EQ.RATIO= 4.257083 PHI,EQ.RATIO= 4.257083

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7799	50.000
P, BAR	101.33	98.691	56.928	2.0265
T, K	1478.84	1474.99	1372.88	992.35
RHO, KG/CU M	1.3864 1	1.3537 1	8.5088 0	4.6082-1
H, KJ/KG	-1162.80	-1172.53	-1556.73	-3357.60
U, KJ/KG	-1893.65	-1901.58	-2225.78	-3797.36
G, KJ/KG	-18243.9	-18218.7	-17422.8	-14826.0
S, KJ/(KG)(K)	11.5504	11.5568	11.5568	11.5568
M, (1/n)	16.824	16.822	17.061	18.762
MW, MOL WT	14.179	14.171	14.142	13.747
(dLV/dLP)t	-1.08068	-1.08068	-1.08908	-1.11055
(dLV/dLT)p	1.7616	1.7644	1.9368	2.7269
Cp, KJ/(KG)(K)	6.3302	6.3565	7.6207	15.1061
GAMMAS	1.1927	1.1924	1.1776	1.1206
SON VEL,M/SEC	933.7	932.4	887.6	702.0
MACH NUMBER	0.000	0.150	1.000	2.985

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.50108 0.50025 0.47803 0.39157

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.8032	6.8294	8.0194	14.7070
CONDUCTIVITY	5.5411	5.5487	6.0788	8.2955
PRANDTL NUMBER	0.6152	0.6157	0.6306	0.6942

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.6207	2.6195	2.5942	2.5336
CONDUCTIVITY	2.5324	2.5282	2.3847	1.9314
PRANDTL NUMBER	0.5185	0.5183	0.5200	0.5137

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8225
CSTAR, M/SEC	1324.3	1324.3	1324.3
CF	0.1053	0.6703	1.5821
Ivac, M/SEC	5366.4	1641.4	2305.0
Isp, M/SEC	139.5	887.6	2095.1

MASS FRACTIONS

CH4	0.06385	0.06353	0.06243	0.04624
*CO	0.66909	0.66861	0.63357	0.36673
*CO2	0.03440	0.03464	0.04983	0.19061
C2H2,acetylene	0.00001	0.00000	0.00000	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00010	0.00009	0.00004	0.00000
C2H6	0.00005	0.00005	0.00003	0.00000

*H2	0.05736	0.05743	0.05659	0.05436
HCHO,formaldehy	0.00002	0.00002	0.00001	0.00000
H2O	0.04193	0.04204	0.05215	0.10852
C(gr)	0.13319	0.13357	0.14534	0.23354

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013355
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0272	1.7952	50.000
P, BAR	10.133	9.8640	5.6443	0.20265
T, K	1376.42	1372.58	1258.27	912.02
RHO, KG/CU M	1.3741 0	1.3415 0	8.4854-1	4.6549-2
H, KJ/KG	-1122.95	-1132.96	-1523.15	-3295.10
U, KJ/KG	-1860.36	-1868.27	-2188.33	-3730.45
G, KJ/KG	-18937.8	-18907.8	-17817.8	-15105.8
S, KJ/(KG)(K)	12.9429	12.9500	12.9500	12.9500
M, (1/n)	15.519	15.520	15.728	17.418
MW, MOL WT	13.785	13.784	13.833	13.788
(dLV/dLP)t	-1.02668	-1.02673	-1.03790	-1.08407
(dLV/dLT)p	1.2767	1.2785	1.4544	2.5661

Cp, KJ/(KG)(K)	4.0238	4.0405	5.4063	16.8500
GAMMAS	1.2351	1.2345	1.2033	1.1142
SON VEL,M/SEC	954.3	952.8	894.6	696.5
MACH NUMBER	0.000	0.148	1.000	2.993

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.48326	0.48238	0.45607	0.37296
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.1169	4.1292	5.1533	9.8350
CONDUCTIVITY	3.4927	3.4929	3.8573	5.2351
PRANDTL NUMBER	0.5696	0.5703	0.6093	0.7007

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4393	2.4382	2.4091	2.3697
CONDUCTIVITY	2.4576	2.4522	2.2760	1.8418
PRANDTL NUMBER	0.4797	0.4796	0.4827	0.4799

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8246
CSTAR, M/SEC	1317.1	1317.1	1317.1
CF	0.1074	0.6792	1.5825
Ivac, M/SEC	5338.9	1638.2	2293.2
Isp, M/SEC	141.5	894.7	2084.3

MASS FRACTIONS

CH4	0.01469	0.01463	0.01672	0.01482
*CO	0.79429	0.79397	0.76559	0.48380
*CO2	0.01221	0.01237	0.02527	0.19127
C2H4	0.00001	0.00001	0.00000	0.00000
*H2	0.06892	0.06893	0.06754	0.06295
H2O	0.01250	0.01258	0.02027	0.06560
C(gr)	0.09736	0.09751	0.10459	0.18155

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013303

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0271	1.7926	50.000
P, BAR	20.265	19.730	11.305	0.40530
T, K	1415.46	1411.55	1298.86	938.81
RHO, KG/CU M	2.7072 0	2.6431 0	1.6694 0	9.1773-2
H, KJ/KG	-1122.95	-1133.07	-1528.85	-3332.73
U, KJ/KG	-1871.51	-1879.54	-2206.00	-3774.36
G, KJ/KG	-18920.7	-18891.6	-17869.6	-15143.7
S, KJ/(KG)(K)	12.5738	12.5808	12.5808	12.5808
M, (1/n)	15.722	15.722	15.948	17.675
MW, MOL WT	13.967	13.965	14.011	13.912
(dLV/dLP)t	-1.03716	-1.03720	-1.04847	-1.09109
(dLV/dLT)p	1.3706	1.3726	1.5541	2.6149
Cp, KJ/(KG)(K)	4.4837	4.5024	5.8751	16.4353
GAMMAS	1.2261	1.2256	1.1988	1.1169
SON VEL,M/SEC	958.0	956.5	901.0	702.3
MACH NUMBER	0.000	0.149	1.000	2.993

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.49214 0.49126 0.46566 0.38061

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.6252	4.6401	5.7345	10.9707
CONDUCTIVITY	3.8822	3.8836	4.3061	5.9173
PRANDTL NUMBER	0.5863	0.5869	0.6201	0.7057

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4532	2.4521	2.4243	2.3782
CONDUCTIVITY	2.4839	2.4786	2.3070	1.8588
PRANDTL NUMBER	0.4861	0.4860	0.4893	0.4870

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.7963
CSTAR, M/SEC	1329.6	1329.6	1329.6
CF	0.1070	0.6777	1.5812
Ivac, M/SEC	5389.1	1652.6	2312.3
Isp, M/SEC	142.3	901.0	2102.3

MASS FRACTIONS

CH4	0.02227	0.02216	0.02406	0.02002
*CO	0.78185	0.78148	0.75086	0.46926
*CO2	0.01606	0.01624	0.02992	0.19168
C2H4	0.00002	0.00002	0.00001	0.00000
*H2	0.06647	0.06649	0.06506	0.06064
H2O	0.01736	0.01744	0.02594	0.07462
C(gr)	0.09596	0.09615	0.10414	0.18378

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013280
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0271	1.7916	50.000
P, BAR	30.398	29.596	16.967	0.60795
T, K	1441.83	1437.87	1325.11	955.40
RHO, KG/CU M	4.0227 0	3.9276 0	2.4790 0	1.3653-1
H, KJ/KG	-1122.95	-1133.15	-1532.57	-3355.17
U, KJ/KG	-1878.59	-1886.71	-2216.99	-3800.45

G, KJ/KG	-18944.5	-18915.6	-17920.6	-15170.8
S, KJ/(KG)(K)	12.3604	12.3673	12.3673	12.3673
M, (1/n)	15.865	15.865	16.098	17.839
MW, MOL WT	14.103	14.099	14.140	14.001
(dLV/dLP)t	-1.04391	-1.04394	-1.05500	-1.09532
(dLV/dLT)p	1.4273	1.4294	1.6111	2.6415
Cp, KJ/(KG)(K)	4.7340	4.7536	6.1057	16.1615
GAMMAS	1.2219	1.2215	1.1970	1.1184
SON VEL,M/SEC	960.9	959.4	905.1	705.7
MACH NUMBER	0.000	0.149	1.000	2.994

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.49805	0.49716	0.47176	0.38527
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.9029	4.9192	6.0321	11.5589
CONDUCTIVITY	4.1161	4.1183	4.5651	6.3125
PRANDTL NUMBER	0.5933	0.5938	0.6234	0.7055

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4626	2.4615	2.4340	2.3833
CONDUCTIVITY	2.4992	2.4940	2.3242	1.8670
PRANDTL NUMBER	0.4908	0.4907	0.4941	0.4918

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.7780
CSTAR, M/SEC	1337.0	1337.0	1337.0
CF	0.1068	0.6770	1.5804
Ivac, M/SEC	5419.0	1661.3	2323.7
Isp, M/SEC	142.8	905.1	2112.9

MASS FRACTIONS

CH4	0.02777	0.02763	0.02928	0.02365
*CO	0.77394	0.77355	0.74198	0.46111
*CO2	0.01840	0.01859	0.03256	0.19150
C2H4	0.00003	0.00003	0.00001	0.00000
C2H6	0.00001	0.00001	0.00000	0.00000
*H2	0.06473	0.06476	0.06336	0.05912
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.02053	0.02061	0.02949	0.08002
C(gr)	0.09458	0.09480	0.10332	0.18461

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013266
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0270	1.7910	50.000
P, BAR	40.530	39.463	22.630	0.81060
T, K	1462.09	1458.06	1344.86	967.60
RHO, KG/CU M	5.3270 0	5.2010 0	3.2813 0	1.8099-1
H, KJ/KG	-1122.95	-1133.21	-1535.33	-3371.20
U, KJ/KG	-1883.79	-1891.96	-2224.98	-3819.07
G, KJ/KG	-18975.2	-18946.3	-17965.5	-15192.4
S, KJ/(KG)(K)	12.2101	12.2170	12.2170	12.2170
M, (1/n)	15.978	15.978	16.214	17.963
MW, MOL WT	14.214	14.209	14.244	14.071
(dLV/dLP)t	-1.04888	-1.04890	-1.05972	-1.09834
(dLV/dLT)p	1.4672	1.4694	1.6501	2.6589
Cp, KJ/(KG)(K)	4.8972	4.9173	6.2463	15.9516
GAMMAS	1.2193	1.2189	1.1959	1.1196
SON VEL,M/SEC	963.2	961.7	908.2	708.1
MACH NUMBER	0.000	0.149	1.000	2.995

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.50254 0.50164 0.47630 0.38865

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.0828	5.1001	6.2164	11.9269
CONDUCTIVITY	4.2797	4.2825	4.7422	6.5844
PRANDTL NUMBER	0.5968	0.5974	0.6244	0.7040

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4699	2.4688	2.4414	2.3869
CONDUCTIVITY	2.5098	2.5046	2.3359	1.8719

PRANDTL NUMBER 0.4945 0.4945 0.4978 0.4956

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000	7.7647
CSTAR, M/SEC	1342.3	1342.3	1342.3
CF	0.1067	0.6766	1.5798
Ivac, M/SEC	5440.3	1667.6	2331.7
Isp, M/SEC	143.2	908.2	2120.5

MASS FRACTIONS

CH4	0.03218	0.03202	0.03341	0.02652
*CO	0.76809	0.76769	0.73558	0.45548
*CO2	0.02009	0.02029	0.03440	0.19122
C2H4	0.00004	0.00004	0.00002	0.00000
C2H6	0.00001	0.00001	0.00001	0.00000
*H2	0.06336	0.06339	0.06202	0.05797
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.02290	0.02299	0.03209	0.08386
C(gr)	0.09331	0.09355	0.10245	0.18495

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013266
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8391
P, BAR	50.663	48.682	27.547
T, K	1478.66	1475.65	1358.89
RHO, KG/CU M	6.6232 0	6.3704 0	3.9737 0

H, KJ/KG	-1122.95	-1122.95	-1537.26
U, KJ/KG	-1887.88	-1887.14	-2230.50
G, KJ/KG	-19006.4	-19000.4	-18000.2
S, KJ/(KG)(K)	12.0943	12.1150	12.1150
M, (1/n)	16.073	16.055	16.298
MW, MOL WT	14.308	14.291	14.321
(dLV/dLP)t	-1.05280	-1.05210	-1.06296
(dLV/dLT)p	1.4976	1.4923	1.6758
Cp, KJ/(KG)(K)	5.0137	4.9935	6.3305
GAMMAS	1.2175	1.2178	1.1953
SON VEL,M/SEC	965.0	964.7	910.3
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.50618	0.50164	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.2100	5.1001	5.3207
CONDUCTIVITY	4.4034	4.2825	NaN
PRANDTL NUMBER	0.5989	0.5974	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4759	2.4688	2.6779
CONDUCTIVITY	2.5177	2.5046	NaN
PRANDTL NUMBER	0.4978	0.4945	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1382.3	1382.3
CF	0.0000	0.6585
Ivac, M/SEC	*****	1671.8
Isp, M/SEC	0.0	910.3

MASS FRACTIONS

*C	0.00000	0.00000	0.00121
CH4	0.03590	0.03521	0.03645
*CO	0.76342	0.76426	0.73116
*CO2	0.02142	0.02118	0.03565
C2H2,acetylene	0.00001	0.00001	0.00000
C2H4	0.00005	0.00005	0.00002
C2H6	0.00002	0.00001	0.00001
*H2	0.06221	0.06242	0.06106
HCHO,formaldehy	0.00001	0.00001	0.00000
H2O	0.02481	0.02447	0.03391
*O	0.00000	0.00000	0.00049
C(gr)	0.09215	0.09237	0.10173

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013266
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0132	1.7903
P, BAR	60.795	60.000	33.958
T, K	1492.75	1491.71	1374.30
RHO, KG/CU M	7.9130 0	7.8120 0	4.8715 0
H, KJ/KG	-1122.95	-1122.95	-1539.33
U, KJ/KG	-1891.25	-1891.00	-2236.40
G, KJ/KG	-19036.3	-19034.0	-18040.6
S, KJ/(KG)(K)	12.0003	12.0070	12.0070
M, (1/n)	16.155	16.148	16.392
MW, MOL WT	14.391	14.385	14.409
(dLV/dLP)t	-1.05603	-1.05579	-1.06639
(dLV/dLT)p	1.5219	1.5202	1.7022
Cp, KJ/(KG)(K)	5.1015	5.0954	6.4092
GAMMAS	1.2160	1.2161	1.1946
SON VEL,M/SEC	966.6	966.5	912.5
MACH NUMBER	0.000	NaN	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.50925 0.50164 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.3047	5.1001	3.6639
CONDUCTIVITY	4.5017	4.2825	NaN
PRANDTL NUMBER	0.6001	0.5974	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4809	2.4688	2.7548
CONDUCTIVITY	2.5239	2.5046	NaN
PRANDTL NUMBER	0.5006	0.4945	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1349.7	1349.7
CF	NaN	0.6761
Ivac, M/SEC	NaN	1676.4
Isp, M/SEC	NaN	912.6

MASS FRACTIONS

*C	0.00000	0.00000	0.00004
CH4	0.03912	0.03888	0.03986
*CO	0.75952	0.75980	0.72642
*CO2	0.02253	0.02245	0.03698
C2H2, acetylene	0.00001	0.00001	0.00000
CH2CO, ketene	0.00001	0.00001	0.00000
C2H4	0.00007	0.00006	0.00003
C2H6	0.00002	0.00002	0.00001
*H2	0.06121	0.06129	0.05998
HCHO, formaldehy	0.00001	0.00001	0.00001
H2O	0.02641	0.02630	0.03587
*O	0.00000	0.00000	0.00004
C(gr)	0.09110	0.09118	0.10083

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013266
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8386

P, BAR	70.927	68.155	38.577
T, K	1505.04	1501.82	1383.93
RHO, KG/CU M	9.1976 0	8.8466 0	5.5157 0
H, KJ/KG	-1122.95	-1122.95	-1540.59
U, KJ/KG	-1894.10	-1893.37	-2240.00
G, KJ/KG	-19064.6	-19057.0	-18066.9
S, KJ/(KG)(K)	11.9211	11.9415	11.9415

M, (1/n)	16.227	16.208	16.452
MW, MOL WT	14.466	14.446	14.466
(dLV/dLP)t	-1.05875	-1.05805	-1.06848
(dLV/dLT)p	1.5419	1.5368	1.7178
Cp, KJ/(KG)(K)	5.1703	5.1530	6.4516
GAMMAS	1.2148	1.2151	1.1943
SON VEL,M/SEC	967.9	967.6	913.9
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.51192	0.50164	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.3779	5.1001	5.3895
CONDUCTIVITY	4.5822	4.2825	NaN
PRANDTL NUMBER	0.6008	0.5974	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4854	2.4688	2.7053
CONDUCTIVITY	2.5290	2.5046	NaN
PRANDTL NUMBER	0.5031	0.4945	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1388.6	1388.6
CF	0.0000	0.6582
Ivac, M/SEC	*****	1679.2
Isp, M/SEC	0.0	913.9

MASS FRACTIONS

*C	0.00000	0.00000	0.00146
CH4	0.04198	0.04123	0.04204
*CO	0.75616	0.75703	0.72350
*CO2	0.02347	0.02323	0.03779
C2H2,acetylene	0.00001	0.00001	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00008	0.00007	0.00003
C2H6	0.00002	0.00002	0.00001
*H2	0.06034	0.06057	0.05929
HCHO,formaldehy	0.00001	0.00001	0.00001
H2O	0.02780	0.02744	0.03709
*O	0.00000	0.00000	0.00053
C(gr)	0.09012	0.09038	0.10023

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013266

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8384
P, BAR	81.060	77.892	44.093
T, K	1515.96	1512.67	1394.23
RHO, KG/CU M	1.0478 1	1.0078 1	6.2824 0
H, KJ/KG	-1122.95	-1122.95	-1541.92
U, KJ/KG	-1896.58	-1895.84	-2243.78
G, KJ/KG	-19091.3	-19083.1	-18095.8
S, KJ/(KG)(K)	11.8528	11.8732	11.8732

M, (1/n)	16.293	16.273	16.517
MW, MOL WT	14.534	14.513	14.528
(dLV/dLP)t	-1.06111	-1.06040	-1.07064
(dLV/dLT)p	1.5588	1.5538	1.7335
Cp, KJ/(KG)(K)	5.2256	5.2095	6.4914
GAMMAS	1.2139	1.2141	1.1939
SON VEL,M/SEC	969.1	968.7	915.4
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.51428 0.50164 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.4360	5.1001	4.0057
CONDUCTIVITY	4.6500	4.2825	NaN
PRANDTL NUMBER	0.6012	0.5974	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4894	2.4688	2.7303
CONDUCTIVITY	2.5333	2.5046	NaN
PRANDTL NUMBER	0.5054	0.4945	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000
CSTAR, M/SEC	1391.1	1391.1
CF	0.0000	0.6580
Ivac, M/SEC	*****	1682.1
Isp, M/SEC	0.0	915.4

MASS FRACTIONS

*C	0.00000	0.00000	0.00018
CH4	0.04455	0.04377	0.04440
*CO	0.75321	0.75410	0.72043
*CO2	0.02430	0.02405	0.03864
C2H2, acetylene	0.00001	0.00001	0.00000
CH2CO, ketene	0.00001	0.00001	0.00000
C2H4	0.00009	0.00008	0.00004
C2H6	0.00003	0.00003	0.00002
*H2	0.05955	0.05979	0.05856
HCHO, formaldehy	0.00001	0.00001	0.00001
H2O	0.02901	0.02865	0.03837
*O	0.00000	0.00000	0.00010
C(gr)	0.08922	0.08950	0.09954

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013234

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0270	1.7897	50.000
P, BAR	91.192	88.797	50.954	1.8238
T, K	1525.80	1521.58	1405.59	1004.08
RHO, KG/CU M	1.1754 1	1.1476 1	7.2327 0	4.0075-1
H, KJ/KG	-1122.95	-1133.39	-1543.36	-3416.49
U, KJ/KG	-1898.76	-1907.12	-2247.86	-3871.60
G, KJ/KG	-19116.4	-19087.2	-18128.6	-15264.1
S, KJ/(KG)(K)	11.7928	11.7995	11.7995	11.7995
M, (1/n)	16.352	16.351	16.589	18.344
MW, MOL WT	14.596	14.589	14.598	14.307
(dLV/dLP)t	-1.06317	-1.06317	-1.07296	-1.10666
(dLV/dLT)p	1.5733	1.5755	1.7500	2.6986
Cp, KJ/(KG)(K)	5.2711	5.2922	6.5291	15.2837
GAMMAS	1.2130	1.2126	1.1935	1.1227
SON VEL,M/SEC	970.1	968.6	917.0	714.8
MACH NUMBER	0.000	0.149	1.000	2.996

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.51640 0.51548 0.48999 0.39854

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.4829	5.5025	6.5897	12.6852
CONDUCTIVITY	4.7079	4.7123	5.1908	7.2789
PRANDTL NUMBER	0.6014	0.6019	0.6220	0.6945

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4930	2.4919	2.4642	2.3976
CONDUCTIVITY	2.5369	2.5320	2.3660	1.8822
PRANDTL NUMBER	0.5075	0.5073	0.5103	0.5077

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.7269
CSTAR, M/SEC	1357.1	1357.1	1357.1
CF	0.1065	0.6757	1.5782
Ivac, M/SEC	5500.1	1685.3	2354.2
Isp, M/SEC	144.5	917.0	2141.7

MASS FRACTIONS

CH4	0.04689	0.04664	0.04703	0.03591
*CO	0.75057	0.75016	0.71708	0.44034
*CO2	0.02504	0.02525	0.03956	0.18993
C2H2,acetylene	0.00001	0.00001	0.00000	0.00000

CH2CO, ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00010	0.00009	0.00004	0.00000
C2H6	0.00003	0.00003	0.00002	0.00000
*H2	0.05884	0.05889	0.05773	0.05440
HCHO, formaldehy	0.00002	0.00002	0.00001	0.00000
H2O	0.03010	0.03020	0.03977	0.09466
C(gr)	0.08838	0.08869	0.09875	0.18476

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013234
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 0.90000 %FUEL= 52.631579 R,EQ.RATIO= 3.784074 PHI,EQ.RATIO= 3.784074

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8381
P, BAR	101.33	97.365	55.126
T, K	1534.76	1531.35	1411.88
RHO, KG/CU M	1.3028 1	1.2531 1	7.8090 0
H, KJ/KG	-1122.95	-1122.95	-1544.14
U, KJ/KG	-1900.71	-1899.97	-2250.07
G, KJ/KG	-19140.0	-19130.9	-18147.2
S, KJ/(KG)(K)	11.7393	11.7595	11.7595
M, (1/n)	16.407	16.386	16.629
MW, MOL WT	14.654	14.632	14.637
(dLV/dLP)t	-1.06500	-1.06431	-1.07421
(dLV/dLT)p	1.5859	1.5812	1.7586
Cp, KJ/(KG)(K)	5.3091	5.2950	6.5473
GAMMAS	1.2122	1.2125	1.1933
SON VEL,M/SEC	971.0	970.6	917.8

MACH NUMBER 0.000 0.000 1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.51832 0.51548 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.5215	5.5025	3.7383
CONDUCTIVITY	4.7583	4.7123	NaN
PRANDTL NUMBER	0.6015	0.6019	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.4963	2.4919	2.7633
CONDUCTIVITY	2.5401	2.5320	NaN
PRANDTL NUMBER	0.5094	0.5073	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1395.3	1395.3
CF	0.0000	0.6578
Ivac, M/SEC	*****	1687.0
Isp, M/SEC	0.1	917.8

MASS FRACTIONS

*C	0.00000	0.00000	0.00001
CH4	0.04904	0.04822	0.04851
*CO	0.74818	0.74909	0.71524
*CO2	0.02571	0.02546	0.04007
C2H2,acetylene	0.00001	0.00001	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00011	0.00010	0.00005
C2H6	0.00004	0.00004	0.00002
*H2	0.05819	0.05844	0.05728
HCHO,formaldehy	0.00002	0.00002	0.00001
H2O	0.03109	0.03072	0.04053
*O	0.00000	0.00000	0.00001
C(gr)	0.08760	0.08790	0.09829

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013608
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0277	1.8138	50.000
P, BAR	10.133	9.8590	5.5863	0.20265
T, K	1459.40	1454.92	1311.43	925.48
RHO, KG/CU M	1.2833 0	1.2526 0	7.9554-1	4.5255-2
H, KJ/KG	-1087.08	-1098.00	-1520.12	-3353.51
U, KJ/KG	-1876.64	-1885.11	-2222.31	-3801.31
G, KJ/KG	-20237.7	-20200.4	-18738.6	-15504.7
S, KJ/(KG)(K)	13.1222	13.1296	13.1296	13.1296
M, (1/n)	15.368	15.369	15.528	17.184
MW, MOL WT	14.378	14.377	14.434	14.450
(dLV/dLP)t	-1.01545	-1.01548	-1.02479	-1.08016
(dLV/dLT)p	1.1480	1.1490	1.2827	2.5041
Cp, KJ/(KG)(K)	3.1435	3.1520	4.1170	16.4195
GAMMAS	1.2680	1.2676	1.2333	1.1168
SON VEL,M/SEC	1000.6	998.9	930.6	707.2
MACH NUMBER	0.000	0.148	1.000	3.011

TRANSPORT PROPERTIES (GASES ONLY) CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.50589 0.50487 0.47185 0.37920

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.1752	3.1819	3.9173	8.0446
CONDUCTIVITY	3.0219	3.0191	3.2219	4.4675
PRANDTL NUMBER	0.5316	0.5321	0.5737	0.6828

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3488	2.3476	2.3116	2.2540
CONDUCTIVITY	2.4850	2.4787	2.2645	1.7771
PRANDTL NUMBER	0.4781	0.4782	0.4817	0.4810

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.6840
CSTAR, M/SEC	1350.2	1350.2	1350.2
CF	0.1094	0.6892	1.5768
Ivac, M/SEC	5474.4	1685.2	2339.4
Isp, M/SEC	147.8	930.6	2129.0

MASS FRACTIONS

CH4	0.00886	0.00883	0.01104	0.01164
*CO	0.85713	0.85694	0.83628	0.55823

*CO2	0.00617	0.00626	0.01539	0.18086
C2H4	0.00001	0.00001	0.00000	0.00000
*H2	0.06734	0.06734	0.06614	0.06113
H2O	0.00667	0.00671	0.01253	0.05590
C(gr)	0.05381	0.05390	0.05862	0.13224

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013608
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8567
P, BAR	20.265	19.473	10.915
T, K	1489.77	1487.77	1346.19
RHO, KG/CU M	2.5388 0	2.4413 0	1.5310 0
H, KJ/KG	-1087.08	-1087.08	-1523.44
U, KJ/KG	-1885.30	-1884.74	-2236.35
G, KJ/KG	-20080.0	-20086.3	-18714.7
S, KJ/(KG)(K)	12.7489	12.7703	12.7703
M, (1/n)	15.518	15.508	15.700
MW, MOL WT	14.527	14.517	14.580
(dLV/dLP)t	-1.02394	-1.02339	-1.03398
(dLV/dLT)p	1.2230	1.2183	1.3728
Cp, KJ/(KG)(K)	3.5227	3.4997	4.5973
GAMMAS	1.2556	1.2563	1.2241
SON VEL,M/SEC	1001.1	1001.0	934.2
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.51272 0.50487 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.5682	3.1819	3.4874
CONDUCTIVITY	3.3148	3.0191	NaN
PRANDTL NUMBER	0.5519	0.5321	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3590	2.3476	2.5691
CONDUCTIVITY	2.5043	2.4787	NaN
PRANDTL NUMBER	0.4830	0.4782	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1397.9	1397.9
CF	0.0001	0.6683
Ivac, M/SEC	9448574.3	1697.3
Isp, M/SEC	0.1	934.2

MASS FRACTIONS

*C	0.00000	0.00000	0.00047
CH4	0.01455	0.01416	0.01660
*CO	0.84755	0.84817	0.82340
*CO2	0.00923	0.00903	0.01984
C2H2,acetylene	0.00001	0.00001	0.00000
C2H4	0.00002	0.00002	0.00001
*H2	0.06550	0.06562	0.06422
H2O	0.01032	0.01008	0.01717
*O	0.00000	0.00000	0.00023
C(gr)	0.05281	0.05289	0.05876

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013608
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0135	1.8055
P, BAR	30.398	29.993	16.836
T, K	1511.86	1511.08	1371.94
RHO, KG/CU M	3.7798 0	3.7305 0	2.3370 0
H, KJ/KG	-1087.08	-1087.08	-1526.38
U, KJ/KG	-1891.30	-1891.09	-2246.78
G, KJ/KG	-20034.5	-20035.4	-18730.0
S, KJ/(KG)(K)	12.5325	12.5396	12.5396
M, (1/n)	15.631	15.627	15.834
MW, MOL WT	14.643	14.639	14.702
(dLV/dLP)t	-1.02991	-1.02970	-1.04063
(dLV/dLT)p	1.2733	1.2716	1.4338
Cp, KJ/(KG)(K)	3.7606	3.7527	4.8916
GAMMAS	1.2491	1.2493	1.2196
SON VEL,M/SEC	1002.3	1002.2	937.3
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.51764 0.50487 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.8154	3.1819	4.7062
CONDUCTIVITY	3.5106	3.0191	NaN
PRANDTL NUMBER	0.5626	0.5321	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3665	2.3476	2.5487
CONDUCTIVITY	2.5168	2.4787	NaN
PRANDTL NUMBER	0.4867	0.4782	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1369.0	1369.0
CF	0.0000	0.6847
Ivac, M/SEC	*****	1705.9
Isp, M/SEC	0.1	937.3

MASS FRACTIONS

*C 0.00000 0.00000 0.00151

CH4	0.01893	0.01877	0.02115
*CO	0.84089	0.84112	0.81435
*CO2	0.01129	0.01122	0.02282
C2H2, acetylene	0.00001	0.00001	0.00000
C2H4	0.00004	0.00004	0.00001
*H2	0.06410	0.06415	0.06270
HCHO, formaldehy	0.00001	0.00001	0.00000
H2O	0.01291	0.01282	0.02055
*O	0.00000	0.00000	0.00054
C(gr)	0.05181	0.05185	0.05841

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013608
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8527
P, BAR	40.530	38.946	21.877
T, K	1529.48	1526.94	1388.75
RHO, KG/CU M	5.0110 0	4.8191 0	3.0171 0
H, KJ/KG	-1087.08	-1087.08	-1528.40
U, KJ/KG	-1895.90	-1895.25	-2253.49
G, KJ/KG	-20021.8	-20022.7	-18750.2
S, KJ/(KG)(K)	12.3799	12.4010	12.4010
M, (1/n)	15.723	15.709	15.925
MW, MOL WT	14.741	14.727	14.787
(dLV/dLP)t	-1.03452	-1.03386	-1.04486
(dLV/dLT)p	1.3109	1.3056	1.4709
Cp, KJ/(KG)(K)	3.9292	3.9060	5.0575
GAMMAS	1.2449	1.2455	1.2173
SON VEL,M/SEC	1003.5	1003.3	939.5

MACH NUMBER 0.000 0.000 1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.52152 0.50487 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.9904	3.1819	3.9709
CONDUCTIVITY	3.6563	3.0191	NaN
PRANDTL NUMBER	0.5692	0.5321	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3725	2.3476	2.5488
CONDUCTIVITY	2.5259	2.4787	NaN
PRANDTL NUMBER	0.4898	0.4782	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1410.7	1410.7
CF	0.0000	0.6660
Ivac, M/SEC	*****	1711.3
Isp, M/SEC	0.0	939.5

MASS FRACTIONS

*C	0.00000	0.00000	0.00061
CH4	0.02255	0.02203	0.02429
*CO	0.83574	0.83647	0.80865
*CO2	0.01286	0.01264	0.02465
C2H2,acetylene	0.00001	0.00001	0.00000
C2H4	0.00005	0.00005	0.00002
C2H6	0.00001	0.00001	0.00000
*H2	0.06296	0.06313	0.06166
HCHO,formaldehy	0.00001	0.00001	0.00000
H2O	0.01494	0.01465	0.02272
*O	0.00000	0.00000	0.00020
C(gr)	0.05086	0.05100	0.05800

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
 REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013608
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0134	1.8030
P, BAR	50.663	49.991	28.098
T, K	1544.23	1543.32	1405.67
RHO, KG/CU M	6.2350 0	6.1541 0	3.8509 0
H, KJ/KG	-1087.08	-1087.08	-1530.47
U, KJ/KG	-1899.64	-1899.41	-2260.13
G, KJ/KG	-20022.7	-20022.4	-18776.9
S, KJ/(KG)(K)	12.2622	12.2692	12.2692
M, (1/n)	15.801	15.797	16.018
MW, MOL WT	14.827	14.821	14.878
(dLV/dLP)t	-1.03827	-1.03804	-1.04900
(dLV/dLT)p	1.3406	1.3388	1.5060
Cp, KJ/(KG)(K)	4.0573	4.0497	5.2053
GAMMAS	1.2419	1.2421	1.2153
SON VEL,M/SEC	1004.6	1004.5	941.7
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY) CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.52475 0.50487 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.1227	3.1819	4.6383
CONDUCTIVITY	3.7713	3.0191	NaN
PRANDTL NUMBER	0.5736	0.5321	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3775	2.3476	2.5820
CONDUCTIVITY	2.5330	2.4787	NaN
PRANDTL NUMBER	0.4925	0.4782	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1378.3	1378.3
CF	0.0000	0.6832

Ivac, M/SEC	*****	1716.5
Isp, M/SEC	0.0	941.7

MASS FRACTIONS

*C	0.00000	0.00000	0.00159
CH4	0.02567	0.02547	0.02758
*CO	0.83151	0.83177	0.80306
*CO2	0.01413	0.01405	0.02640
C2H2,acetylene	0.00001	0.00001	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00006	0.00006	0.00002
C2H6	0.00001	0.00001	0.00001
*H2	0.06199	0.06205	0.06060
HCHO,formaldehy	0.00001	0.00001	0.00001
H2O	0.01662	0.01651	0.02487
*O	0.00000	0.00000	0.00058
C(gr)	0.04998	0.05004	0.05745

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013419
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0274	1.8023	50.000
P, BAR	60.795	59.176	33.732	1.2159
T, K	1556.98	1552.37	1418.55	999.73
RHO, KG/CU M	7.4532 0	7.2760 0	4.6016 0	2.6128-1
H, KJ/KG	-1087.08	-1098.21	-1532.06	-3454.48
U, KJ/KG	-1902.78	-1911.52	-2265.10	-3919.84
G, KJ/KG	-20029.9	-19995.9	-18800.7	-15624.6
S, KJ/(KG)(K)	12.1664	12.1734	12.1734	12.1734
M, (1/n)	15.871	15.870	16.090	17.862
MW, MOL WT	14.903	14.898	14.950	14.810
(dLV/dLP)t	-1.04142	-1.04142	-1.05207	-1.09877
(dLV/dLT)p	1.3650	1.3666	1.5313	2.6325
Cp, KJ/(KG)(K)	4.1588	4.1734	5.3057	15.4360
GAMMAS	1.2396	1.2392	1.2140	1.1239
SON VEL,M/SEC	1005.6	1003.9	943.4	723.2
MACH NUMBER	0.000	0.149	1.000	3.009

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.52753	0.52651	0.49666	0.40017
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.2270	4.2399	5.1921	10.5470
CONDUCTIVITY	3.8655	3.8663	4.2493	6.0845
PRANDTL NUMBER	0.5769	0.5774	0.6069	0.6937

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3819	2.3807	2.3500	2.2799
CONDUCTIVITY	2.5387	2.5329	2.3385	1.8241
PRANDTL NUMBER	0.4949	0.4949	0.4991	0.5002

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.6354
CSTAR, M/SEC	1381.9	1381.9	1381.9
CF	0.1079	0.6826	1.5746
Ivac, M/SEC	5601.9	1720.4	2389.8
Isp, M/SEC	149.2	943.4	2176.0

MASS FRACTIONS

CH4	0.02841	0.02826	0.03015	0.02515
*CO	0.82792	0.82762	0.79890	0.51685
*CO2	0.01520	0.01535	0.02769	0.18567
C2H2,acetylene	0.00001	0.00001	0.00000	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00007	0.00007	0.00003	0.00000
C2H6	0.00001	0.00001	0.00001	0.00000
*H2	0.06114	0.06117	0.05977	0.05520
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.01805	0.01812	0.02649	0.07857
C(gr)	0.04916	0.04936	0.05694	0.13856

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013419

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8503
P, BAR	70.927	68.155	38.333
T, K	1568.23	1565.28	1427.84
RHO, KG/CU M	8.6666 0	8.3351 0	5.2124 0
H, KJ/KG	-1087.08	-1087.08	-1533.19
U, KJ/KG	-1905.48	-1904.78	-2268.62
G, KJ/KG	-20040.4	-20037.3	-18819.5
S, KJ/(KG)(K)	12.0858	12.1066	12.1066

M, (1/n)	15.932	15.916	16.143
MW, MOL WT	14.971	14.953	15.003
(dLV/dLP)t	-1.04414	-1.04344	-1.05423
(dLV/dLT)p	1.3856	1.3803	1.5487
Cp, KJ/(KG)(K)	4.2418	4.2206	5.3718
GAMMAS	1.2377	1.2382	1.2132
SON VEL,M/SEC	1006.5	1006.2	944.6
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.52996 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.3117	4.2399	3.3023
CONDUCTIVITY	3.9449	3.8663	NaN
PRANDTL NUMBER	0.5792	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3858	2.3807	2.6113
CONDUCTIVITY	2.5435	2.5329	NaN
PRANDTL NUMBER	0.4971	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1421.5	1421.5
CF	0.0000	0.6645
Ivac, M/SEC	*****	1723.2
Isp, M/SEC	0.0	944.6

MASS FRACTIONS

CH4	0.03087	0.03022	0.03205
*CO	0.82479	0.82561	0.79595
*CO2	0.01613	0.01589	0.02860
C2H2, acetylene	0.00002	0.00001	0.00000
CH2CO, ketene	0.00001	0.00001	0.00000
C2H4	0.00008	0.00008	0.00003
C2H6	0.00002	0.00002	0.00001
*H2	0.06038	0.06058	0.05916
HCHO, formaldehy	0.00001	0.00001	0.00001
H2O	0.01930	0.01897	0.02765
C(gr)	0.04839	0.04859	0.05654

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013419
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150

OXIDANT O2(L) 1.0000000 -12979.000 90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0134	1.8012
P, BAR	81.060	79.988	45.003
T, K	1578.32	1577.30	1439.79
RHO, KG/CU M	9.8761 0	9.7483 0	6.0943 0
H, KJ/KG	-1087.08	-1087.08	-1534.65
U, KJ/KG	-1907.85	-1907.62	-2273.08
G, KJ/KG	-20052.7	-20051.3	-18845.5
S, KJ/(KG)(K)	12.0163	12.0232	12.0232
M, (1/n)	15.989	15.983	16.212
MW, MOL WT	15.035	15.028	15.073
(dLV/dLP)t	-1.04653	-1.04629	-1.05695
(dLV/dLT)p	1.4034	1.4016	1.5701
Cp, KJ/(KG)(K)	4.3112	4.3043	5.4496
GAMMAS	1.2362	1.2363	1.2122
SON VEL,M/SEC	1007.3	1007.2	946.1
MACH NUMBER	0.000	NaN	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.53214 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.3822	4.2399	3.4606
CONDUCTIVITY	4.0132	3.8663	NaN
PRANDTL NUMBER	0.5811	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3892	2.3807	2.6067
CONDUCTIVITY	2.5475	2.5329	NaN
PRANDTL NUMBER	0.4991	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1387.2	1387.2
CF	NaN	0.6820
Ivac, M/SEC	NaN	1726.6
Isp, M/SEC	NaN	946.1

MASS FRACTIONS

*C	0.00000	0.00000	0.00012
CH4	0.03311	0.03288	0.03453
*CO	0.82201	0.82229	0.79220
*CO2	0.01695	0.01687	0.02974
C2H2,acetylene	0.00002	0.00002	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00010	0.00009	0.00004
C2H6	0.00002	0.00002	0.00001
*H2	0.05969	0.05976	0.05837
HCHO,formaldehy	0.00001	0.00001	0.00001
H2O	0.02041	0.02030	0.02912
*O	0.00000	0.00000	0.00004
C(gr)	0.04766	0.04774	0.05597

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013419

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0134	1.8008
P, BAR	91.192	89.987	50.639
T, K	1587.49	1586.45	1448.80
RHO, KG/CU M	1.1082 1	1.0939 1	6.8371 0
H, KJ/KG	-1087.08	-1087.08	-1535.74
U, KJ/KG	-1909.97	-1909.73	-2276.39
G, KJ/KG	-20065.8	-20064.2	-18866.3
S, KJ/(KG)(K)	11.9551	11.9620	11.9620
M, (1/n)	16.040	16.034	16.264
MW, MOL WT	15.093	15.086	15.127
(dLV/dLP)t	-1.04865	-1.04841	-1.05896
(dLV/dLT)p	1.4189	1.4172	1.5855
Cp, KJ/(KG)(K)	4.3702	4.3637	5.5032
GAMMAS	1.2348	1.2350	1.2115
SON VEL,M/SEC	1008.0	1007.9	947.3
MACH NUMBER	0.000	NaN	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.53411 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.4417	4.2399	4.5636
CONDUCTIVITY	4.0728	3.8663	NaN
PRANDTL NUMBER	0.5825	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3924	2.3807	2.6255
CONDUCTIVITY	2.5510	2.5329	NaN
PRANDTL NUMBER	0.5009	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1389.4	1389.4
CF	NaN	0.6818
Ivac, M/SEC	NaN	1729.2
Isp, M/SEC	NaN	947.3

MASS FRACTIONS

*C	0.00000	0.00000	0.00180
CH4	0.03516	0.03492	0.03643
*CO	0.81950	0.81979	0.78941
*CO2	0.01769	0.01761	0.03058
C2H2,acetylene	0.00002	0.00002	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00011	0.00011	0.00004
C2H6	0.00002	0.00002	0.00001
*H2	0.05906	0.05913	0.05777
HCHO,formaldehy	0.00002	0.00002	0.00001
H2O	0.02142	0.02130	0.03022
*O	0.00000	0.00000	0.00061
C(gr)	0.04698	0.04706	0.05550

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013419
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.00000 %FUEL= 50.000000 R,EQ.RATIO= 3.405666 PHI,EQ.RATIO= 3.405666

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8491
P, BAR	101.33	97.365	54.798
T, K	1595.90	1592.70	1454.93
RHO, KG/CU M	1.2285 1	1.1815 1	7.3838 0
H, KJ/KG	-1087.08	-1087.08	-1536.47
U, KJ/KG	-1911.87	-1911.15	-2278.61
G, KJ/KG	-20079.2	-20073.9	-18880.9
S, KJ/(KG)(K)	11.9006	11.9212	11.9212
M, (1/n)	16.088	16.070	16.300
MW, MOL WT	15.148	15.127	15.165
(dLV/dLP)t	-1.05055	-1.04983	-1.06030
(dLV/dLT)p	1.4327	1.4275	1.5957
Cp, KJ/(KG)(K)	4.4212	4.4021	5.5372
GAMMAS	1.2336	1.2341	1.2110
SON VEL,M/SEC	1008.7	1008.4	948.0
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.53591 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.4928	4.2399	3.3370
CONDUCTIVITY	4.1255	3.8663	NaN
PRANDTL NUMBER	0.5836	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3954	2.3807	2.6410
CONDUCTIVITY	2.5541	2.5329	NaN
PRANDTL NUMBER	0.5026	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1428.3	1428.3
CF	0.0000	0.6637
Ivac, M/SEC	*****	1730.9
Isp, M/SEC	0.0	948.0

MASS FRACTIONS

*C	0.00000	0.00000	0.00008
CH3	0.00001	0.00001	0.00000
CH4	0.03706	0.03633	0.03774
*CO	0.81722	0.81809	0.78753
*CO2	0.01836	0.01811	0.03115
C2H2,acetylene	0.00002	0.00002	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000

C2H4	0.00012	0.00011	0.00005
C2H6	0.00003	0.00003	0.00002
*H2	0.05848	0.05870	0.05735
HCHO, formaldehy	0.00002	0.00002	0.00001
H2O	0.02233	0.02198	0.03097
*O	0.00000	0.00000	0.00004
C(gr)	0.04634	0.04659	0.05517

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013419
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8840
P, BAR	10.133	9.7365	5.3782
T, K	1554.07	1553.12	1371.78
RHO, KG/CU M	1.1996 0	1.1531 0	7.2622-1
H, KJ/KG	-1054.63	-1054.63	-1523.91
U, KJ/KG	-1899.30	-1899.03	-2264.49
G, KJ/KG	-21680.3	-21701.3	-19759.9
S, KJ/(KG)(K)	13.2720	13.2937	13.2937
M, (1/n)	15.298	15.293	15.401
MW, MOL WT	15.008	15.003	15.055
(dLV/dLP)t	-1.00872	-1.00844	-1.01506
(dLV/dLT)p	1.0766	1.0742	1.1620
Cp, KJ/(KG)(K)	2.6634	2.6514	3.2254
GAMMAS	1.2950	1.2956	1.2673
SON VEL,M/SEC	1045.9	1046.0	968.8
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.53054 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.6674	4.2399	3.8437
CONDUCTIVITY	2.7956	3.8663	NaN
PRANDTL NUMBER	0.5062	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2773	2.3807	2.4533
CONDUCTIVITY	2.5254	2.5329	NaN
PRANDTL NUMBER	0.4784	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000
CSTAR, M/SEC	1421.1	1421.1
CF	0.0000	0.6817
Ivac, M/SEC	*****	1733.2
Isp, M/SEC	0.0	968.8

MASS FRACTIONS

*C	0.00000	0.00000	0.00173
CH4	0.00527	0.00509	0.00694
*CO	0.90782	0.90811	0.89489
*CO2	0.00301	0.00291	0.00858
C2H2,acetylene	0.00001	0.00001	0.00000
C2H4	0.00001	0.00001	0.00000
*H2	0.06525	0.06531	0.06441
H2O	0.00346	0.00335	0.00722
*O	0.00000	0.00000	0.00044
C(gr)	0.01516	0.01519	0.01795

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013419
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8750
P, BAR	20.265	19.473	10.808
T, K	1575.26	1573.79	1401.66
RHO, KG/CU M	2.3826 0	2.2906 0	1.4409 0
H, KJ/KG	-1054.63	-1054.63	-1524.62
U, KJ/KG	-1905.16	-1904.76	-2274.69
G, KJ/KG	-21369.8	-21384.8	-19631.1
S, KJ/(KG)(K)	12.8964	12.9179	12.9179

M, (1/n)	15.399	15.392	15.537
MW, MOL WT	15.122	15.114	15.180
(dLV/dLP)t	-1.01482	-1.01440	-1.02290
(dLV/dLT)p	1.1279	1.1244	1.2387
Cp, KJ/(KG)(K)	2.9156	2.8990	3.6505
GAMMAS	1.2833	1.2840	1.2532
SON VEL,M/SEC	1044.7	1044.8	969.5
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.53523	0.52651	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.9202	4.2399	2.9466
CONDUCTIVITY	2.9854	3.8663	NaN
PRANDTL NUMBER	0.5235	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2841	2.3807	2.4678
CONDUCTIVITY	2.5372	2.5329	NaN
PRANDTL NUMBER	0.4818	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1431.4	1431.4
CF	0.0001	0.6773
Ivac, M/SEC	9929224.0	1743.2
Isp, M/SEC	0.1	969.5

MASS FRACTIONS

*C	0.00000	0.00000	0.00024
CH4	0.00928	0.00899	0.01133
*CO	0.90146	0.90190	0.88416
*CO2	0.00503	0.00489	0.01244
C2H2,acetylene	0.00002	0.00002	0.00000
C2H4	0.00003	0.00003	0.00001
*H2	0.06397	0.06406	0.06289
H2O	0.00589	0.00573	0.01096

*O	0.00000	0.00000	0.00006
C(gr)	0.01431	0.01438	0.01821

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013419
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8707
P, BAR	30.398	29.209	16.250
T, K	1592.12	1590.31	1422.72
RHO, KG/CU M	3.5551 0	3.4181 0	2.1482 0
H, KJ/KG	-1054.63	-1054.63	-1525.95
U, KJ/KG	-1909.66	-1909.19	-2282.37
G, KJ/KG	-21239.6	-21250.7	-19593.8
S, KJ/(KG)(K)	12.6780	12.6995	12.6995

M, (1/n)	15.482	15.473	15.639
MW, MOL WT	15.217	15.207	15.278
(dLV/dLP)t	-1.01955	-1.01904	-1.02840
(dLV/dLT)p	1.1665	1.1624	1.2898
Cp, KJ/(KG)(K)	3.0977	3.0789	3.9146
GAMMAS	1.2761	1.2768	1.2462
SON VEL,M/SEC	1044.6	1044.6	970.9
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.53893 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.1027	4.2399	3.3642
CONDUCTIVITY	3.1279	3.8663	NaN
PRANDTL NUMBER	0.5346	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2895	2.3807	2.4696
CONDUCTIVITY	2.5457	2.5329	NaN
PRANDTL NUMBER	0.4847	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1438.1	1438.1
CF	0.0000	0.6751
Ivac, M/SEC	*****	1750.0
Isp, M/SEC	0.1	970.9

MASS FRACTIONS

*C	0.00000	0.00000	0.00072
CH4	0.01259	0.01223	0.01473
*CO	0.89654	0.89706	0.87681
*CO2	0.00657	0.00641	0.01499
C2H2,acetylene	0.00002	0.00002	0.00000
C2H4	0.00004	0.00004	0.00001
*H2	0.06292	0.06304	0.06174
HCHO,formaldehy	0.00001	0.00001	0.00000
H2O	0.00780	0.00759	0.01360
*O	0.00000	0.00000	0.00012
C(gr)	0.01351	0.01360	0.01811

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013419
CASE = _____

REACTANT	WT FRACTION	ENERGY	TEMP
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FUEL	RP-1	(SEE NOTE)	KJ/KG-MOL	K
OXIDANT	O2(L)	1.0000000	-24717.700	298.150
		1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8680
P, BAR	40.530	38.946	21.697
T, K	1606.26	1604.19	1439.28
RHO, KG/CU M	4.7200 0	4.5383 0	2.8503 0
H, KJ/KG	-1054.63	-1054.63	-1527.29
U, KJ/KG	-1913.33	-1912.80	-2288.51
G, KJ/KG	-21171.2	-21179.5	-19583.4
S, KJ/(KG)(K)	12.5239	12.5452	12.5452
M, (1/n)	15.553	15.543	15.721
MW, MOL WT	15.300	15.288	15.361
(dLV/dLP)t	-1.02342	-1.02285	-1.03266
(dLV/dLT)p	1.1973	1.1929	1.3280
Cp, KJ/(KG)(K)	3.2384	3.2184	4.1017
GAMMAS	1.2710	1.2717	1.2418
SON VEL,M/SEC	1044.7	1044.7	972.3
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.54201 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.2434	4.2399	2.8770
CONDUCTIVITY	3.2414	3.8663	NaN
PRANDTL NUMBER	0.5423	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2940	2.3807	2.4922
CONDUCTIVITY	2.5524	2.5329	NaN
PRANDTL NUMBER	0.4872	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1443.1	1443.1
CF	0.0000	0.6737
Ivac, M/SEC	*****	1755.2
Isp, M/SEC	0.0	972.3

MASS FRACTIONS

*C	0.00000	0.00000	0.00001
CH4	0.01543	0.01501	0.01756
*CO	0.89249	0.89308	0.87117
*CO2	0.00782	0.00764	0.01690
C2H2,acetylene	0.00002	0.00002	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00005	0.00005	0.00002
*H2	0.06203	0.06216	0.06080
HCHO,formaldehy	0.00001	0.00001	0.00000
H2O	0.00937	0.00914	0.01566
*O	0.00000	0.00000	0.00001
C(gr)	0.01275	0.01287	0.01788

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013419

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8662
P, BAR	50.663	48.682	27.148
T, K	1618.48	1616.22	1453.05
RHO, KG/CU M	5.8788 0	5.6527 0	3.5483 0
H, KJ/KG	-1054.63	-1054.63	-1528.54
U, KJ/KG	-1916.42	-1915.85	-2293.63
G, KJ/KG	-21131.7	-21137.9	-19584.2
S, KJ/(KG)(K)	12.4048	12.4261	12.4261

M, (1/n)	15.615	15.604	15.791
MW, MOL WT	15.374	15.361	15.434
(dLV/dLP)t	-1.02669	-1.02609	-1.03614
(dLV/dLT)p	1.2228	1.2182	1.3583
Cp, KJ/(KG)(K)	3.3517	3.3313	4.2440
GAMMAS	1.2672	1.2679	1.2388
SON VEL,M/SEC	1045.0	1044.9	973.6
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.54467 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.3565	4.2399	2.9142
CONDUCTIVITY	3.3355	3.8663	NaN
PRANDTL NUMBER	0.5481	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2980	2.3807	2.4984
CONDUCTIVITY	2.5578	2.5329	NaN
PRANDTL NUMBER	0.4893	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1447.1	1447.1
CF	0.0000	0.6727
Ivac, M/SEC	*****	1759.4
Isp, M/SEC	0.0	973.6

MASS FRACTIONS

*C	0.00000	0.00000	0.00001
CH4	0.01795	0.01748	0.02001
*CO	0.88905	0.88968	0.86658
*CO2	0.00888	0.00868	0.01843
C2H2, acetylene	0.00003	0.00003	0.00000
CH2CO, ketene	0.00001	0.00001	0.00000
C2H4	0.00007	0.00006	0.00003
C2H6	0.00001	0.00001	0.00000
*H2	0.06124	0.06139	0.05999
HCHO, formaldehy	0.00001	0.00001	0.00001
H2O	0.01072	0.01047	0.01736
*O	0.00000	0.00000	0.00001
C(gr)	0.01204	0.01218	0.01759

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013419
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8648
P, BAR	60.795	58.419	32.602
T, K	1629.30	1626.87	1464.88
RHO, KG/CU M	7.0327 0	6.7625 0	4.2431 0
H, KJ/KG	-1054.63	-1054.63	-1529.68
U, KJ/KG	-1919.09	-1918.49	-2298.02
G, KJ/KG	-21107.9	-21112.5	-19590.3
S, KJ/(KG)(K)	12.3079	12.3291	12.3291
M, (1/n)	15.671	15.658	15.852
MW, MOL WT	15.442	15.427	15.499
(dLV/dLP)t	-1.02953	-1.02890	-1.03908
(dLV/dLT)p	1.2446	1.2398	1.3834
Cp, KJ/(KG)(K)	3.4459	3.4252	4.3572
GAMMAS	1.2642	1.2648	1.2365
SON VEL,M/SEC	1045.4	1045.3	974.7
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.54700 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.4502	4.2399	5.7431
CONDUCTIVITY	3.4154	3.8663	NaN
PRANDTL NUMBER	0.5526	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3015	2.3807	2.4803
CONDUCTIVITY	2.5623	2.5329	NaN
PRANDTL NUMBER	0.4913	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1450.5	1450.5
CF	0.0000	0.6720
Ivac, M/SEC	*****	1763.0
Isp, M/SEC	0.0	974.7

MASS FRACTIONS

*C	0.00000	0.00000	0.00433
CH3	0.00001	0.00001	0.00000
CH4	0.02020	0.01969	0.02217
*CO	0.88604	0.88671	0.86270
*CO2	0.00980	0.00959	0.01971
C2H2,acetylene	0.00003	0.00003	0.00000

CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00008	0.00008	0.00003
C2H6	0.00001	0.00001	0.00001
*H2	0.06054	0.06070	0.05928
HCHO,formaldehy	0.00001	0.00001	0.00001
H2O	0.01190	0.01164	0.01881
*O	0.00000	0.00000	0.00057
C(gr)	0.01137	0.01153	0.01728

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013419
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8637
P, BAR	70.927	68.155	38.057
T, K	1639.02	1636.46	1475.30
RHO, KG/CU M	8.1826 0	7.8684 0	4.9352 0
H, KJ/KG	-1054.63	-1054.63	-1530.72
U, KJ/KG	-1921.44	-1920.82	-2301.86
G, KJ/KG	-21093.7	-21096.9	-19599.3
S, KJ/(KG)(K)	12.2263	12.2474	12.2474
M, (1/n)	15.722	15.708	15.907
MW, MOL WT	15.504	15.487	15.557
(dLV/dLP)t	-1.03203	-1.03137	-1.04163
(dLV/dLT)p	1.2634	1.2585	1.4046
Cp, KJ/(KG)(K)	3.5258	3.5052	4.4501
GAMMA _s	1.2617	1.2623	1.2347

SON VEL,M/SEC	1045.8	1045.7	975.8
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.54909	0.52651	NaN
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.5295	4.2399	3.2582
CONDUCTIVITY	3.4847	3.8663	NaN
PRANDTL NUMBER	0.5561	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3047	2.3807	2.5297
CONDUCTIVITY	2.5662	2.5329	NaN
PRANDTL NUMBER	0.4931	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1453.3	1453.3
CF	0.0000	0.6714
Ivac, M/SEC	*****	1766.1
Isp, M/SEC	0.0	975.8

MASS FRACTIONS

*C	0.00000	0.00000	0.00066
CH3	0.00001	0.00001	0.00000
CH4	0.02226	0.02172	0.02412
*CO	0.88336	0.88407	0.85932
*CO2	0.01061	0.01040	0.02081
C2H2,acetylene	0.00003	0.00003	0.00001
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00009	0.00009	0.00004
C2H6	0.00001	0.00001	0.00001
*H2	0.05990	0.06007	0.05865
HCHO,formaldehy	0.00001	0.00001	0.00001
H2O	0.01296	0.01268	0.02007
*O	0.00000	0.00000	0.00008
C(gr)	0.01074	0.01091	0.01696

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013419

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8628
P, BAR	81.060	77.892	43.514
T, K	1647.86	1645.18	1484.63
RHO, KG/CU M	9.3290 0	8.9709 0	5.6249 0
H, KJ/KG	-1054.63	-1054.63	-1531.67
U, KJ/KG	-1923.54	-1922.91	-2305.27
G, KJ/KG	-21085.7	-21087.7	-19609.7
S, KJ/(KG)(K)	12.1558	12.1768	12.1768

M, (1/n)	15.768	15.754	15.957
MW, MOL WT	15.561	15.544	15.611
(dLV/dLP)t	-1.03426	-1.03359	-1.04387
(dLV/dLT)p	1.2801	1.2751	1.4230
Cp, KJ/(KG)(K)	3.5948	3.5743	4.5280
GAMMAS	1.2596	1.2602	1.2333
SON VEL,M/SEC	1046.2	1046.0	976.8
MACH NUMBER	0.000	NaN	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.55099 0.52651 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.5977	4.2399	6.1705
CONDUCTIVITY	3.5457	3.8663	NaN
PRANDTL NUMBER	0.5591	0.5774	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3076	2.3807	2.5018
CONDUCTIVITY	2.5695	2.5329	NaN
PRANDTL NUMBER	0.4948	0.4949	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1455.8	1455.8
CF	NaN	0.6709
Ivac, M/SEC	NaN	1768.8
Isp, M/SEC	NaN	976.8

MASS FRACTIONS

*C	0.00000	0.00000	0.00573
CH3	0.00001	0.00001	0.00000
CH4	0.02415	0.02358	0.02590
*CO	0.88094	0.88168	0.85634
*CO2	0.01134	0.01112	0.02178
C2H2,acetylene	0.00003	0.00003	0.00001
CH2CO,ketene	0.00001	0.00001	0.00000
C2H4	0.00010	0.00010	0.00004
C2H6	0.00001	0.00001	0.00001
*H2	0.05932	0.05949	0.05808
HCHO,formaldehy	0.00002	0.00001	0.00001
H2O	0.01391	0.01362	0.02120
*O	0.00000	0.00000	0.00057
C(gr)	0.01015	0.01033	0.01663

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN
TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

TRY REMOVING CONDENSED SPECIES (EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013562
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0277	1.8134	50.000
P, BAR	91.192	88.739	50.287	1.8238
T, K	1655.99	1650.80	1495.02	1031.29
RHO, KG/CU M	1.0472 1	1.0222 1	6.4779 0	3.7860-1
H, KJ/KG	-1054.63	-1066.63	-1532.75	-3538.77
U, KJ/KG	-1925.43	-1934.76	-2309.03	-4020.50

G, KJ/KG	-21081.7	-21042.6	-19623.6	-16018.3
S, KJ/(KG)(K)	12.0937	12.1008	12.1008	12.1008
M, (1/n)	15.812	15.811	16.013	17.800
MW, MOL WT	15.615	15.610	15.673	15.566
(dLV/dLP)t	-1.03628	-1.03625	-1.04633	-1.09902
(dLV/dLT)p	1.2949	1.2961	1.4427	2.5996
Cp, KJ/(KG)(K)	3.6552	3.6656	4.6091	14.8341
GAMMAS	1.2578	1.2574	1.2318	1.1284
SON VEL,M/SEC	1046.5	1044.8	977.9	737.3
MACH NUMBER	0.000	0.148	1.000	3.023

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.55273	0.55159	0.51698	0.41096
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.6571	3.6665	4.4654	9.4934
CONDUCTIVITY	3.6000	3.5988	3.8980	5.6998
PRANDTL NUMBER	0.5615	0.5620	0.5922	0.6845

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3102	2.3090	2.2760	2.1926
CONDUCTIVITY	2.5725	2.5661	2.3473	1.7821
PRANDTL NUMBER	0.4964	0.4963	0.5013	0.5056

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.5064
CSTAR, M/SEC	1420.3	1420.3	1420.3
CF	0.1091	0.6885	1.5693
Ivac, M/SEC	5758.4	1771.7	2445.1
Isp, M/SEC	154.9	977.9	2229.0

MASS FRACTIONS

CH3	0.00001	0.00001	0.00000	0.00000
CH4	0.02590	0.02576	0.02792	0.02445
*CO	0.87874	0.87851	0.85305	0.57082
*CO2	0.01201	0.01212	0.02283	0.18070
C2H2,acetylene	0.00004	0.00004	0.00001	0.00000
CH2CO,ketene	0.00002	0.00001	0.00001	0.00000
C2H4	0.00012	0.00011	0.00005	0.00000
C2H6	0.00002	0.00002	0.00001	0.00000
*H2	0.05878	0.05881	0.05743	0.05246
HCHO,formaldehy	0.00002	0.00002	0.00001	0.00000
H2O	0.01478	0.01484	0.02245	0.07474
C(gr)	0.00958	0.00977	0.01624	0.09684

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

WARNING!! MAXIMUM ALLOWED NO. OF SPECIES 40 WAS USED IN

TRANSPORT PROPERTY CALCULATIONS FOR POINT 1(TRANIN))

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

50 ITERATIONS DID NOT SATISFY CONVERGENCE
REQUIREMENTS FOR THE POINT 4 (EQLBRM)

CALCULATIONS STOPPED AFTER POINT 3(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013562

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.10000 %FUEL= 47.619048 R,EQ.RATIO= 3.096060 PHI,EQ.RATIO= 3.096060

	INJECTOR	COMB END	THROAT
Pinj/P	1.0000	1.0407	1.8615
P, BAR	101.33	97.365	54.433
T, K	1663.51	1660.64	1500.84
RHO, KG/CU M	1.1613 1	1.1167 1	6.9986 0
H, KJ/KG	-1054.63	-1054.63	-1533.35
U, KJ/KG	-1927.16	-1926.50	-2311.12
G, KJ/KG	-21080.6	-21080.8	-19632.5
S, KJ/(KG)(K)	12.0384	12.0593	12.0593
M, (1/n)	15.852	15.837	16.044
MW, MOL WT	15.665	15.646	15.709
(dLV/dLP)t	-1.03811	-1.03741	-1.04768
(dLV/dLT)p	1.3082	1.3031	1.4535
Cp, KJ/(KG)(K)	3.7086	3.6885	4.6521
GAMMAS	1.2562	1.2568	1.2310
SON VEL,M/SEC	1046.9	1046.8	978.5
MACH NUMBER	0.000	0.000	1.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.55433 0.55159 NaN

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.7095	3.6665	2.9168
CONDUCTIVITY	3.6489	3.5988	NaN
PRANDTL NUMBER	0.5635	0.5620	NaN

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.3127	2.3090	2.5692
CONDUCTIVITY	2.5751	2.5661	NaN
PRANDTL NUMBER	0.4978	0.4963	NaN

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000
CSTAR, M/SEC	1459.8	1459.8
CF	0.0000	0.6703
Ivac, M/SEC	*****	1773.4
Isp, M/SEC	0.0	978.5

MASS FRACTIONS

*C	0.00000	0.00000	0.00005
CH3	0.00001	0.00001	0.00000
CH4	0.02754	0.02691	0.02906
*CO	0.87671	0.87748	0.85123
*CO2	0.01262	0.01238	0.02342
C2H2,acetylene	0.00004	0.00004	0.00001
CH2CO,ketene	0.00002	0.00002	0.00001
C2H4	0.00013	0.00012	0.00005
C2H6	0.00002	0.00002	0.00001
*H2	0.05827	0.05847	0.05706
HCHO,formaldehy	0.00002	0.00002	0.00001
H2O	0.01558	0.01528	0.02314
*O	0.00000	0.00000	0.00002
C(gr)	0.00904	0.00925	0.01600

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.014081
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0287	1.8668	50.000
P, BAR	10.133	9.8496	5.4278	0.20265
T, K	1737.70	1731.83	1503.95	946.09

RHO, KG/CU M	1.0920 0	1.0651 0	6.7629-1	4.3483-2
H, KJ/KG	-1025.13	-1038.41	-1552.27	-3500.32
U, KJ/KG	-1952.99	-1963.13	-2354.86	-3966.36
G, KJ/KG	-24262.2	-24209.8	-21674.7	-16158.8
S, KJ/(KG)(K)	13.3723	13.3797	13.3797	13.3797

M, (1/n)	15.572	15.572	15.580	16.879
MW, MOL WT	15.572	15.572	15.580	15.807
(dLV/dLP)t	-1.00045	-1.00045	-1.00150	-1.07273
(dLV/dLT)p	1.0039	1.0039	1.0140	2.3741
Cp, KJ/(KG)(K)	2.2775	2.2763	2.2844	15.2933
GAMMAS	1.3086	1.3088	1.3136	1.1221
SON VEL,M/SEC	1101.9	1100.1	1026.8	723.2
MACH NUMBER	0.000	0.148	1.000	3.077

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.57741	0.57609	0.52405	0.38866
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2775	2.2763	2.2844	5.7980
CONDUCTIVITY	2.7289	2.7204	2.4358	3.4548
PRANDTL NUMBER	0.4819	0.4820	0.4915	0.6523

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2479	2.2467	2.1980	2.0802
CONDUCTIVITY	2.6934	2.6855	2.3791	1.6617
PRANDTL NUMBER	0.4819	0.4820	0.4842	0.4865

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.1775
CSTAR, M/SEC	1438.9	1438.9	1438.9
CF	0.1133	0.7136	1.5463
Ivac, M/SEC	5836.7	1808.4	2434.4
Isp, M/SEC	163.0	1026.8	2224.9

MASS FRACTIONS

CH4	0.00011	0.00011	0.00039	0.00779
*CO	0.90069	0.90064	0.89746	0.68120
*CO2	0.01583	0.01591	0.02015	0.16291
*H2	0.06144	0.06144	0.06153	0.05719
H2O	0.02192	0.02189	0.02047	0.04267
C(gr)	0.00000	0.00000	0.00000	0.04823

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.014045

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0286	1.8604	50.000
P, BAR	20.265	19.701	10.893	0.40530
T, K	1739.86	1733.98	1511.36	974.22
RHO, KG/CU M	2.1828 0	2.1292 0	1.3531 0	8.5439-2
H, KJ/KG	-1025.13	-1038.38	-1550.16	-3529.63
U, KJ/KG	-1953.54	-1963.66	-2355.17	-4004.00
G, KJ/KG	-23647.2	-23597.0	-21212.4	-16203.9
S, KJ/(KG)(K)	13.0023	13.0097	13.0097	13.0097

M, (1/n)	15.582	15.581	15.610	17.075
MW, MOL WT	15.582	15.581	15.610	15.901
(dLV/dLP)t	-1.00168	-1.00168	-1.00498	-1.07932
(dLV/dLT)p	1.0135	1.0135	1.0464	2.4298
Cp, KJ/(KG)(K)	2.3180	2.3171	2.4470	15.1065
GAMMAS	1.3068	1.3070	1.3044	1.1248
SON VEL,M/SEC	1101.5	1099.7	1024.7	730.5
MACH NUMBER	0.000	0.148	1.000	3.064

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.57789 0.57657 0.52576 0.39672

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3180	2.3171	2.4470	6.6056
CONDUCTIVITY	2.7542	2.7460	2.5453	3.9320
PRANDTL NUMBER	0.4864	0.4865	0.5055	0.6665

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2486	2.2474	2.2002	2.0904
CONDUCTIVITY	2.6947	2.6868	2.3848	1.6870
PRANDTL NUMBER	0.4822	0.4823	0.4851	0.4916

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2513
CSTAR, M/SEC	1441.3	1441.3	1441.3
CF	0.1130	0.7110	1.5529
Ivac, M/SEC	5846.0	1810.3	2450.0
Isp, M/SEC	162.8	1024.7	2238.1

MASS FRACTIONS

CH4	0.00044	0.00044	0.00137	0.01078
*CO	0.90000	0.89995	0.89534	0.66444
*CO2	0.01602	0.01610	0.02079	0.16742
*H2	0.06132	0.06133	0.06119	0.05565
H2O	0.02221	0.02218	0.02130	0.04977
C(gr)	0.00000	0.00000	0.00000	0.05195

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.014003
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0286	1.8544	50.000
P, BAR	30.398	29.553	16.392	0.60795
T, K	1743.04	1737.18	1520.30	991.53
RHO, KG/CU M	3.2713 0	3.1912 0	2.0292 0	1.2687-1
H, KJ/KG	-1025.13	-1038.36	-1548.43	-3548.89
U, KJ/KG	-1954.34	-1964.44	-2356.25	-4028.07
G, KJ/KG	-23311.7	-23262.8	-20998.2	-16233.9
S, KJ/(KG)(K)	12.7860	12.7934	12.7934	12.7934
M, (1/n)	15.597	15.597	15.648	17.204
MW, MOL WT	15.597	15.597	15.648	15.970
(dLV/dLP)t	-1.00349	-1.00348	-1.00900	-1.08342
(dLV/dLT)p	1.0278	1.0278	1.0833	2.4622
Cp, KJ/(KG)(K)	2.3785	2.3780	2.6297	14.9710
GAMMAS	1.3042	1.3043	1.2956	1.1265
SON VEL,M/SEC	1100.9	1099.1	1023.0	734.7
MACH NUMBER	0.000	0.148	1.000	3.058

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.57861 0.57729 0.52782 0.40163

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3785	2.3780	2.6297	7.0912
CONDUCTIVITY	2.7969	2.7890	2.6719	4.2355
PRANDTL NUMBER	0.4921	0.4922	0.5195	0.6724

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2496	2.2484	2.2030	2.0967
CONDUCTIVITY	2.6965	2.6887	2.3913	1.7009
PRANDTL NUMBER	0.4827	0.4828	0.4862	0.4951

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2828
CSTAR, M/SEC	1444.1	1444.1	1444.1
CF	0.1126	0.7084	1.5558
Ivac, M/SEC	5857.2	1812.7	2460.0
Isp, M/SEC	162.6	1023.0	2246.7

MASS FRACTIONS

CH4	0.00094	0.00093	0.00261	0.01295
*CO	0.89894	0.89890	0.89265	0.65438
*CO2	0.01630	0.01638	0.02161	0.16986
*H2	0.06115	0.06116	0.06076	0.05460
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.02265	0.02262	0.02236	0.05424
C(gr)	0.00000	0.00000	0.00000	0.05398

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013963
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0285	1.8497	50.000
P, BAR	40.530	39.408	21.911	0.81060
T, K	1746.99	1741.12	1529.37	1004.21
RHO, KG/CU M	4.3572 0	4.2508 0	2.7032 0	1.6798-1
H, KJ/KG	-1025.13	-1038.33	-1547.33	-3563.53
U, KJ/KG	-1955.32	-1965.40	-2357.90	-4046.08
G, KJ/KG	-23094.3	-23046.3	-20878.7	-16256.8
S, KJ/(KG)(K)	12.6327	12.6401	12.6401	12.6401
M, (1/n)	15.616	15.615	15.688	17.303
MW, MOL WT	15.616	15.615	15.688	16.026
(dLV/dLP)t	-1.00562	-1.00561	-1.01286	-1.08644
(dLV/dLT)p	1.0445	1.0446	1.1183	2.4849
Cp, KJ/(KG)(K)	2.4499	2.4497	2.7994	14.8614
GAMMAS	1.3012	1.3013	1.2885	1.1277
SON VEL,M/SEC	1100.2	1098.4	1022.0	737.7
MACH NUMBER	0.000	0.148	1.000	3.054

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.57950	0.57818	0.52991	0.40520
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4499	2.4497	2.7994	7.4325
CONDUCTIVITY	2.8492	2.8414	2.7931	4.4588
PRANDTL NUMBER	0.4983	0.4985	0.5311	0.6754

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2508	2.2497	2.2058	2.1013
CONDUCTIVITY	2.6988	2.6910	2.3978	1.7102
PRANDTL NUMBER	0.4833	0.4834	0.4875	0.4979

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2990
CSTAR, M/SEC	1446.9	1446.9	1446.9
CF	0.1123	0.7063	1.5572
Ivac, M/SEC	5868.4	1815.1	2467.3
Isp, M/SEC	162.5	1022.0	2253.2

MASS FRACTIONS

CH4	0.00155	0.00155	0.00391	0.01470
*CO	0.89763	0.89759	0.88982	0.64714
*CO2	0.01666	0.01674	0.02246	0.17151
*H2	0.06093	0.06094	0.06031	0.05379
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.02320	0.02317	0.02348	0.05755
C(gr)	0.00000	0.00000	0.00000	0.05532

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013929

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8461	50.000
P, BAR	50.663	49.263	27.443	1.0132
T, K	1751.42	1745.55	1538.07	1014.29
RHO, KG/CU M	5.4401 0	5.3076 0	3.3749 0	2.0885-1
H, KJ/KG	-1025.13	-1038.31	-1546.74	-3575.42
U, KJ/KG	-1956.41	-1966.48	-2359.87	-4060.57
G, KJ/KG	-22942.3	-22894.9	-20805.4	-16275.7
S, KJ/(KG)(K)	12.5140	12.5213	12.5213	12.5213

M, (1/n)	15.637	15.637	15.727	17.383
MW, MOL WT	15.637	15.637	15.727	16.074
(dLV/dLP)t	-1.00790	-1.00788	-1.01636	-1.08882
(dLV/dLT)p	1.0623	1.0624	1.1495	2.5021
Cp, KJ/(KG)(K)	2.5251	2.5254	2.9485	14.7677
GAMMAS	1.2983	1.2983	1.2830	1.1286
SON VEL,M/SEC	1099.6	1097.8	1021.4	740.0
MACH NUMBER	0.000	0.148	1.000	3.052

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.58049 0.57917 0.53192 0.40802

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.5251	2.5254	2.9485	7.6913
CONDUCTIVITY	2.9056	2.8981	2.9025	4.6351
PRANDTL NUMBER	0.5045	0.5047	0.5403	0.6771

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2522	2.2511	2.2086	2.1047
CONDUCTIVITY	2.7013	2.6935	2.4037	1.7171
PRANDTL NUMBER	0.4840	0.4840	0.4887	0.5001

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3080
CSTAR, M/SEC	1449.5	1449.5	1449.5
CF	0.1120	0.7046	1.5581
Ivac, M/SEC	5878.8	1817.5	2473.3
Isp, M/SEC	162.4	1021.4	2258.4

MASS FRACTIONS

CH4	0.00225	0.00224	0.00520	0.01619
*CO	0.89615	0.89611	0.88704	0.64147
*CO2	0.01706	0.01714	0.02331	0.17275
*H2	0.06069	0.06069	0.05986	0.05312
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.02383	0.02378	0.02458	0.06018
C(gr)	0.00000	0.00000	0.00000	0.05629

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013900

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0283	1.8433	50.000
P, BAR	60.795	59.119	32.981	1.2159
T, K	1756.12	1750.25	1546.25	1022.69

RHO, KG/CU M	6.5201 0	6.3615 0	4.0444 0	2.4954-1
H, KJ/KG	-1025.13	-1038.30	-1546.49	-3585.47
U, KJ/KG	-1957.55	-1967.62	-2361.96	-4072.72
G, KJ/KG	-22831.0	-22784.2	-20757.8	-16291.8
S, KJ/(KG)(K)	12.4171	12.4244	12.4244	12.4244

M, (1/n)	15.660	15.659	15.765	17.451
MW, MOL WT	15.660	15.659	15.765	16.116
(dLV/dLP)t	-1.01019	-1.01016	-1.01948	-1.09078
(dLV/dLT)p	1.0801	1.0802	1.1770	2.5157
Cp, KJ/(KG)(K)	2.5998	2.6005	3.0777	14.6852
GAMMAS	1.2954	1.2955	1.2786	1.1294
SON VEL,M/SEC	1099.0	1097.2	1021.1	741.8
MACH NUMBER	0.000	0.148	1.000	3.051

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.58155	0.58023	0.53380	0.41035
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.5998	2.6005	3.0777	7.8969
CONDUCTIVITY	2.9629	2.9555	2.9999	4.7803
PRANDTL NUMBER	0.5103	0.5105	0.5476	0.6779

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2537	2.2526	2.2112	2.1076
CONDUCTIVITY	2.7040	2.6962	2.4092	1.7226
PRANDTL NUMBER	0.4847	0.4848	0.4899	0.5021

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3134
CSTAR, M/SEC	1451.9	1451.9	1451.9
CF	0.1118	0.7033	1.5586
Ivac, M/SEC	5888.4	1819.7	2478.2
Isp, M/SEC	162.3	1021.1	2262.9

MASS FRACTIONS

CH4	0.00299	0.00298	0.00643	0.01750
*CO	0.89457	0.89454	0.88437	0.63681
*CO2	0.01749	0.01757	0.02411	0.17373
C2H2,acetylene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00001	0.00001	0.00001	0.00000
*H2	0.06043	0.06043	0.05944	0.05255
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.02449	0.02444	0.02564	0.06237
C(gr)	0.00000	0.00000	0.00000	0.05704

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013875

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0283	1.8411	50.000
P, BAR	70.927	68.976	38.524	1.4185
T, K	1760.95	1755.08	1553.92	1029.91
RHO, KG/CU M	7.5973 0	7.4128 0	4.7116 0	2.9009-1
H, KJ/KG	-1025.13	-1038.29	-1546.45	-3594.19
U, KJ/KG	-1958.72	-1968.79	-2364.08	-4083.20
G, KJ/KG	-22747.0	-22700.5	-20725.9	-16306.0
S, KJ/(KG)(K)	12.3353	12.3426	12.3426	12.3426
M, (1/n)	15.683	15.683	15.802	17.511
MW, MOL WT	15.683	15.683	15.802	16.154
(dLV/dLP)t	-1.01242	-1.01239	-1.02228	-1.09246
(dLV/dLT)p	1.0973	1.0975	1.2014	2.5270
Cp, KJ/(KG)(K)	2.6716	2.6726	3.1897	14.6112
GAMMAS	1.2929	1.2929	1.2752	1.1300
SON VEL,M/SEC	1098.6	1096.8	1021.1	743.4
MACH NUMBER	0.000	0.148	1.000	3.049

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.58263 0.58131 0.53556 0.41235

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.6716	2.6726	3.1897	8.0654
CONDUCTIVITY	3.0190	3.0118	3.0866	4.9033
PRANDTL NUMBER	0.5156	0.5159	0.5535	0.6783

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2553	2.2541	2.2137	2.1101
CONDUCTIVITY	2.7067	2.6989	2.4142	1.7271
PRANDTL NUMBER	0.4855	0.4855	0.4911	0.5038

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3166
CSTAR, M/SEC	1454.1	1454.1	1454.1
CF	0.1116	0.7022	1.5589

Ivac, M/SEC	5897.1	1821.8	2482.5
Isp, M/SEC	162.3	1021.1	2266.7

MASS FRACTIONS

CH4	0.00375	0.00374	0.00760	0.01867
*CO	0.89295	0.89292	0.88183	0.63286
*CO2	0.01793	0.01801	0.02487	0.17454
C2H2,acetylene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00001	0.00001	0.00001	0.00000
*H2	0.06016	0.06017	0.05903	0.05204
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.02517	0.02512	0.02664	0.06425
C(gr)	0.00000	0.00000	0.00000	0.05764

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013854

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0283	1.8394	50.000
P, BAR	81.060	78.833	44.070	1.6212
T, K	1765.81	1759.93	1561.10	1036.26
RHO, KG/CU M	8.6718 0	8.4615 0	5.3769 0	3.3050-1
H, KJ/KG	-1025.13	-1038.29	-1546.56	-3601.89
U, KJ/KG	-1959.89	-1969.96	-2366.17	-4092.42
G, KJ/KG	-22682.0	-22635.9	-20704.1	-16318.7
S, KJ/(KG)(K)	12.2646	12.2718	12.2718	12.2718
M, (1/n)	15.707	15.706	15.836	17.565
MW, MOL WT	15.707	15.706	15.836	16.188
(dLV/dLP)t	-1.01456	-1.01453	-1.02480	-1.09391

(dLV/dLT)p	1.1137	1.1139	1.2230	2.5365
Cp, KJ/(KG)(K)	2.7394	2.7407	3.2876	14.5436
GAMMAS	1.2905	1.2905	1.2724	1.1306
SON VEL,M/SEC	1098.3	1096.5	1021.2	744.7
MACH NUMBER	0.000	0.148	1.000	3.048

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.58372	0.58240	0.53721	0.41410
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.7394	2.7407	3.2876	8.2067
CONDUCTIVITY	3.0729	3.0659	3.1641	5.0098
PRANDTL NUMBER	0.5204	0.5206	0.5582	0.6784

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2568	2.2557	2.2160	2.1122
CONDUCTIVITY	2.7094	2.7016	2.4188	1.7309
PRANDTL NUMBER	0.4862	0.4863	0.4922	0.5053

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3185
CSTAR, M/SEC	1456.1	1456.1	1456.1
CF	0.1114	0.7013	1.5591
Ivac, M/SEC	5905.1	1823.8	2486.2
Isp, M/SEC	162.2	1021.2	2270.1

MASS FRACTIONS

CH4	0.00452	0.00450	0.00870	0.01973
*CO	0.89132	0.89130	0.87944	0.62942
*CO2	0.01837	0.01845	0.02559	0.17523
C2H2,acetylene	0.00001	0.00001	0.00000	0.00000
CH2CO,ketene	0.00001	0.00000	0.00000	0.00000
C2H4	0.00001	0.00001	0.00001	0.00000
*H2	0.05989	0.05990	0.05864	0.05159
HCHO,formaldehy	0.00002	0.00001	0.00001	0.00000
H2O	0.02585	0.02581	0.02759	0.06589
C(gr)	0.00000	0.00000	0.00000	0.05813

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013836

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8379	50.000
P, BAR	91.192	88.690	49.618	1.8238
T, K	1770.64	1764.74	1567.83	1041.92
RHO, KG/CU M	9.7438 0	9.5078 0	6.0404 0	3.7080-1
H, KJ/KG	-1025.13	-1038.29	-1546.75	-3608.80
U, KJ/KG	-1961.04	-1971.11	-2368.20	-4100.66
G, KJ/KG	-22630.9	-22585.0	-20689.3	-16330.2
S, KJ/(KG)(K)	12.2023	12.2095	12.2095	12.2095
M, (1/n)	15.730	15.730	15.869	17.613
MW, MOL WT	15.730	15.730	15.869	16.220
(dLV/dLP)t	-1.01659	-1.01655	-1.02707	-1.09520
(dLV/dLT)p	1.1292	1.1294	1.2423	2.5446
Cp, KJ/(KG)(K)	2.8027	2.8044	3.3738	14.4813
GAMMAS	1.2885	1.2884	1.2700	1.1311
SON VEL,M/SEC	1098.1	1096.3	1021.4	745.9
MACH NUMBER	0.000	0.148	1.000	3.048

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.58481 0.58348 0.53875 0.41565

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.8027	2.8044	3.3738	8.3272
CONDUCTIVITY	3.1242	3.1173	3.2338	5.1033
PRANDTL NUMBER	0.5246	0.5249	0.5621	0.6782

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2584	2.2572	2.2182	2.1142
CONDUCTIVITY	2.7120	2.7043	2.4230	1.7341
PRANDTL NUMBER	0.4870	0.4870	0.4932	0.5067

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3195
CSTAR, M/SEC	1457.9	1457.9	1457.9
CF	0.1113	0.7006	1.5592
Ivac, M/SEC	5912.4	1825.6	2489.6
Isp, M/SEC	162.2	1021.4	2273.2

MASS FRACTIONS

CH4	0.00528	0.00526	0.00975	0.02070
*CO	0.88970	0.88968	0.87718	0.62639

*CO2	0.01881	0.01889	0.02626	0.17582
C2H2,acetylene	0.00001	0.00001	0.00000	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00001	0.00001	0.00001	0.00000
*H2	0.05962	0.05963	0.05828	0.05118
HCHO,formaldehy	0.00002	0.00002	0.00001	0.00000
H2O	0.02654	0.02649	0.02850	0.06736
C(gr)	0.00000	0.00000	0.00000	0.05854

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013821

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.20000 %FUEL= 45.454545 R,EQ.RATIO= 2.838055 PHI,EQ.RATIO= 2.838055

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8366	50.000
P, BAR	101.33	98.547	55.169	2.0265
T, K	1775.39	1769.49	1574.17	1047.05
RHO, KG/CU M	1.0813 1	1.0552 1	6.7022 0	4.1101-1
H, KJ/KG	-1025.13	-1038.29	-1547.01	-3615.05
U, KJ/KG	-1962.16	-1972.23	-2370.16	-4108.11
G, KJ/KG	-22590.1	-22544.4	-20679.3	-16340.7
S, KJ/(KG)(K)	12.1466	12.1539	12.1539	12.1539
M, (1/n)	15.754	15.753	15.901	17.657
MW, MOL WT	15.754	15.753	15.901	16.250
(dLV/dLP)t	-1.01851	-1.01847	-1.02915	-1.09635
(dLV/dLT)p	1.1437	1.1439	1.2598	2.5517
Cp, KJ/(KG)(K)	2.8615	2.8635	3.4502	14.4233
GAMMAS	1.2866	1.2865	1.2680	1.1315
SON VEL,M/SEC	1098.0	1096.2	1021.6	746.9
MACH NUMBER	0.000	0.148	1.000	3.047

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.58587 0.58455 0.54020 0.41705

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.8615	2.8635	3.4502	8.4314
CONDUCTIVITY	3.1727	3.1660	3.2969	5.1865
PRANDTL NUMBER	0.5284	0.5287	0.5653	0.6780

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2599	2.2588	2.2203	2.1160
CONDUCTIVITY	2.7146	2.7069	2.4270	1.7370
PRANDTL NUMBER	0.4877	0.4878	0.4942	0.5080

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3199
CSTAR, M/SEC	1459.6	1459.6	1459.6
CF	0.1111	0.6999	1.5593
Ivac, M/SEC	5919.1	1827.4	2492.6
Isp, M/SEC	162.2	1021.6	2275.9

MASS FRACTIONS

CH4	0.00603	0.00601	0.01074	0.02161
*CO	0.88810	0.88809	0.87503	0.62367
*CO2	0.01924	0.01932	0.02690	0.17635
C2H2,acetylene	0.00001	0.00001	0.00000	0.00000
CH2CO,ketene	0.00001	0.00001	0.00000	0.00000
C2H4	0.00002	0.00002	0.00002	0.00000
*H2	0.05936	0.05937	0.05793	0.05081
HCHO,formaldehy	0.00002	0.00002	0.00001	0.00000
H2O	0.02721	0.02716	0.02935	0.06868
C(gr)	0.00000	0.00000	0.00000	0.05889

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013938

CASE = _____

REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
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FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8566	50.000
P, BAR	10.133	9.8524	5.4576	0.20265
T, K	2009.63	2003.26	1752.68	948.41
RHO, KG/CU M	9.8682-1	9.6259-1	6.0954-1	4.3473-2
H, KJ/KG	-998.20	-1012.75	-1578.80	-3667.48
U, KJ/KG	-2024.98	-2036.27	-2474.16	-4133.63
G, KJ/KG	-27865.2	-27808.8	-25023.0	-16353.6
S, KJ/(KG)(K)	13.3692	13.3762	13.3762	13.3762
M, (1/n)	16.273	16.273	16.276	16.916
MW, MOL WT	16.273	16.273	16.276	16.510
(dLV/dLP)t	-1.00011	-1.00010	-1.00005	-1.07305
(dLV/dLT)p	1.0026	1.0025	1.0008	2.3890
Cp, KJ/(KG)(K)	2.2964	2.2947	2.2342	15.4113
GAMMAS	1.2879	1.2881	1.2970	1.1223
SON VEL,M/SEC	1150.0	1148.2	1077.6	723.3
MACH NUMBER	0.000	0.149	1.000	3.194

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.64622	0.64480	0.58825	0.39111
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2964	2.2947	2.2342	5.3160
CONDUCTIVITY	3.0717	3.0604	2.6493	3.2216
PRANDTL NUMBER	0.4831	0.4835	0.4961	0.6454

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2480	2.2469	2.2022	2.0150
CONDUCTIVITY	2.9340	2.9258	2.6052	1.6065
PRANDTL NUMBER	0.4951	0.4952	0.4973	0.4905

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.5392
CSTAR, M/SEC	1521.4	1521.4	1521.4
CF	0.1121	0.7083	1.5187
Ivac, M/SEC	6170.5	1908.5	2512.3
Isp, M/SEC	170.6	1077.6	2310.5

MASS FRACTIONS

CH4	0.00000	0.00000	0.00001	0.00698
*CO	0.84820	0.84811	0.84364	0.71104
*CO2	0.03637	0.03651	0.04353	0.16869
*H	0.00002	0.00002	0.00000	0.00000
*H2	0.05428	0.05429	0.05463	0.05480
H2O	0.06111	0.06105	0.05819	0.04101
*OH	0.00001	0.00001	0.00000	0.00000
C(gr)	0.00000	0.00000	0.00000	0.01749

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013942

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8567	50.000
P, BAR	20.265	19.705	10.915	0.40530
T, K	2010.35	2003.96	1752.90	977.61
RHO, KG/CU M	1.9731 0	1.9246 0	1.2189 0	8.5184-2
H, KJ/KG	-998.20	-1012.75	-1578.92	-3682.01
U, KJ/KG	-2025.27	-2036.56	-2474.34	-4157.81
G, KJ/KG	-27162.9	-27108.5	-24405.3	-16412.6
S, KJ/(KG)(K)	13.0150	13.0221	13.0221	13.0221

M, (1/n)	16.274	16.275	16.277	17.084
MW, MOL WT	16.274	16.275	16.277	16.598
(dLV/dLP)t	-1.00013	-1.00012	-1.00014	-1.07888
(dLV/dLT)p	1.0022	1.0021	1.0014	2.4312
Cp, KJ/(KG)(K)	2.2874	2.2860	2.2348	15.1130
GAMMAS	1.2890	1.2892	1.2971	1.1254
SON VEL,M/SEC	1150.6	1148.9	1077.7	731.8
MACH NUMBER	0.000	0.149	1.000	3.166

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.64638 0.64495 0.58830 0.39944

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2874	2.2860	2.2348	6.0106
CONDUCTIVITY	3.0362	3.0258	2.6434	3.6412
PRANDTL NUMBER	0.4870	0.4873	0.4974	0.6594

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2481	2.2470	2.2023	2.0248
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CONDUCTIVITY	2.9346	2.9264	2.6053	1.6328
PRANDTL NUMBER	0.4952	0.4952	0.4973	0.4953

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.6564
CSTAR, M/SEC	1521.4	1521.4	1521.4
CF	0.1122	0.7084	1.5228
Ivac, M/SEC	6170.5	1908.6	2522.2
Isp, M/SEC	170.6	1077.7	2316.8

MASS FRACTIONS

CH4	0.00001	0.00001	0.00003	0.00957
*CO	0.84819	0.84810	0.84359	0.69751
*CO2	0.03636	0.03650	0.04354	0.17156
*H	0.00002	0.00002	0.00000	0.00000
*H2	0.05428	0.05429	0.05462	0.05344
H2O	0.06113	0.06107	0.05821	0.04736
C(gr)	0.00000	0.00000	0.00000	0.02056

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013943
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8566	50.000
P, BAR	30.398	29.557	16.373	0.60795
T, K	2010.75	2004.35	1753.20	995.58
RHO, KG/CU M	2.9592 0	2.8866 0	1.8283 0	1.2628-1
H, KJ/KG	-998.20	-1012.76	-1578.94	-3692.31
U, KJ/KG	-2025.41	-2036.70	-2474.43	-4173.74

G, KJ/KG	-26751.7	-26698.4	-24046.1	-16450.7
S, KJ/(KG)(K)	12.8079	12.8149	12.8149	12.8149
M, (1/n)	16.275	16.276	16.278	17.194
MW, MOL WT	16.275	16.276	16.278	16.663
(dLV/dLP)t	-1.00019	-1.00019	-1.00030	-1.08255
(dLV/dLT)p	1.0023	1.0023	1.0026	2.4563
Cp, KJ/(KG)(K)	2.2847	2.2834	2.2389	14.9236
GAMMAS	1.2894	1.2896	1.2970	1.1273
SON VEL,M/SEC	1150.9	1149.1	1077.7	736.7
MACH NUMBER	0.000	0.149	1.000	3.151

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.64646	0.64504	0.58837	0.40451
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2847	2.2834	2.2389	6.4315
CONDUCTIVITY	3.0214	3.0114	2.6436	3.9090
PRANDTL NUMBER	0.4888	0.4891	0.4983	0.6655

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2481	2.2471	2.2024	2.0310
CONDUCTIVITY	2.9350	2.9268	2.6055	1.6476
PRANDTL NUMBER	0.4952	0.4952	0.4973	0.4986

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7222
CSTAR, M/SEC	1521.5	1521.5	1521.5
CF	0.1122	0.7083	1.5257
Ivac, M/SEC	6170.7	1908.6	2528.7
Isp, M/SEC	170.7	1077.7	2321.3

MASS FRACTIONS

CH4	0.00003	0.00003	0.00007	0.01146
*CO	0.84815	0.84807	0.84351	0.68931
*CO2	0.03636	0.03650	0.04356	0.17312
*H	0.00001	0.00001	0.00000	0.00000
*H2	0.05428	0.05429	0.05461	0.05252
HCHO,formaldehy	0.00001	0.00000	0.00000	0.00000
H2O	0.06115	0.06109	0.05825	0.05136
C(gr)	0.00000	0.00000	0.00000	0.02224

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013943
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8564	50.000
P, BAR	40.530	39.409	21.832	0.81060
T, K	2011.08	2004.67	1753.60	1008.75
RHO, KG/CU M	3.9452 0	3.8484 0	2.4377 0	1.6699-1
H, KJ/KG	-998.20	-1012.76	-1578.90	-3700.51
U, KJ/KG	-2025.51	-2036.80	-2474.50	-4185.94
G, KJ/KG	-26460.4	-26407.9	-23793.4	-16479.4
S, KJ/(KG)(K)	12.6609	12.6680	12.6680	12.6680
M, (1/n)	16.277	16.277	16.280	17.278
MW, MOL WT	16.277	16.277	16.280	16.716
(dLV/dLP)t	-1.00029	-1.00028	-1.00051	-1.08526
(dLV/dLT)p	1.0028	1.0028	1.0042	2.4741
Cp, KJ/(KG)(K)	2.2845	2.2832	2.2453	14.7811
GAMMAS	1.2896	1.2898	1.2968	1.1287
SON VEL,M/SEC	1151.0	1149.3	1077.7	740.2
MACH NUMBER	0.000	0.148	1.000	3.141

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.64654 0.64511 0.58846 0.40820

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2845	2.2832	2.2453	6.7297
CONDUCTIVITY	3.0137	3.0039	2.6467	4.1071
PRANDTL NUMBER	0.4901	0.4903	0.4992	0.6689

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2482	2.2472	2.2025	2.0353
CONDUCTIVITY	2.9352	2.9270	2.6057	1.6577
PRANDTL NUMBER	0.4952	0.4953	0.4974	0.5012

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7673
CSTAR, M/SEC	1521.5	1521.5	1521.5
CF	0.1122	0.7083	1.5279
Ivac, M/SEC	6171.0	1908.7	2533.6
Isp, M/SEC	170.7	1077.7	2324.8

MASS FRACTIONS

CH4	0.00006	0.00006	0.00012	0.01298
*CO	0.84810	0.84801	0.84340	0.68335
*CO2	0.03637	0.03651	0.04358	0.17419
*H	0.00001	0.00001	0.00000	0.00000
*H2	0.05427	0.05428	0.05459	0.05180
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.06117	0.06112	0.05830	0.05431
C(gr)	0.00000	0.00000	0.00000	0.02336

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013942

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8562	50.000
P, BAR	50.663	49.261	27.294	1.0132
T, K	2011.40	2004.99	1754.09	1019.21
RHO, KG/CU M	4.9311 0	4.8101 0	3.0471 0	2.0742-1
H, KJ/KG	-998.20	-1012.76	-1578.84	-3707.42
U, KJ/KG	-2025.60	-2036.88	-2474.56	-4195.93
G, KJ/KG	-26235.1	-26183.4	-23599.7	-16502.6
S, KJ/(KG)(K)	12.5469	12.5540	12.5540	12.5540
M, (1/n)	16.278	16.278	16.282	17.347
MW, MOL WT	16.278	16.278	16.282	16.761
(dLV/dLP)t	-1.00041	-1.00041	-1.00079	-1.08741
(dLV/dLT)p	1.0036	1.0035	1.0064	2.4877
Cp, KJ/(KG)(K)	2.2858	2.2845	2.2539	14.6655
GAMMAS	1.2897	1.2899	1.2965	1.1298
SON VEL,M/SEC	1151.1	1149.4	1077.6	742.9
MACH NUMBER	0.000	0.148	1.000	3.133

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.64661 0.64518 0.58857 0.41111

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2858	2.2845	2.2539	6.9578
CONDUCTIVITY	3.0096	2.9999	2.6519	4.2643
PRANDTL NUMBER	0.4911	0.4913	0.5002	0.6708

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2483	2.2472	2.2027	2.0387
CONDUCTIVITY	2.9354	2.9272	2.6060	1.6654
PRANDTL NUMBER	0.4953	0.4953	0.4975	0.5033

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8011
CSTAR, M/SEC	1521.6	1521.6	1521.6
CF	0.1122	0.7082	1.5298
Ivac, M/SEC	6171.4	1908.8	2537.6
Isp, M/SEC	170.7	1077.6	2327.8

MASS FRACTIONS

CH4	0.00009	0.00009	0.00019	0.01427
*CO	0.84804	0.84795	0.84326	0.67864
*CO2	0.03638	0.03652	0.04362	0.17501
*H	0.00001	0.00001	0.00000	0.00000
*H2	0.05426	0.05427	0.05456	0.05122
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.06120	0.06115	0.05836	0.05667
C(gr)	0.00000	0.00000	0.00000	0.02419

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013941

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8559	50.000
P, BAR	60.795	59.114	32.758	1.2159
T, K	2011.73	2005.31	1754.68	1027.92
RHO, KG/CU M	5.9169 0	5.7717 0	3.6565 0	2.4763-1
H, KJ/KG	-998.20	-1012.76	-1578.75	-3713.44
U, KJ/KG	-2025.68	-2036.96	-2474.63	-4204.46
G, KJ/KG	-26051.9	-26000.7	-23443.6	-16522.3
S, KJ/(KG)(K)	12.4538	12.4609	12.4609	12.4609
M, (1/n)	16.279	16.279	16.285	17.406
MW, MOL WT	16.279	16.279	16.285	16.801
(dLV/dLP)t	-1.00057	-1.00056	-1.00112	-1.08920
(dLV/dLT)p	1.0046	1.0045	1.0090	2.4987
Cp, KJ/(KG)(K)	2.2882	2.2869	2.2643	14.5674
GAMMAS	1.2898	1.2900	1.2961	1.1306
SON VEL,M/SEC	1151.2	1149.4	1077.6	745.1
MACH NUMBER	0.000	0.148	1.000	3.128

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.64668	0.64525	0.58871	0.41352
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2882	2.2869	2.2643	7.1406
CONDUCTIVITY	3.0077	2.9982	2.6588	4.3945
PRANDTL NUMBER	0.4920	0.4922	0.5014	0.6719

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2484	2.2473	2.2028	2.0415
CONDUCTIVITY	2.9356	2.9273	2.6064	1.6715
PRANDTL NUMBER	0.4953	0.4954	0.4976	0.5050

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8278
CSTAR, M/SEC	1521.8	1521.8	1521.8
CF	0.1121	0.7081	1.5313
Ivac, M/SEC	6172.0	1908.9	2541.0
Isp, M/SEC	170.7	1077.5	2330.3

MASS FRACTIONS

CH4	0.00013	0.00013	0.00028	0.01541
*CO	0.84795	0.84787	0.84308	0.67473
*CO2	0.03640	0.03654	0.04366	0.17567
*H	0.00001	0.00001	0.00000	0.00000
*H2	0.05425	0.05426	0.05453	0.05071
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.06124	0.06118	0.05844	0.05864
C(gr)	0.00000	0.00000	0.00000	0.02483

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013939

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8556	50.000
P, BAR	70.927	68.966	38.224	1.4185
T, K	2012.09	2005.66	1755.37	1035.40
RHO, KG/CU M	6.9025 0	6.7332 0	4.2659 0	2.8767-1
H, KJ/KG	-998.20	-1012.76	-1578.65	-3718.81
U, KJ/KG	-2025.75	-2037.04	-2474.69	-4211.94
G, KJ/KG	-25897.9	-25847.1	-23313.9	-16539.3
S, KJ/(KG)(K)	12.3751	12.3821	12.3821	12.3821

M, (1/n)	16.281	16.281	16.288	17.458
MW, MOL WT	16.281	16.281	16.288	16.837
(dLV/dLP)t	-1.00075	-1.00074	-1.00151	-1.09073
(dLV/dLT)p	1.0057	1.0057	1.0120	2.5079
Cp, KJ/(KG)(K)	2.2916	2.2903	2.2765	14.4819
GAMMAS	1.2898	1.2899	1.2956	1.1314
SON VEL,M/SEC	1151.2	1149.5	1077.5	746.9
MACH NUMBER	0.000	0.148	1.000	3.123

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.64676 0.64533 0.58886 0.41559

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2916	2.2903	2.2765	7.2917
CONDUCTIVITY	3.0075	2.9980	2.6671	4.5054
PRANDTL NUMBER	0.4928	0.4930	0.5026	0.6726

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2485	2.2474	2.2030	2.0439
CONDUCTIVITY	2.9357	2.9275	2.6068	1.6766
PRANDTL NUMBER	0.4954	0.4954	0.4977	0.5066

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8497
CSTAR, M/SEC	1521.9	1521.9	1521.9
CF	0.1121	0.7079	1.5327
Ivac, M/SEC	6172.6	1909.1	2544.0
Isp, M/SEC	170.7	1077.5	2332.6

MASS FRACTIONS

CH4	0.00017	0.00017	0.00037	0.01643
*CO	0.84786	0.84777	0.84288	0.67139
*CO2	0.03642	0.03656	0.04371	0.17623
*H	0.00001	0.00001	0.00000	0.00000
*H2	0.05423	0.05424	0.05450	0.05026
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.06128	0.06122	0.05852	0.06033
C(gr)	0.00000	0.00000	0.00000	0.02535

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013937

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8552	50.000

P, BAR	81.060	78.819	43.694	1.6212
T, K	2012.47	2006.04	1756.14	1041.97
RHO, KG/CU M	7.8880 0	7.6945 0	4.8753 0	3.2755-1
H, KJ/KG	-998.20	-1012.76	-1578.52	-3723.67
U, KJ/KG	-2025.83	-2037.11	-2474.76	-4218.62
G, KJ/KG	-25765.4	-25715.0	-23203.5	-16554.5
S, KJ/(KG)(K)	12.3069	12.3140	12.3140	12.3140

M, (1/n)	16.283	16.283	16.292	17.504
MW, MOL WT	16.283	16.283	16.292	16.870
(dLV/dLP)t	-1.00096	-1.00095	-1.00194	-1.09207
(dLV/dLT)p	1.0071	1.0070	1.0154	2.5157
Cp, KJ/(KG)(K)	2.2958	2.2945	2.2903	14.4057
GAMMAS	1.2897	1.2899	1.2950	1.1320
SON VEL,M/SEC	1151.2	1149.5	1077.3	748.5
MACH NUMBER	0.000	0.148	1.000	3.119

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.64685	0.64541	0.58904	0.41739
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2958	2.2945	2.2903	7.4195
CONDUCTIVITY	3.0085	2.9991	2.6769	4.6018
PRANDTL NUMBER	0.4936	0.4938	0.5040	0.6730

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2486	2.2475	2.2033	2.0460
CONDUCTIVITY	2.9359	2.9277	2.6072	1.6809
PRANDTL NUMBER	0.4954	0.4955	0.4978	0.5081

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000	6.8680
CSTAR, M/SEC	1522.1	1522.1	1522.1
CF	0.1121	0.7078	1.5339
Ivac, M/SEC	6173.3	1909.2	2546.7
Isp, M/SEC	170.7	1077.3	2334.7

MASS FRACTIONS

CH4	0.00023	0.00022	0.00048	0.01735
*CO	0.84774	0.84766	0.84265	0.66845
*CO2	0.03645	0.03659	0.04377	0.17672
*H	0.00001	0.00001	0.00000	0.00000
*H2	0.05421	0.05422	0.05446	0.04987
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.06133	0.06127	0.05862	0.06182
C(gr)	0.00000	0.00000	0.00000	0.02579

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013935

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8548	50.000
P, BAR	91.192	88.672	49.167	1.8238
T, K	2012.88	2006.44	1756.99	1047.83
RHO, KG/CU M	8.8733 0	8.6557 0	5.4846 0	3.6731-1
H, KJ/KG	-998.20	-1012.76	-1578.39	-3728.13
U, KJ/KG	-2025.91	-2037.19	-2474.84	-4224.66
G, KJ/KG	-25649.5	-25599.4	-23108.2	-16568.1
S, KJ/(KG)(K)	12.2467	12.2538	12.2538	12.2538
M, (1/n)	16.285	16.285	16.296	17.546
MW, MOL WT	16.285	16.285	16.296	16.900
(dLV/dLP)t	-1.00120	-1.00119	-1.00242	-1.09326
(dLV/dLT)p	1.0086	1.0085	1.0192	2.5224
Cp, KJ/(KG)(K)	2.3007	2.2994	2.3055	14.3368
GAMMAS	1.2896	1.2898	1.2944	1.1326
SON VEL,M/SEC	1151.2	1149.5	1077.2	749.9
MACH NUMBER	0.000	0.148	1.000	3.116

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.64694 0.64550 0.58923 0.41899

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3007	2.2994	2.3055	7.5294
CONDUCTIVITY	3.0105	3.0011	2.6878	4.6869
PRANDTL NUMBER	0.4944	0.4946	0.5054	0.6731

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2487	2.2477	2.2035	2.0480
CONDUCTIVITY	2.9361	2.9279	2.6077	1.6846
PRANDTL NUMBER	0.4955	0.4955	0.4979	0.5094

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8837
CSTAR, M/SEC	1522.3	1522.3	1522.3

CF	0.1121	0.7076	1.5349
Ivac, M/SEC	6174.1	1909.4	2549.1
Isp, M/SEC	170.6	1077.2	2336.6

MASS FRACTIONS

CH4	0.00029	0.00028	0.00060	0.01820
*CO	0.84762	0.84754	0.84240	0.66584
*CO2	0.03648	0.03662	0.04383	0.17716
*H	0.00001	0.00001	0.00000	0.00000
*H2	0.05419	0.05420	0.05442	0.04950
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.06139	0.06133	0.05873	0.06315
C(gr)	0.00000	0.00000	0.00000	0.02615

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013932

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.30000 %FUEL= 43.478261 R,EQ.RATIO= 2.619743 PHI,EQ.RATIO= 2.619743

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0284	1.8543	50.000
P, BAR	101.33	98.525	54.643	2.0265
T, K	2013.33	2006.88	1757.92	1053.13
RHO, KG/CU M	9.8584 0	9.6167 0	6.0939 0	4.0696-1
H, KJ/KG	-998.20	-1012.75	-1578.25	-3732.24
U, KJ/KG	-2026.00	-2037.28	-2474.93	-4230.20
G, KJ/KG	-25546.6	-25496.8	-23024.9	-16580.5
S, KJ/(KG)(K)	12.1930	12.2000	12.2000	12.2000
M, (1/n)	16.287	16.287	16.300	17.584
MW, MOL WT	16.287	16.287	16.300	16.928
(dLV/dLP)t	-1.00146	-1.00144	-1.00294	-1.09433

(dLV/dLT)p	1.0104	1.0103	1.0232	2.5284
Cp, KJ/(KG)(K)	2.3063	2.3050	2.3220	14.2738
GAMMAS	1.2895	1.2897	1.2938	1.1331
SON VEL,M/SEC	1151.2	1149.5	1077.1	751.1
MACH NUMBER	0.000	0.148	1.000	3.113

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.64704	0.64560	0.58945	0.42044
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3063	2.3050	2.3220	7.6252
CONDUCTIVITY	3.0134	3.0040	2.6998	4.7630
PRANDTL NUMBER	0.4952	0.4954	0.5070	0.6731

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2489	2.2478	2.2038	2.0497
CONDUCTIVITY	2.9363	2.9281	2.6082	1.6879
PRANDTL NUMBER	0.4956	0.4956	0.4981	0.5105

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8972
CSTAR, M/SEC	1522.5	1522.5	1522.5
CF	0.1121	0.7074	1.5359
Ivac, M/SEC	6174.9	1909.6	2551.3
Isp, M/SEC	170.6	1077.1	2338.4

MASS FRACTIONS

CH4	0.00035	0.00035	0.00073	0.01899
*CO	0.84748	0.84740	0.84212	0.66348
*CO2	0.03651	0.03665	0.04390	0.17755
*H	0.00001	0.00001	0.00000	0.00000
*H2	0.05417	0.05418	0.05437	0.04917
HCHO, formaldehy	0.00002	0.00002	0.00001	0.00000
H2O	0.06145	0.06139	0.05886	0.06435
C(gr)	0.00000	0.00000	0.00000	0.02647

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013786

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0281	1.8451	50.000
P, BAR	10.133	9.8554	5.4917	0.20265
T, K	2258.96	2252.29	1988.21	968.62
RHO, KG/CU M	9.1549-1	8.9311-1	5.6409-1	4.3009-2
H, KJ/KG	-973.50	-989.02	-1595.75	-3870.18
U, KJ/KG	-2080.29	-2092.51	-2569.30	-4341.36
G, KJ/KG	-31044.8	-30986.6	-28076.2	-16771.0
S, KJ/(KG)(K)	13.3120	13.3187	13.3187	13.3187

M, (1/n)	16.970	16.970	16.980	17.093
MW, MOL WT	16.970	16.970	16.980	17.093
(dLV/dLP)t	-1.00041	-1.00040	-1.00011	-1.01193
(dLV/dLT)p	1.0099	1.0097	1.0029	1.1834
Cp, KJ/(KG)(K)	2.3731	2.3704	2.2610	3.5686
GAMMAS	1.2661	1.2663	1.2783	1.2180
SON VEL,M/SEC	1183.7	1182.1	1115.6	757.5
MACH NUMBER	0.000	0.149	1.000	3.177

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.71015 0.70867 0.64950 0.39930

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3731	2.3704	2.2610	3.5686
CONDUCTIVITY	3.6047	3.5879	2.9498	2.3888
PRANDTL NUMBER	0.4675	0.4682	0.4978	0.5965

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2412	2.2402	2.2002	1.9707
CONDUCTIVITY	3.1227	3.1145	2.7905	1.5910
PRANDTL NUMBER	0.5097	0.5097	0.5121	0.4946

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.0788
CSTAR, M/SEC	1588.3	1588.3	1588.3
CF	0.1109	0.7024	1.5154
Ivac, M/SEC	6440.7	1988.3	2602.7
Isp, M/SEC	176.1	1115.6	2406.9

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00301
*CO	0.80127	0.80117	0.79625	0.71194
*CO2	0.05307	0.05323	0.06097	0.18519
*H	0.00009	0.00009	0.00002	0.00000

*H2	0.04754	0.04755	0.04797	0.05255
H2O	0.09796	0.09790	0.09478	0.04732
*OH	0.00006	0.00006	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013801

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0281	1.8457	50.000
P, BAR	20.265	19.710	10.980	0.40530
T, K	2261.70	2254.96	1988.66	988.37
RHO, KG/CU M	1.8292 0	1.7845 0	1.1276 0	8.4848-2
H, KJ/KG	-973.50	-989.05	-1596.42	-3873.52
U, KJ/KG	-2081.37	-2093.60	-2570.12	-4351.20
G, KJ/KG	-30313.2	-30256.5	-27407.5	-16701.7
S, KJ/(KG)(K)	12.9724	12.9791	12.9791	12.9791

M, (1/n)	16.974	16.974	16.981	17.204
MW, MOL WT	16.974	16.974	16.981	17.204
(dLV/dLP)t	-1.00030	-1.00029	-1.00008	-1.02251
(dLV/dLT)p	1.0071	1.0070	1.0021	1.3387
Cp, KJ/(KG)(K)	2.3398	2.3376	2.2499	4.6619
GAMMAS	1.2691	1.2693	1.2795	1.1951
SON VEL,M/SEC	1185.7	1184.1	1116.2	755.6
MACH NUMBER	0.000	0.149	1.000	3.187

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.71075 0.70925 0.64960 0.40473

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3398	2.3376	2.2499	4.6619
CONDUCTIVITY	3.4739	3.4594	2.9088	2.9706
PRANDTL NUMBER	0.4787	0.4793	0.5024	0.6352

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2415	2.2405	2.2003	1.9757
CONDUCTIVITY	3.1252	3.1169	2.7908	1.6030
PRANDTL NUMBER	0.5098	0.5098	0.5121	0.4988

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000	6.1594
CSTAR, M/SEC	1588.2	1588.2	1588.2
CF	0.1110	0.7028	1.5164
Ivac, M/SEC	6440.4	1988.5	2606.7
Isp, M/SEC	176.3	1116.2	2408.3

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00604
*CO	0.80132	0.80122	0.79626	0.70677
*CO2	0.05299	0.05315	0.06095	0.18500
*H	0.00007	0.00006	0.00002	0.00000
*H2	0.04756	0.04757	0.04797	0.05139
H2O	0.09801	0.09795	0.09480	0.05080
*OH	0.00004	0.00004	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013808
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

INJECTOR COMB END THROAT EXIT

Pinj/P	1.0000	1.0282	1.8460	50.000
P, BAR	30.398	29.565	16.467	0.60795
T, K	2262.94	2256.17	1988.86	1002.88
RHO, KG/CU M	2.7426 0	2.6755 0	1.6910 0	1.2604-1
H, KJ/KG	-973.50	-989.06	-1596.72	-3876.61
U, KJ/KG	-2081.86	-2094.09	-2570.49	-4358.94
G, KJ/KG	-29879.9	-29824.1	-27015.5	-16693.9
S, KJ/(KG)(K)	12.7738	12.7806	12.7806	12.7806

M, (1/n)	16.976	16.976	16.982	17.288
MW, MOL WT	16.976	16.976	16.982	17.288
(dLV/dLP)t	-1.00026	-1.00025	-1.00008	-1.02965
(dLV/dLT)p	1.0059	1.0058	1.0018	1.4393
Cp, KJ/(KG)(K)	2.3249	2.3229	2.2451	5.3294
GAMMAS	1.2705	1.2707	1.2801	1.1866
SON VEL,M/SEC	1186.7	1185.0	1116.5	756.5
MACH NUMBER	0.000	0.149	1.000	3.185

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.71102	0.70952	0.64965	0.40870
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3249	2.3229	2.2451	5.3294
CONDUCTIVITY	3.4149	3.4015	2.8907	3.3474
PRANDTL NUMBER	0.4841	0.4845	0.5046	0.6507

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2416	2.2407	2.2003	1.9794
CONDUCTIVITY	3.1263	3.1180	2.7909	1.6115
PRANDTL NUMBER	0.5098	0.5099	0.5122	0.5020

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2161
CSTAR, M/SEC	1588.2	1588.2	1588.2
CF	0.1111	0.7030	1.5172
Ivac, M/SEC	6440.3	1988.6	2609.8
Isp, M/SEC	176.4	1116.4	2409.6

MASS FRACTIONS

CH4	0.00000	0.00000	0.00001	0.00831
*CO	0.80133	0.80123	0.79626	0.70285
*CO2	0.05296	0.05312	0.06094	0.18493
*H	0.00005	0.00005	0.00001	0.00000
*H2	0.04757	0.04758	0.04797	0.05054
H2O	0.09804	0.09797	0.09480	0.05338
*OH	0.00004	0.00003	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013811

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8462	50.000
P, BAR	40.530	39.419	21.954	0.81060
T, K	2263.70	2256.91	1989.00	1014.27
RHO, KG/CU M	3.6558 0	3.5664 0	2.2544 0	1.6682-1
H, KJ/KG	-973.50	-989.07	-1596.91	-3879.44
U, KJ/KG	-2082.15	-2094.39	-2570.72	-4365.34
G, KJ/KG	-29570.7	-29515.6	-26737.1	-16699.4
S, KJ/(KG)(K)	12.6329	12.6397	12.6397	12.6397

M, (1/n)	16.977	16.977	16.982	17.356
MW, MOL WT	16.977	16.977	16.982	17.356
(dLV/dLP)t	-1.00024	-1.00023	-1.00009	-1.03492
(dLV/dLT)p	1.0052	1.0051	1.0017	1.5111
Cp, KJ/(KG)(K)	2.3160	2.3142	2.2425	5.7846
GAMMAS	1.2713	1.2715	1.2804	1.1823
SON VEL,M/SEC	1187.2	1185.5	1116.6	758.0
MACH NUMBER	0.000	0.149	1.000	3.181

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.71119 0.70968 0.64968 0.41179

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3160	2.3142	2.2425	5.7846
CONDUCTIVITY	3.3795	3.3668	2.8801	3.6173
PRANDTL NUMBER	0.4874	0.4878	0.5059	0.6585

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2417	2.2407	2.2003	1.9823
CONDUCTIVITY	3.1270	3.1187	2.7910	1.6180
PRANDTL NUMBER	0.5098	0.5099	0.5122	0.5045

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2592
CSTAR, M/SEC	1588.1	1588.1	1588.1
CF	0.1111	0.7031	1.5180
Ivac, M/SEC	6440.3	1988.7	2612.3
Isp, M/SEC	176.5	1116.6	2410.8

MASS FRACTIONS

CH4	0.00001	0.00001	0.00001	0.01012
*CO	0.80134	0.80124	0.79625	0.69970
*CO2	0.05294	0.05310	0.06093	0.18492
*H	0.00005	0.00005	0.00001	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04757	0.04758	0.04797	0.04985
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.09805	0.09799	0.09481	0.05542
*OH	0.00003	0.00003	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013814

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8463	50.000
P, BAR	50.663	49.274	27.440	1.0132
T, K	2264.23	2257.42	1989.11	1023.67
RHO, KG/CU M	4.5689 0	4.4571 0	2.8177 0	2.0729-1
H, KJ/KG	-973.50	-989.08	-1597.03	-3882.04
U, KJ/KG	-2082.36	-2094.59	-2570.87	-4370.84
G, KJ/KG	-29329.9	-29275.4	-26521.3	-16709.0
S, KJ/(KG)(K)	12.5237	12.5304	12.5304	12.5304
M, (1/n)	16.978	16.978	16.983	17.413
MW, MOL WT	16.978	16.978	16.983	17.413
(dLV/dLP)t	-1.00023	-1.00023	-1.00011	-1.03905
(dLV/dLT)p	1.0047	1.0046	1.0017	1.5661
Cp, KJ/(KG)(K)	2.3101	2.3084	2.2410	6.1193
GAMMAS	1.2719	1.2721	1.2806	1.1797
SON VEL,M/SEC	1187.6	1185.9	1116.7	759.4
MACH NUMBER	0.000	0.149	1.000	3.176

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.71130 0.70979 0.64970 0.41434

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3101	2.3084	2.2410	6.1193
CONDUCTIVITY	3.3553	3.3430	2.8730	3.8244
PRANDTL NUMBER	0.4897	0.4901	0.5068	0.6630

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2417	2.2408	2.2003	1.9847
CONDUCTIVITY	3.1275	3.1191	2.7911	1.6232
PRANDTL NUMBER	0.5099	0.5099	0.5122	0.5066

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2937
CSTAR, M/SEC	1588.1	1588.1	1588.1
CF	0.1111	0.7032	1.5187
Ivac, M/SEC	6440.3	1988.8	2614.5
Isp, M/SEC	176.5	1116.7	2411.9

MASS FRACTIONS

CH4	0.00001	0.00001	0.00001	0.01163
*CO	0.80134	0.80124	0.79624	0.69704
*CO2	0.05292	0.05308	0.06093	0.18494
*H	0.00004	0.00004	0.00001	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04758	0.04758	0.04797	0.04928
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.09806	0.09800	0.09482	0.05711
*OH	0.00003	0.00003	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013816

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150

OXIDANT O2(L) 1.0000000 -12979.000 90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8464	50.000
P, BAR	60.795	59.129	32.927	1.2159
T, K	2264.63	2257.81	1989.20	1031.69
RHO, KG/CU M	5.4819 0	5.3478 0	3.3810 0	2.4752-1
H, KJ/KG	-973.50	-989.08	-1597.12	-3884.45
U, KJ/KG	-2082.51	-2094.74	-2570.99	-4375.69
G, KJ/KG	-29132.8	-29078.8	-26345.0	-16719.8
S, KJ/(KG)(K)	12.4344	12.4411	12.4411	12.4411
M, (1/n)	16.979	16.979	16.983	17.462
MW, MOL WT	16.979	16.979	16.983	17.462
(dLV/dLP)t	-1.00023	-1.00023	-1.00013	-1.04244
(dLV/dLT)p	1.0045	1.0044	1.0018	1.6102
Cp, KJ/(KG)(K)	2.3058	2.3041	2.2401	6.3782
GAMMAS	1.2723	1.2725	1.2807	1.1780
SON VEL,M/SEC	1187.9	1186.2	1116.8	760.7
MACH NUMBER	0.000	0.149	1.000	3.172

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.71139 0.70988 0.64972 0.41650

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3058	2.3041	2.2401	6.3782
CONDUCTIVITY	3.3375	3.3255	2.8680	3.9908
PRANDTL NUMBER	0.4915	0.4919	0.5075	0.6657

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2418	2.2408	2.2004	1.9869
CONDUCTIVITY	3.1278	3.1195	2.7911	1.6276
PRANDTL NUMBER	0.5099	0.5099	0.5122	0.5084

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3224
CSTAR, M/SEC	1588.1	1588.1	1588.1
CF	0.1111	0.7032	1.5193
Ivac, M/SEC	6440.3	1988.8	2616.5
Isp, M/SEC	176.5	1116.8	2412.9

MASS FRACTIONS

CH4	0.00001	0.00001	0.00002	0.01294
*CO	0.80134	0.80124	0.79623	0.69474
*CO2	0.05291	0.05307	0.06093	0.18498
*H	0.00004	0.00004	0.00001	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04758	0.04759	0.04797	0.04879
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.09808	0.09801	0.09482	0.05856
*OH	0.00003	0.00002	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013818

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8464	50.000
P, BAR	70.927	68.983	38.414	1.4185
T, K	2264.96	2258.13	1989.30	1038.70
RHO, KG/CU M	6.3949 0	6.2385 0	3.9443 0	2.8754-1
H, KJ/KG	-973.50	-989.09	-1597.19	-3886.71
U, KJ/KG	-2082.63	-2094.86	-2571.08	-4380.04
G, KJ/KG	-28965.8	-28912.2	-26196.0	-16730.9
S, KJ/(KG)(K)	12.3589	12.3656	12.3656	12.3656
M, (1/n)	16.979	16.979	16.983	17.506
MW, MOL WT	16.979	16.979	16.983	17.506
(dLV/dLP)t	-1.00024	-1.00024	-1.00016	-1.04530
(dLV/dLT)p	1.0043	1.0042	1.0019	1.6467
Cp, KJ/(KG)(K)	2.3025	2.3009	2.2397	6.5856
GAMMAS	1.2727	1.2729	1.2808	1.1768
SON VEL,M/SEC	1188.1	1186.4	1116.9	762.0
MACH NUMBER	0.000	0.149	1.000	3.168

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.71146 0.70995 0.64974 0.41838

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3025	2.3009	2.2397	6.5856
CONDUCTIVITY	3.3237	3.3119	2.8643	4.1288
PRANDTL NUMBER	0.4929	0.4932	0.5080	0.6673

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2418	2.2409	2.2004	1.9888
CONDUCTIVITY	3.1281	3.1197	2.7912	1.6314
PRANDTL NUMBER	0.5099	0.5100	0.5122	0.5100

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3470
CSTAR, M/SEC	1588.1	1588.1	1588.1
CF	0.1112	0.7033	1.5199
Ivac, M/SEC	6440.3	1988.8	2618.2
Isp, M/SEC	176.5	1116.9	2413.8

MASS FRACTIONS

CH4	0.00002	0.00002	0.00003	0.01409
*CO	0.80133	0.80123	0.79622	0.69269
*CO2	0.05291	0.05307	0.06094	0.18503
*H	0.00004	0.00004	0.00001	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04758	0.04759	0.04797	0.04836
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.09808	0.09802	0.09483	0.05983
*OH	0.00002	0.00002	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013819

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8465	50.000
P, BAR	81.060	78.838	43.900	1.6212
T, K	2265.23	2258.39	1989.39	1044.93
RHO, KG/CU M	7.3078 0	7.1290 0	4.5076 0	3.2740-1
H, KJ/KG	-973.50	-989.09	-1597.24	-3888.83
U, KJ/KG	-2082.72	-2094.96	-2571.15	-4384.01
G, KJ/KG	-28821.0	-28767.8	-26067.1	-16741.7
S, KJ/(KG)(K)	12.2935	12.3002	12.3002	12.3002
M, (1/n)	16.980	16.980	16.984	17.545
MW, MOL WT	16.980	16.980	16.984	17.545
(dLV/dLP)t	-1.00026	-1.00025	-1.00019	-1.04776

(dLV/dLT)p	1.0042	1.0041	1.0021	1.6776
Cp, KJ/(KG)(K)	2.3001	2.2985	2.2395	6.7564
GAMMAS	1.2729	1.2731	1.2809	1.1760
SON VEL,M/SEC	1188.3	1186.6	1116.9	763.1
MACH NUMBER	0.000	0.149	1.000	3.164

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.71152	0.71001	0.64976	0.42005
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3001	2.2985	2.2395	6.7564
CONDUCTIVITY	3.3126	3.3011	2.8615	4.2460
PRANDTL NUMBER	0.4940	0.4944	0.5085	0.6684

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2419	2.2409	2.2004	1.9905
CONDUCTIVITY	3.1283	3.1199	2.7912	1.6347
PRANDTL NUMBER	0.5099	0.5100	0.5122	0.5115

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3684
CSTAR, M/SEC	1588.1	1588.1	1588.1
CF	0.1112	0.7033	1.5205
Ivac, M/SEC	6440.3	1988.9	2619.7
Isp, M/SEC	176.6	1116.9	2414.7

MASS FRACTIONS

CH4	0.00002	0.00002	0.00004	0.01512
*CO	0.80132	0.80122	0.79620	0.69085
*CO2	0.05290	0.05307	0.06094	0.18510
*H	0.00003	0.00003	0.00001	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04758	0.04759	0.04797	0.04798
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.09809	0.09803	0.09484	0.06096
*OH	0.00002	0.00002	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013820
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8465	50.000
P, BAR	91.192	88.692	49.387	1.8238
T, K	2265.46	2258.62	1989.48	1050.55
RHO, KG/CU M	8.2207 0	8.0196 0	5.0709 0	3.6710-1
H, KJ/KG	-973.50	-989.09	-1597.28	-3890.84
U, KJ/KG	-2082.80	-2095.04	-2571.21	-4387.66
G, KJ/KG	-28693.3	-28640.4	-25953.5	-16752.2
S, KJ/(KG)(K)	12.2358	12.2425	12.2425	12.2425
M, (1/n)	16.980	16.980	16.984	17.581
MW, MOL WT	16.980	16.980	16.984	17.581
(dLV/dLP)t	-1.00028	-1.00027	-1.00023	-1.04992
(dLV/dLT)p	1.0041	1.0040	1.0023	1.7043
Cp, KJ/(KG)(K)	2.2981	2.2966	2.2397	6.8998
GAMMAS	1.2732	1.2733	1.2810	1.1753
SON VEL,M/SEC	1188.4	1186.7	1116.9	764.1
MACH NUMBER	0.000	0.149	1.000	3.161

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.71157 0.71006 0.64979 0.42155

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2981	2.2966	2.2397	6.8998
CONDUCTIVITY	3.3036	3.2922	2.8594	4.3475
PRANDTL NUMBER	0.4950	0.4953	0.5090	0.6690

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2419	2.2410	2.2004	1.9921
CONDUCTIVITY	3.1285	3.1201	2.7913	1.6377
PRANDTL NUMBER	0.5099	0.5100	0.5122	0.5128

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3873
CSTAR, M/SEC	1588.1	1588.1	1588.1
CF	0.1112	0.7033	1.5210
Ivac, M/SEC	6440.3	1988.9	2621.2
Isp, M/SEC	176.6	1116.9	2415.5

MASS FRACTIONS

CH4	0.00003	0.00003	0.00004	0.01605
*CO	0.80131	0.80121	0.79618	0.68917
*CO2	0.05290	0.05306	0.06094	0.18517
*H	0.00003	0.00003	0.00001	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04758	0.04759	0.04796	0.04763
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000

H2O	0.09810	0.09804	0.09485	0.06198
*OH	0.00002	0.00002	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013821

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.40000 %FUEL= 41.666667 R,EQ.RATIO= 2.432619 PHI,EQ.RATIO= 2.432619

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0282	1.8465	50.000
P, BAR	101.33	98.547	54.874	2.0265
T, K	2265.67	2258.82	1989.57	1055.67
RHO, KG/CU M	9.1336 0	8.9101 0	5.6341 0	4.0668-1
H, KJ/KG	-973.50	-989.09	-1597.31	-3892.74
U, KJ/KG	-2082.87	-2095.11	-2571.27	-4391.05
G, KJ/KG	-28578.9	-28526.3	-25852.1	-16762.3
S, KJ/(KG)(K)	12.1842	12.1910	12.1910	12.1910

M, (1/n)	16.981	16.981	16.985	17.614
MW, MOL WT	16.981	16.981	16.985	17.614
(dLV/dLP)t	-1.00030	-1.00029	-1.00027	-1.05184
(dLV/dLT)p	1.0041	1.0040	1.0025	1.7276
Cp, KJ/(KG)(K)	2.2966	2.2951	2.2401	7.0221
GAMMAS	1.2733	1.2735	1.2810	1.1748
SON VEL,M/SEC	1188.5	1186.8	1117.0	765.1
MACH NUMBER	0.000	0.149	1.000	3.158

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.71162 0.71010 0.64981 0.42292

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.2966	2.2951	2.2401	7.0221
CONDUCTIVITY	3.2960	3.2847	2.8578	4.4366
PRANDTL NUMBER	0.4958	0.4962	0.5093	0.6694

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2419	2.2410	2.2004	1.9935
CONDUCTIVITY	3.1286	3.1203	2.7913	1.6403
PRANDTL NUMBER	0.5099	0.5100	0.5123	0.5140

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4042
CSTAR, M/SEC	1588.1	1588.1	1588.1
CF	0.1112	0.7033	1.5215
Ivac, M/SEC	6440.3	1988.9	2622.5
Isp, M/SEC	176.6	1117.0	2416.3

MASS FRACTIONS

CH4	0.00004	0.00004	0.00006	0.01691
*CO	0.80129	0.80119	0.79616	0.68763
*CO2	0.05290	0.05306	0.06095	0.18524
*H	0.00003	0.00003	0.00001	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04758	0.04758	0.04796	0.04731
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.09811	0.09805	0.09486	0.06291
*OH	0.00002	0.00002	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013619
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0278	1.8328	50.000
P, BAR	10.133	9.8587	5.5286	0.20265
T, K	2482.46	2475.71	2207.88	1082.78

RHO, KG/CU M	8.6642-1	8.4533-1	5.3237-1	3.9829-2
H, KJ/KG	-950.79	-966.99	-1604.21	-4065.10
U, KJ/KG	-2120.26	-2133.23	-2642.69	-4573.90
G, KJ/KG	-33779.2	-33721.9	-30815.6	-18390.9
S, KJ/(KG)(K)	13.2241	13.2305	13.2305	13.2305

M, (1/n)	17.649	17.650	17.677	17.694
MW, MOL WT	17.649	17.650	17.677	17.694
(dLV/dLP)t	-1.00119	-1.00117	-1.00040	-1.00032
(dLV/dLT)p	1.0268	1.0264	1.0100	1.0044
Cp, KJ/(KG)(K)	2.5281	2.5240	2.3321	2.2124
GAMMAS	1.2427	1.2429	1.2584	1.2722
SON VEL,M/SEC	1205.5	1204.0	1143.2	804.5
MACH NUMBER	0.000	0.149	1.000	3.102

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.76853	0.76704	0.70731	0.43492
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.5281	2.5240	2.3321	2.2124
CONDUCTIVITY	4.4650	4.4412	3.4223	1.8199
PRANDTL NUMBER	0.4351	0.4359	0.4820	0.5287

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2296	2.2288	2.1936	1.9634
CONDUCTIVITY	3.2657	3.2577	2.9407	1.6739
PRANDTL NUMBER	0.5247	0.5248	0.5276	0.5101

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.1225
CSTAR, M/SEC	1642.5	1642.5	1642.5
CF	0.1096	0.6960	1.5194
Ivac, M/SEC	6659.7	2051.6	2699.6
Isp, M/SEC	180.0	1143.2	2495.7

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00007
*CO	0.75773	0.75763	0.75281	0.67316
*CO2	0.06901	0.06916	0.07674	0.20168
*H	0.00025	0.00025	0.00009	0.00000
HCO	0.00001	0.00000	0.00000	0.00000
*H2	0.04128	0.04129	0.04178	0.04756
H2O	0.13139	0.13133	0.12850	0.07752
*OH	0.00034	0.00033	0.00008	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013651

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0278	1.8345	50.000
P, BAR	20.265	19.716	11.046	0.40530
T, K	2489.95	2483.06	2209.68	1083.86
RHO, KG/CU M	1.7287 0	1.6866 0	1.0631 0	7.9615-2
H, KJ/KG	-950.79	-967.06	-1606.17	-4065.93
U, KJ/KG	-2123.04	-2136.03	-2645.26	-4575.01
G, KJ/KG	-33065.5	-33008.6	-30120.1	-18052.2
S, KJ/(KG)(K)	12.8977	12.9041	12.9041	12.9041
M, (1/n)	17.661	17.661	17.681	17.702
MW, MOL WT	17.661	17.661	17.681	17.702
(dLV/dLP)t	-1.00087	-1.00086	-1.00029	-1.00123
(dLV/dLT)p	1.0195	1.0193	1.0072	1.0168
Cp, KJ/(KG)(K)	2.4508	2.4475	2.2982	2.2917
GAMMAS	1.2481	1.2484	1.2615	1.2669
SON VEL,M/SEC	1209.6	1208.0	1144.9	803.1
MACH NUMBER	0.000	0.149	1.000	3.108

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.77015 0.76863 0.70770 0.43521

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4508	2.4475	2.2982	2.2917
CONDUCTIVITY	4.1502	4.1302	3.2908	1.8619
PRANDTL NUMBER	0.4548	0.4555	0.4942	0.5357

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2303	2.2295	2.1937	1.9637
CONDUCTIVITY	3.2721	3.2640	2.9420	1.6743
PRANDTL NUMBER	0.5249	0.5250	0.5277	0.5104

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000	6.1247
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1098	0.6970	1.5196
Ivac, M/SEC	6660.0	2052.5	2700.0

Isp, M/SEC 180.4 1144.9 2496.1

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00028
*CO	0.75786	0.75776	0.75286	0.67278
*CO2	0.06879	0.06895	0.07666	0.20171
*H	0.00018	0.00018	0.00006	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04133	0.04134	0.04180	0.04748
H2O	0.13157	0.13151	0.12856	0.07774
*OH	0.00025	0.00024	0.00006	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013666

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0279	1.8353	50.000
P, BAR	30.398	29.573	16.562	0.60795
T, K	2493.44	2486.47	2210.49	1085.84
RHO, KG/CU M	2.5902 0	2.5271 0	1.5935 0	1.1929-1
H, KJ/KG	-950.79	-967.10	-1607.07	-4066.44
U, KJ/KG	-2124.33	-2137.33	-2646.43	-4576.09
G, KJ/KG	-32634.5	-32578.1	-29709.5	-17871.0
S, KJ/(KG)(K)	12.7068	12.7132	12.7132	12.7132

M, (1/n)	17.666	17.666	17.683	17.715
MW, MOL WT	17.666	17.666	17.683	17.715
(dLV/dLP)t	-1.00073	-1.00072	-1.00024	-1.00259
(dLV/dLT)p	1.0162	1.0160	1.0059	1.0353
Cp, KJ/(KG)(K)	2.4152	2.4123	2.2830	2.4096

GAMMAS	1.2508	1.2510	1.2629	1.2597
SON VEL,M/SEC	1211.6	1210.0	1145.7	801.3
MACH NUMBER	0.000	0.149	1.000	3.115

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.77091	0.76937	0.70788	0.43574
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4152	2.4123	2.2830	2.4096
CONDUCTIVITY	4.0044	3.9863	3.2317	1.9249
PRANDTL NUMBER	0.4650	0.4656	0.5001	0.5455

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2306	2.2298	2.1938	1.9642
CONDUCTIVITY	3.2751	3.2669	2.9426	1.6753
PRANDTL NUMBER	0.5251	0.5251	0.5278	0.5109

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.1310
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1100	0.6975	1.5197
Ivac, M/SEC	6660.1	2052.9	2700.4
Isp, M/SEC	180.6	1145.7	2496.3

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00060
*CO	0.75792	0.75782	0.75288	0.67226
*CO2	0.06869	0.06885	0.07662	0.20166
*H	0.00015	0.00015	0.00005	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04135	0.04136	0.04181	0.04736
H2O	0.13166	0.13160	0.12858	0.07812
*OH	0.00021	0.00020	0.00005	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013676
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0279	1.8358	50.000
P, BAR	40.530	39.430	22.077	0.81060
T, K	2495.57	2488.55	2210.97	1088.36
RHO, KG/CU M	3.4513 0	3.3672 0	2.1238 0	1.5882-1
H, KJ/KG	-950.79	-967.12	-1607.61	-4066.89
U, KJ/KG	-2125.12	-2138.12	-2647.13	-4577.28
G, KJ/KG	-32323.7	-32267.8	-29416.9	-17756.2
S, KJ/(KG)(K)	12.5715	12.5779	12.5779	12.5779
M, (1/n)	17.669	17.670	17.684	17.730
MW, MOL WT	17.669	17.670	17.684	17.730
(dLV/dLP)t	-1.00064	-1.00063	-1.00021	-1.00425
(dLV/dLT)p	1.0142	1.0139	1.0051	1.0577
Cp, KJ/(KG)(K)	2.3935	2.3909	2.2739	2.5512
GAMMAS	1.2524	1.2527	1.2637	1.2522
SON VEL,M/SEC	1212.8	1211.1	1146.1	799.4
MACH NUMBER	0.000	0.149	1.000	3.123

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.77137 0.76982 0.70799 0.43642

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3935	2.3909	2.2739	2.5512
CONDUCTIVITY	3.9156	3.8986	3.1962	2.0012
PRANDTL NUMBER	0.4715	0.4721	0.5037	0.5564

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2308	2.2300	2.1939	1.9648
CONDUCTIVITY	3.2769	3.2686	2.9429	1.6766
PRANDTL NUMBER	0.5251	0.5252	0.5278	0.5115

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.1394
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1100	0.6978	1.5198
Ivac, M/SEC	6660.2	2053.1	2700.9
Isp, M/SEC	180.7	1146.1	2496.4

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00098
*CO	0.75795	0.75785	0.75289	0.67164
*CO2	0.06863	0.06879	0.07660	0.20158
*H	0.00013	0.00013	0.00004	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04137	0.04138	0.04182	0.04721

H2O	0.13171	0.13165	0.12860	0.07859
*OH	0.00018	0.00018	0.00004	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013682
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0279	1.8361	50.000
P, BAR	50.663	49.287	27.592	1.0132
T, K	2497.04	2490.00	2211.31	1091.20
RHO, KG/CU M	4.3122 0	4.2071 0	2.6540 0	1.9820-1
H, KJ/KG	-950.79	-967.13	-1607.97	-4067.32
U, KJ/KG	-2125.66	-2138.67	-2647.60	-4578.56
G, KJ/KG	-32080.1	-32024.5	-29189.4	-17677.8
S, KJ/(KG)(K)	12.4665	12.4729	12.4729	12.4729
M, (1/n)	17.671	17.672	17.685	17.747
MW, MOL WT	17.671	17.672	17.685	17.747
(dLV/dLP)t	-1.00058	-1.00057	-1.00019	-1.00606
(dLV/dLT)p	1.0128	1.0126	1.0046	1.0821
Cp, KJ/(KG)(K)	2.3786	2.3762	2.2677	2.7043
GAMMAS	1.2536	1.2538	1.2643	1.2450
SON VEL,M/SEC	1213.6	1212.0	1146.5	797.8
MACH NUMBER	0.000	0.149	1.000	3.129

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.77169 0.77013 0.70806 0.43718

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3786	2.3762	2.2677	2.7043
CONDUCTIVITY	3.8541	3.8380	3.1719	2.0845
PRANDTL NUMBER	0.4763	0.4768	0.5062	0.5671

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2309	2.2301	2.1939	1.9656
CONDUCTIVITY	3.2781	3.2699	2.9431	1.6780
PRANDTL NUMBER	0.5252	0.5252	0.5278	0.5121

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.1491
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1101	0.6980	1.5199
Ivac, M/SEC	6660.2	2053.3	2701.4
Isp, M/SEC	180.8	1146.5	2496.6

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00142
*CO	0.75798	0.75787	0.75290	0.67095
*CO2	0.06859	0.06875	0.07659	0.20148
*H	0.00012	0.00012	0.00004	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04138	0.04139	0.04182	0.04704
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.13175	0.13169	0.12861	0.07912
*OH	0.00016	0.00016	0.00004	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013687
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0279	1.8364	50.000
P, BAR	60.795	59.144	33.106	1.2159
T, K	2498.15	2491.08	2211.56	1094.20
RHO, KG/CU M	5.1728 0	5.0467 0	3.1841 0	2.3742-1
H, KJ/KG	-950.79	-967.15	-1608.24	-4067.76
U, KJ/KG	-2126.06	-2139.07	-2647.96	-4579.88
G, KJ/KG	-31879.6	-31824.3	-29003.0	-17621.8
S, KJ/(KG)(K)	12.3807	12.3871	12.3871	12.3871
M, (1/n)	17.673	17.673	17.686	17.765
MW, MOL WT	17.673	17.673	17.686	17.765
(dLV/dLP)t	-1.00054	-1.00053	-1.00018	-1.00794
(dLV/dLT)p	1.0117	1.0115	1.0042	1.1071
Cp, KJ/(KG)(K)	2.3675	2.3652	2.2632	2.8602
GAMMAS	1.2545	1.2547	1.2647	1.2386
SON VEL,M/SEC	1214.2	1212.6	1146.7	796.4
MACH NUMBER	0.000	0.149	1.000	3.135

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.77193	0.77037	0.70812	0.43798
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3675	2.3652	2.2632	2.8602
CONDUCTIVITY	3.8083	3.7927	3.1540	2.1703
PRANDTL NUMBER	0.4799	0.4804	0.5081	0.5772

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2310	2.2302	2.1939	1.9664
CONDUCTIVITY	3.2790	3.2708	2.9433	1.6796
PRANDTL NUMBER	0.5252	0.5253	0.5278	0.5128

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.1593
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1101	0.6981	1.5200
Ivac, M/SEC	6660.2	2053.4	2701.9
Isp, M/SEC	180.9	1146.7	2496.8

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00187
*CO	0.75799	0.75789	0.75290	0.67022
*CO2	0.06856	0.06872	0.07658	0.20137
*H	0.00011	0.00011	0.00004	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04139	0.04140	0.04182	0.04687
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.13178	0.13171	0.12862	0.07967
*OH	0.00015	0.00015	0.00003	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)
 SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)
 SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)
 SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013691
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0279	1.8366	50.000
P, BAR	70.927	69.001	38.619	1.4185
T, K	2499.01	2491.92	2211.76	1097.26
RHO, KG/CU M	6.0333 0	5.8862 0	3.7142 0	2.7651-1
H, KJ/KG	-950.79	-967.15	-1608.46	-4068.21
U, KJ/KG	-2126.38	-2139.39	-2648.24	-4581.23
G, KJ/KG	-31709.1	-31654.1	-28845.3	-17580.5
S, KJ/(KG)(K)	12.3082	12.3146	12.3146	12.3146
M, (1/n)	17.675	17.675	17.686	17.783
MW, MOL WT	17.675	17.675	17.686	17.783
(dLV/dLP)t	-1.00051	-1.00050	-1.00018	-1.00980
(dLV/dLT)p	1.0109	1.0107	1.0040	1.1320
Cp, KJ/(KG)(K)	2.3588	2.3566	2.2596	3.0136
GAMMAS	1.2552	1.2554	1.2651	1.2330
SON VEL,M/SEC	1214.7	1213.1	1146.9	795.3
MACH NUMBER	0.000	0.149	1.000	3.139

TRANSPORT PROPERTIES (GASES ONLY) CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.77211 0.77055 0.70816 0.43880

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3588	2.3566	2.2596	3.0136
CONDUCTIVITY	3.7724	3.7573	3.1400	2.2556
PRANDTL NUMBER	0.4828	0.4833	0.5096	0.5863

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2311	2.2303	2.1940	1.9672
CONDUCTIVITY	3.2798	3.2715	2.9435	1.6811
PRANDTL NUMBER	0.5252	0.5253	0.5278	0.5135

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.1697
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1101	0.6982	1.5202
Ivac, M/SEC	6660.2	2053.5	2702.4
Isp, M/SEC	180.9	1146.9	2497.0

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00234
*CO	0.75800	0.75790	0.75290	0.66947
*CO2	0.06853	0.06870	0.07657	0.20126
*H	0.00010	0.00010	0.00003	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.04139	0.04140	0.04182	0.04669
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.13180	0.13173	0.12863	0.08024
*OH	0.00014	0.00014	0.00003	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013694

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0279	1.8367	50.000
P, BAR	81.060	78.858	44.133	1.6212
T, K	2499.72	2492.61	2211.92	1100.31
RHO, KG/CU M	6.8937 0	6.7257 0	4.2442 0	3.1546-1
H, KJ/KG	-950.79	-967.16	-1608.64	-4068.66
U, KJ/KG	-2126.64	-2139.65	-2648.47	-4582.58

G, KJ/KG	-31560.7	-31506.0	-28708.5	-17549.4
S, KJ/(KG)(K)	12.2454	12.2518	12.2518	12.2518
M, (1/n)	17.676	17.676	17.687	17.801
MW, MOL WT	17.676	17.676	17.687	17.801
(dLV/dLP)t	-1.00048	-1.00048	-1.00017	-1.01163
(dLV/dLT)p	1.0102	1.0101	1.0037	1.1561
Cp, KJ/(KG)(K)	2.3518	2.3497	2.2568	3.1615
GAMMAS	1.2557	1.2559	1.2653	1.2282
SON VEL,M/SEC	1215.1	1213.5	1147.1	794.5
MACH NUMBER	0.000	0.149	1.000	3.143

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.77227	0.77070	0.70820	0.43962
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3518	2.3497	2.2568	3.1615
CONDUCTIVITY	3.7433	3.7286	3.1287	2.3387
PRANDTL NUMBER	0.4852	0.4857	0.5108	0.5943

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2312	2.2304	2.1940	1.9680
CONDUCTIVITY	3.2804	3.2721	2.9436	1.6827
PRANDTL NUMBER	0.5253	0.5253	0.5279	0.5141

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.1800
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1102	0.6983	1.5203
Ivac, M/SEC	6660.3	2053.6	2702.9
Isp, M/SEC	181.0	1147.0	2497.1

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00280
*CO	0.75801	0.75791	0.75290	0.66873
*CO2	0.06852	0.06868	0.07656	0.20116
*H	0.00010	0.00009	0.00003	0.00000
HCO	0.00002	0.00001	0.00000	0.00000
*H2	0.04140	0.04141	0.04182	0.04651
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
H2O	0.13181	0.13175	0.12863	0.08080
*OH	0.00013	0.00013	0.00003	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013697

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0279	1.8369	50.000
P, BAR	91.192	88.714	49.646	1.8238
T, K	2500.31	2493.19	2212.05	1103.31
RHO, KG/CU M	7.7540 0	7.5650 0	4.7742 0	3.5429-1
H, KJ/KG	-950.79	-967.17	-1608.78	-4069.12
U, KJ/KG	-2126.85	-2139.87	-2648.65	-4583.92
G, KJ/KG	-31429.4	-31375.0	-28587.7	-17525.4
S, KJ/(KG)(K)	12.1900	12.1964	12.1964	12.1964
M, (1/n)	17.677	17.677	17.687	17.820
MW, MOL WT	17.677	17.677	17.687	17.820
(dLV/dLP)t	-1.00047	-1.00046	-1.00017	-1.01340
(dLV/dLT)p	1.0097	1.0096	1.0036	1.1793
Cp, KJ/(KG)(K)	2.3459	2.3439	2.2545	3.3025
GAMMAS	1.2562	1.2564	1.2656	1.2241
SON VEL,M/SEC	1215.5	1213.8	1147.2	793.8
MACH NUMBER	0.000	0.149	1.000	3.146

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.77239 0.77083 0.70823 0.44042

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3459	2.3439	2.2545	3.3025
CONDUCTIVITY	3.7190	3.7047	3.1194	2.4187
PRANDTL NUMBER	0.4872	0.4877	0.5119	0.6013

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2312	2.2304	2.1940	1.9688
CONDUCTIVITY	3.2809	3.2725	2.9437	1.6842
PRANDTL NUMBER	0.5253	0.5254	0.5279	0.5148

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.1901
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1102	0.6984	1.5204
Ivac, M/SEC	6660.3	2053.6	2703.5
Isp, M/SEC	181.0	1147.2	2497.3

MASS FRACTIONS

CH4	0.00001	0.00000	0.00001	0.00326
*CO	0.75802	0.75791	0.75290	0.66799
*CO2	0.06850	0.06866	0.07656	0.20106
*H	0.00009	0.00009	0.00003	0.00000
HCO	0.00002	0.00002	0.00000	0.00000
*H2	0.04140	0.04141	0.04182	0.04633
HCHO,formaldehy	0.00001	0.00001	0.00001	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.13183	0.13177	0.12864	0.08136
*OH	0.00012	0.00012	0.00003	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013699

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.50000 %FUEL= 40.000000 R,EQ.RATIO= 2.270444 PHI,EQ.RATIO= 2.270444

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0279	1.8370	50.000
P, BAR	101.33	98.571	55.159	2.0265
T, K	2500.81	2493.68	2212.17	1106.24
RHO, KG/CU M	8.6143 0	8.4042 0	5.3042 0	3.9300-1
H, KJ/KG	-950.79	-967.17	-1608.90	-4069.58
U, KJ/KG	-2127.03	-2140.05	-2648.81	-4585.23
G, KJ/KG	-31311.6	-31257.4	-28479.6	-17506.8
S, KJ/(KG)(K)	12.1404	12.1468	12.1468	12.1468
M, (1/n)	17.677	17.678	17.687	17.837
MW, MOL WT	17.677	17.678	17.687	17.837
(dLV/dLP)t	-1.00045	-1.00044	-1.00017	-1.01510
(dLV/dLT)p	1.0093	1.0091	1.0034	1.2015
Cp, KJ/(KG)(K)	2.3410	2.3390	2.2526	3.4358

GAMMAS	1.2566	1.2568	1.2658	1.2206
SON VEL,M/SEC	1215.8	1214.1	1147.3	793.4
MACH NUMBER	0.000	0.149	1.000	3.148

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.77250	0.77093	0.70825	0.44120
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.3410	2.3390	2.2526	3.4358
CONDUCTIVITY	3.6985	3.6844	3.1115	2.4953
PRANDTL NUMBER	0.4890	0.4894	0.5127	0.6075

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2313	2.2305	2.1940	1.9695
CONDUCTIVITY	3.2813	3.2729	2.9437	1.6857
PRANDTL NUMBER	0.5253	0.5254	0.5279	0.5155

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000	6.1999
CSTAR, M/SEC	1642.6	1642.6	1642.6
CF	0.1102	0.6985	1.5205
Ivac, M/SEC	6660.3	2053.7	2704.0
Isp, M/SEC	181.0	1147.3	2497.5

MASS FRACTIONS

CH4	0.00001	0.00001	0.00001	0.00371
*CO	0.75802	0.75792	0.75290	0.66727
*CO2	0.06849	0.06865	0.07655	0.20097
*H	0.00009	0.00008	0.00003	0.00000
HCO	0.00002	0.00002	0.00000	0.00000
*H2	0.04140	0.04141	0.04183	0.04616
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.13184	0.13178	0.12864	0.08190
*OH	0.00012	0.00012	0.00003	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013445
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0274	1.8192	50.000
P, BAR	10.133	9.8622	5.5698	0.20265
T, K	2677.41	2670.75	2409.05	1213.76
RHO, KG/CU M	8.3299-1	8.1284-1	5.1049-1	3.6947-2
H, KJ/KG	-929.82	-946.45	-1604.47	-4232.16
U, KJ/KG	-2146.22	-2159.74	-2695.55	-4780.65
G, KJ/KG	-36052.7	-35998.1	-33221.5	-20161.9
S, KJ/(KG)(K)	13.1182	13.1243	13.1243	13.1243
M, (1/n)	18.301	18.302	18.358	18.399
MW, MOL WT	18.301	18.302	18.358	18.399
(dLV/dLP)t	-1.00267	-1.00264	-1.00112	-1.00001
(dLV/dLT)p	1.0566	1.0560	1.0259	1.0001
Cp, KJ/(KG)(K)	2.7757	2.7704	2.4765	2.1498
GAMMAS	1.2196	1.2198	1.2367	1.2662
SON VEL,M/SEC	1218.0	1216.6	1161.6	833.4
MACH NUMBER	0.000	0.150	1.000	3.084

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.82080 0.81933 0.76112 0.47456

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.7757	2.7704	2.4765	2.1498
CONDUCTIVITY	5.6852	5.6560	4.1896	1.8776
PRANDTL NUMBER	0.4007	0.4013	0.4499	0.5434

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2147	2.2139	2.1835	1.9610
CONDUCTIVITY	3.3686	3.3610	3.0599	1.7540
PRANDTL NUMBER	0.5396	0.5397	0.5431	0.5306

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2451
CSTAR, M/SEC	1686.1	1686.1	1686.1
CF	0.1082	0.6889	1.5242
Ivac, M/SEC	6835.0	2100.9	2783.4
Isp, M/SEC	182.4	1161.6	2570.0

MASS FRACTIONS

*CO	0.71635	0.71625	0.71175	0.63725
*CO2	0.08557	0.08573	0.09281	0.20986
*H	0.00051	0.00051	0.00022	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.03551	0.03552	0.03608	0.04164
H2O	0.16082	0.16078	0.15876	0.11125
*O	0.00002	0.00002	0.00000	0.00000
*OH	0.00120	0.00118	0.00038	0.00000

*O2 0.00001 0.00001 0.00000 0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013493

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0275	1.8225	50.000
P, BAR	20.265	19.722	11.120	0.40530
T, K	2692.76	2685.87	2414.28	1212.99
RHO, KG/CU M	1.6587 0	1.6185 0	1.0176 0	7.3941-2
H, KJ/KG	-929.82	-946.59	-1608.48	-4233.92
U, KJ/KG	-2151.57	-2165.14	-2701.26	-4782.06
G, KJ/KG	-35406.6	-35351.4	-32534.4	-19771.9
S, KJ/(KG)(K)	12.8035	12.8096	12.8096	12.8096
M, (1/n)	18.325	18.326	18.369	18.399
MW, MOL WT	18.325	18.326	18.369	18.399
(dLV/dLP)t	-1.00201	-1.00198	-1.00081	-1.00004
(dLV/dLT)p	1.0423	1.0418	1.0188	1.0005
Cp, KJ/(KG)(K)	2.6353	2.6311	2.4005	2.1521
GAMMAS	1.2270	1.2273	1.2421	1.2661
SON VEL,M/SEC	1224.4	1222.9	1165.0	833.1
MACH NUMBER	0.000	0.150	1.000	3.086

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.82411 0.82259 0.76227 0.47436

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.6353	2.6311	2.4005	2.1521
CONDUCTIVITY	5.1145	5.0897	3.8866	1.8782
PRANDTL NUMBER	0.4246	0.4252	0.4708	0.5435

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2159	2.2152	2.1840	1.9608
CONDUCTIVITY	3.3809	3.3731	3.0636	1.7532
PRANDTL NUMBER	0.5401	0.5402	0.5434	0.5305

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2370
CSTAR, M/SEC	1686.7	1686.7	1686.7
CF	0.1086	0.6907	1.5241
Ivac, M/SEC	6837.7	2103.0	2783.9
Isp, M/SEC	183.1	1165.0	2570.6

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00001
*CO	0.71661	0.71651	0.71189	0.63710
*CO2	0.08515	0.08531	0.09259	0.21007
*H	0.00038	0.00038	0.00016	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.03560	0.03561	0.03612	0.04165
H2O	0.16131	0.16126	0.15896	0.11117
*O	0.00001	0.00001	0.00000	0.00000
*OH	0.00092	0.00090	0.00028	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013518

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0276	1.8240	50.000
P, BAR	30.398	29.582	16.665	0.60795
T, K	2700.15	2693.14	2416.66	1212.70
RHO, KG/CU M	2.4828 0	2.4226 0	1.5240 0	1.1094-1

H, KJ/KG	-929.82	-946.65	-1610.38	-4234.73
U, KJ/KG	-2154.13	-2167.73	-2703.92	-4782.72
G, KJ/KG	-35004.7	-34949.4	-32122.4	-19545.9
S, KJ/(KG)(K)	12.6196	12.6257	12.6257	12.6257
M, (1/n)	18.337	18.338	18.374	18.400
MW, MOL WT	18.337	18.338	18.374	18.400
(dLV/dLP)t	-1.00169	-1.00167	-1.00067	-1.00010
(dLV/dLT)p	1.0354	1.0350	1.0155	1.0012
Cp, KJ/(KG)(K)	2.5689	2.5651	2.3657	2.1558
GAMMAS	1.2308	1.2311	1.2447	1.2658
SON VEL,M/SEC	1227.6	1226.1	1166.7	832.9
MACH NUMBER	0.000	0.150	1.000	3.087

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.82570	0.82416	0.76279	0.47428
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.5689	2.5651	2.3657	2.1558
CONDUCTIVITY	4.8418	4.8193	3.7476	1.8799
PRANDTL NUMBER	0.4381	0.4387	0.4815	0.5439

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2165	2.2158	2.1842	1.9607
CONDUCTIVITY	3.3868	3.3789	3.0653	1.7529
PRANDTL NUMBER	0.5404	0.5405	0.5435	0.5305

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2335
CSTAR, M/SEC	1686.9	1686.9	1686.9
CF	0.1088	0.6916	1.5241
Ivac, M/SEC	6838.8	2104.0	2784.1
Isp, M/SEC	183.5	1166.7	2571.0

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00002
*CO	0.71673	0.71663	0.71195	0.63702
*CO2	0.08496	0.08511	0.09249	0.21016
*H	0.00032	0.00032	0.00013	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.03564	0.03565	0.03614	0.04165
H2O	0.16154	0.16149	0.15905	0.11115
*O	0.00001	0.00001	0.00000	0.00000
*OH	0.00077	0.00076	0.00023	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013534
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0276	1.8250	50.000
P, BAR	40.530	39.441	22.208	0.81060
T, K	2704.75	2697.66	2418.09	1212.58
RHO, KG/CU M	3.3061 0	3.2259 0	2.0300 0	1.4794-1
H, KJ/KG	-929.82	-946.69	-1611.55	-4235.24
U, KJ/KG	-2155.73	-2169.34	-2705.56	-4783.16
G, KJ/KG	-34710.0	-34654.8	-31826.3	-19386.8
S, KJ/(KG)(K)	12.4892	12.4953	12.4953	12.4953
M, (1/n)	18.345	18.345	18.378	18.401
MW, MOL WT	18.345	18.345	18.378	18.401
(dLV/dLP)t	-1.00150	-1.00147	-1.00059	-1.00017
(dLV/dLT)p	1.0312	1.0308	1.0135	1.0021
Cp, KJ/(KG)(K)	2.5278	2.5244	2.3447	2.1609
GAMMAS	1.2333	1.2335	1.2463	1.2655
SON VEL,M/SEC	1229.6	1228.1	1167.7	832.7
MACH NUMBER	0.000	0.150	1.000	3.088

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.82669 0.82513 0.76311 0.47425

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.5278	2.5244	2.3447	2.1609
CONDUCTIVITY	4.6726	4.6516	3.6633	1.8826
PRANDTL NUMBER	0.4472	0.4478	0.4884	0.5443

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2169	2.2162	2.1843	1.9607
CONDUCTIVITY	3.3905	3.3825	3.0663	1.7527
PRANDTL NUMBER	0.5405	0.5406	0.5436	0.5305

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2316
CSTAR, M/SEC	1687.0	1687.0	1687.0
CF	0.1089	0.6922	1.5241
Ivac, M/SEC	6839.4	2104.6	2784.3
Isp, M/SEC	183.7	1167.7	2571.2

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00004
*CO	0.71680	0.71670	0.71198	0.63696
*CO2	0.08483	0.08499	0.09243	0.21022
*H	0.00028	0.00028	0.00012	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.03567	0.03568	0.03616	0.04164
H2O	0.16169	0.16164	0.15910	0.11114
*O	0.00001	0.00001	0.00000	0.00000
*OH	0.00069	0.00067	0.00020	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013545

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0276	1.8257	50.000
P, BAR	50.663	49.301	27.750	1.0133
T, K	2707.99	2700.84	2419.08	1212.57
RHO, KG/CU M	4.1289 0	4.0287 0	2.5358 0	1.8494-1
H, KJ/KG	-929.82	-946.72	-1612.37	-4235.59
U, KJ/KG	-2156.84	-2170.46	-2706.69	-4783.48
G, KJ/KG	-34476.5	-34421.4	-31594.9	-19264.3
S, KJ/(KG)(K)	12.3881	12.3942	12.3942	12.3942
M, (1/n)	18.350	18.350	18.380	18.402
MW, MOL WT	18.350	18.350	18.380	18.402
(dLV/dLP)t	-1.00136	-1.00134	-1.00053	-1.00027
(dLV/dLT)p	1.0282	1.0279	1.0122	1.0033
Cp, KJ/(KG)(K)	2.4992	2.4960	2.3302	2.1674
GAMMAS	1.2351	1.2353	1.2474	1.2651
SON VEL,M/SEC	1231.0	1229.5	1168.4	832.6
MACH NUMBER	0.000	0.150	1.000	3.088

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.82738 0.82582 0.76332 0.47424

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4992	2.4960	2.3302	2.1674
CONDUCTIVITY	4.5540	4.5341	3.6051	1.8862
PRANDTL NUMBER	0.4541	0.4546	0.4934	0.5449

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2172	2.2164	2.1844	1.9607
CONDUCTIVITY	3.3930	3.3850	3.0670	1.7526
PRANDTL NUMBER	0.5407	0.5407	0.5437	0.5305

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2305
CSTAR, M/SEC	1687.1	1687.1	1687.1
CF	0.1090	0.6925	1.5241
Ivac, M/SEC	6839.8	2105.0	2784.4
Isp, M/SEC	183.9	1168.4	2571.3

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00006
*CO	0.71685	0.71675	0.71201	0.63690
*CO2	0.08475	0.08491	0.09239	0.21025
*H	0.00026	0.00025	0.00010	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.03569	0.03570	0.03617	0.04164
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.16179	0.16174	0.15914	0.11115
*OH	0.00062	0.00061	0.00018	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013553

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0276	1.8262	50.000
P, BAR	60.795	59.160	33.291	1.2159
T, K	2710.42	2703.24	2419.82	1212.62
RHO, KG/CU M	4.9513 0	4.8311 0	3.0415 0	2.2193-1
H, KJ/KG	-929.82	-946.74	-1612.98	-4235.86
U, KJ/KG	-2157.69	-2171.31	-2707.54	-4783.74
G, KJ/KG	-34282.8	-34227.8	-31404.7	-19165.1
S, KJ/(KG)(K)	12.3055	12.3116	12.3116	12.3116
M, (1/n)	18.354	18.354	18.381	18.403
MW, MOL WT	18.354	18.354	18.381	18.403
(dLV/dLP)t	-1.00125	-1.00124	-1.00049	-1.00039
(dLV/dLT)p	1.0260	1.0257	1.0111	1.0047
Cp, KJ/(KG)(K)	2.4777	2.4747	2.3195	2.1753
GAMMAS	1.2364	1.2366	1.2483	1.2647
SON VEL,M/SEC	1232.1	1230.6	1168.9	832.4
MACH NUMBER	0.000	0.150	1.000	3.089

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.82791 0.82633 0.76348 0.47426

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4777	2.4747	2.3195	2.1753
CONDUCTIVITY	4.4648	4.4457	3.5618	1.8906
PRANDTL NUMBER	0.4594	0.4600	0.4972	0.5457

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2174	2.2166	2.1845	1.9607
CONDUCTIVITY	3.3950	3.3869	3.0675	1.7526
PRANDTL NUMBER	0.5407	0.5408	0.5437	0.5306

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2299
CSTAR, M/SEC	1687.2	1687.2	1687.2
CF	0.1090	0.6928	1.5241
Ivac, M/SEC	6840.1	2105.3	2784.5
Isp, M/SEC	184.0	1168.9	2571.4

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00009
*CO	0.71689	0.71679	0.71203	0.63684
*CO2	0.08468	0.08484	0.09236	0.21028
*H	0.00024	0.00023	0.00010	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.03570	0.03571	0.03617	0.04163
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
H2O	0.16187	0.16182	0.15917	0.11117
*OH	0.00058	0.00056	0.00017	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013560

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0277	1.8266	50.000
P, BAR	70.927	69.019	38.831	1.4185
T, K	2712.34	2705.13	2420.39	1212.74
RHO, KG/CU M	5.7734 0	5.6332 0	3.5471 0	2.5891-1
H, KJ/KG	-929.82	-946.76	-1613.46	-4236.08
U, KJ/KG	-2158.35	-2171.98	-2708.20	-4783.97
G, KJ/KG	-34117.1	-34062.2	-31243.3	-19082.1
S, KJ/(KG)(K)	12.2356	12.2417	12.2417	12.2417
M, (1/n)	18.357	18.357	18.383	18.404
MW, MOL WT	18.357	18.357	18.383	18.404
(dLV/dLP)t	-1.00117	-1.00116	-1.00045	-1.00053
(dLV/dLT)p	1.0242	1.0239	1.0103	1.0064
Cp, KJ/(KG)(K)	2.4608	2.4579	2.3111	2.1845
GAMMAS	1.2375	1.2377	1.2489	1.2641
SON VEL,M/SEC	1233.0	1231.4	1169.3	832.2
MACH NUMBER	0.000	0.149	1.000	3.090

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.82832 0.82674 0.76361 0.47429

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4608	2.4579	2.3111	2.1845
CONDUCTIVITY	4.3945	4.3761	3.5279	1.8958
PRANDTL NUMBER	0.4638	0.4644	0.5002	0.5465

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2175	2.2168	2.1845	1.9608
CONDUCTIVITY	3.3965	3.3884	3.0679	1.7526
PRANDTL NUMBER	0.5408	0.5409	0.5437	0.5306

PERFORMANCE PARAMETERS

Ae/At 4.0000 1.0000 6.2296

CSTAR, M/SEC	1687.2	1687.2	1687.2
CF	0.1091	0.6930	1.5241
Ivac, M/SEC	6840.3	2105.5	2784.5
Isp, M/SEC	184.1	1169.3	2571.5

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00012
*CO	0.71692	0.71682	0.71204	0.63677
*CO2	0.08463	0.08479	0.09233	0.21030
*H	0.00022	0.00022	0.00009	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.03571	0.03572	0.03618	0.04162
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00000	0.00000	0.00000
H2O	0.16193	0.16188	0.15919	0.11120
*OH	0.00054	0.00053	0.00015	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013565
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0277	1.8269	50.000
P, BAR	81.060	78.878	44.371	1.6212
T, K	2713.91	2706.67	2420.86	1212.90
RHO, KG/CU M	6.5952 0	6.4351 0	4.0525 0	2.9588-1
H, KJ/KG	-929.82	-946.78	-1613.85	-4236.27
U, KJ/KG	-2158.89	-2172.53	-2708.74	-4784.19
G, KJ/KG	-33972.2	-33917.5	-31102.9	-19010.9
S, KJ/(KG)(K)	12.1752	12.1813	12.1813	12.1813
M, (1/n)	18.359	18.360	18.384	18.405
MW, MOL WT	18.359	18.360	18.384	18.405
(dLV/dLP)t	-1.00111	-1.00109	-1.00043	-1.00069
(dLV/dLT)p	1.0228	1.0225	1.0097	1.0083

Cp, KJ/(KG)(K)	2.4470	2.4443	2.3042	2.1950
GAMMAS	1.2384	1.2386	1.2495	1.2635
SON VEL,M/SEC	1233.7	1232.1	1169.6	832.1
MACH NUMBER	0.000	0.149	1.000	3.091

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.82866	0.82707	0.76371	0.47433
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4470	2.4443	2.3042	2.1950
CONDUCTIVITY	4.3372	4.3193	3.5005	1.9018
PRANDTL NUMBER	0.4675	0.4680	0.5027	0.5475

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2176	2.2169	2.1846	1.9608
CONDUCTIVITY	3.3977	3.3896	3.0682	1.7526
PRANDTL NUMBER	0.5409	0.5409	0.5438	0.5307

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2296
CSTAR, M/SEC	1687.2	1687.2	1687.2
CF	0.1091	0.6932	1.5241
Ivac, M/SEC	6840.5	2105.7	2784.6
Isp, M/SEC	184.1	1169.6	2571.6

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00015
*CO	0.71694	0.71684	0.71205	0.63670
*CO2	0.08459	0.08475	0.09231	0.21031
*H	0.00021	0.00021	0.00008	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.03572	0.03573	0.03618	0.04160
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.16198	0.16193	0.15921	0.11123
*OH	0.00051	0.00050	0.00014	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013570
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0277	1.8271	50.000
P, BAR	91.192	88.737	49.910	1.8238
T, K	2715.23	2707.96	2421.24	1213.10
RHO, KG/CU M	7.4169 0	7.2367 0	4.5579 0	3.3284-1
H, KJ/KG	-929.82	-946.79	-1614.17	-4236.43
U, KJ/KG	-2159.34	-2172.98	-2709.19	-4784.39
G, KJ/KG	-33843.3	-33788.8	-30978.8	-18948.8
S, KJ/(KG)(K)	12.1218	12.1279	12.1279	12.1279
M, (1/n)	18.361	18.362	18.385	18.407
MW, MOL WT	18.361	18.362	18.385	18.407
(dLV/dLP)t	-1.00105	-1.00104	-1.00041	-1.00086
(dLV/dLT)p	1.0216	1.0213	1.0092	1.0105
Cp, KJ/(KG)(K)	2.4355	2.4329	2.2986	2.2067
GAMMAS	1.2391	1.2393	1.2499	1.2629
SON VEL,M/SEC	1234.3	1232.7	1169.9	831.9
MACH NUMBER	0.000	0.149	1.000	3.091

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.82894 0.82735 0.76380 0.47438

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4355	2.4329	2.2986	2.2067
CONDUCTIVITY	4.2892	4.2718	3.4777	1.9084
PRANDTL NUMBER	0.4707	0.4712	0.5048	0.5485

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2178	2.2170	2.1846	1.9609
CONDUCTIVITY	3.3988	3.3906	3.0685	1.7527
PRANDTL NUMBER	0.5409	0.5410	0.5438	0.5307

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2298
CSTAR, M/SEC	1687.3	1687.3	1687.3
CF	0.1092	0.6934	1.5241
Ivac, M/SEC	6840.6	2105.9	2784.7
Isp, M/SEC	184.2	1169.9	2571.6

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00019
*CO	0.71696	0.71686	0.71206	0.63663
*CO2	0.08456	0.08472	0.09230	0.21032
*H	0.00020	0.00019	0.00008	0.00000
HCO	0.00003	0.00002	0.00001	0.00000
*H2	0.03573	0.03574	0.03618	0.04159
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000

HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.16202	0.16197	0.15923	0.11127
*OH	0.00048	0.00047	0.00014	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013574

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.60000 %FUEL= 38.461538 R,EQ.RATIO= 2.128541 PHI,EQ.RATIO= 2.128541

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0277	1.8274	50.000
P, BAR	101.33	98.596	55.448	2.0265
T, K	2716.35	2709.07	2421.57	1213.34
RHO, KG/CU M	8.2384 0	8.0383 0	5.0632 0	3.6979-1
H, KJ/KG	-929.82	-946.80	-1614.45	-4236.57
U, KJ/KG	-2159.73	-2173.37	-2709.57	-4784.58
G, KJ/KG	-33727.4	-33672.9	-30867.5	-18894.0
S, KJ/(KG)(K)	12.0741	12.0802	12.0802	12.0802

M, (1/n)	18.363	18.364	18.385	18.409
MW, MOL WT	18.363	18.364	18.385	18.409
(dLV/dLP)t	-1.00101	-1.00099	-1.00039	-1.00106
(dLV/dLT)p	1.0205	1.0203	1.0087	1.0128
Cp, KJ/(KG)(K)	2.4257	2.4232	2.2938	2.2196
GAMMAS	1.2398	1.2400	1.2503	1.2621
SON VEL,M/SEC	1234.8	1233.2	1170.2	831.7
MACH NUMBER	0.000	0.149	1.000	3.092

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.82918 0.82759 0.76387 0.47444

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.4257	2.4232	2.2938	2.2196
CONDUCTIVITY	4.2483	4.2313	3.4583	1.9158
PRANDTL NUMBER	0.4735	0.4739	0.5067	0.5497

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2178	2.2171	2.1846	1.9609
CONDUCTIVITY	3.3997	3.3915	3.0687	1.7528
PRANDTL NUMBER	0.5409	0.5410	0.5438	0.5308

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.2302
CSTAR, M/SEC	1687.3	1687.3	1687.3
CF	0.1092	0.6935	1.5241
Ivac, M/SEC	6840.8	2106.0	2784.8
Isp, M/SEC	184.3	1170.2	2571.7

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00023
*CO	0.71698	0.71687	0.71207	0.63655
*CO2	0.08453	0.08469	0.09228	0.21033
*H	0.00019	0.00019	0.00007	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.03574	0.03575	0.03619	0.04157
HCHO, formaldehy	0.00001	0.00001	0.00001	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.16206	0.16200	0.15924	0.11132
*OH	0.00046	0.00045	0.00013	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013272
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0271	1.8052	50.000

P, BAR	10.133	9.8655	5.6130	0.20265
T, K	2843.23	2836.74	2588.27	1344.90
RHO, KG/CU M	8.1088-1	7.9140-1	4.9591-1	3.4626-2
H, KJ/KG	-910.41	-927.27	-1597.77	-4372.97
U, KJ/KG	-2159.98	-2173.87	-2729.64	-4958.22
G, KJ/KG	-37877.9	-37826.8	-35265.3	-21867.1
S, KJ/(KG)(K)	13.0019	13.0077	13.0077	13.0077

M, (1/n)	18.919	18.920	19.013	19.107
MW, MOL WT	18.919	18.920	19.013	19.107
(dLV/dLP)t	-1.00498	-1.00493	-1.00246	-1.00000
(dLV/dLT)p	1.1009	1.1001	1.0542	1.0000
Cp, KJ/(KG)(K)	3.1174	3.1113	2.7131	2.1135
GAMMAS	1.1989	1.1990	1.2146	1.2593
SON VEL,M/SEC	1224.0	1222.6	1172.5	858.5
MACH NUMBER	0.000	0.150	1.000	3.065

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.86685	0.86542	0.81023	0.51398
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.1174	3.1113	2.7131	2.1135
CONDUCTIVITY	7.1739	7.1426	5.2948	1.9389
PRANDTL NUMBER	0.3767	0.3770	0.4152	0.5603

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1973	2.1967	2.1709	1.9599
CONDUCTIVITY	3.4377	3.4305	3.1508	1.8274
PRANDTL NUMBER	0.5541	0.5542	0.5582	0.5512

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3810
CSTAR, M/SEC	1719.8	1719.8	1719.8
CF	0.1068	0.6818	1.5301
Ivac, M/SEC	6970.6	2137.8	2854.0
Isp, M/SEC	183.7	1172.5	2631.6

MASS FRACTIONS

*CO	0.67647	0.67637	0.67216	0.60452
*CO2	0.10337	0.10352	0.11016	0.21643
*H	0.00085	0.00084	0.00044	0.00000
HCO	0.00001	0.00001	0.00000	0.00000
*H2	0.03026	0.03028	0.03086	0.03609
H2O	0.18576	0.18575	0.18510	0.14296
*O	0.00009	0.00009	0.00002	0.00000
*OH	0.00313	0.00308	0.00126	0.00000
*O2	0.00005	0.00005	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013335

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0272	1.8098	50.000
P, BAR	20.265	19.729	11.197	0.40530
T, K	2868.86	2862.08	2599.72	1343.24
RHO, KG/CU M	1.6109 0	1.5721 0	9.8617-1	6.9338-2
H, KJ/KG	-910.40	-927.47	-1604.16	-4376.51
U, KJ/KG	-2168.41	-2182.40	-2739.60	-4961.03
G, KJ/KG	-37338.2	-37285.7	-34629.6	-21440.3
S, KJ/(KG)(K)	12.6976	12.7035	12.7035	12.7035
M, (1/n)	18.961	18.963	19.037	19.107
MW, MOL WT	18.961	18.963	19.037	19.107
(dLV/dLP)t	-1.00385	-1.00381	-1.00183	-1.00000
(dLV/dLT)p	1.0773	1.0766	1.0401	1.0000
Cp, KJ/(KG)(K)	2.8993	2.8943	2.5747	2.1136
GAMMAS	1.2073	1.2074	1.2220	1.2593
SON VEL,M/SEC	1232.4	1231.0	1177.9	858.0
MACH NUMBER	0.000	0.150	1.000	3.069

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.87237 0.87088 0.81273 0.51355

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.8993	2.8943	2.5747	2.1136
CONDUCTIVITY	6.3240	6.2967	4.7496	1.9372
PRANDTL NUMBER	0.4000	0.4003	0.4406	0.5603

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1993	2.1986	2.1718	1.9595
CONDUCTIVITY	3.4572	3.4498	3.1588	1.8258
PRANDTL NUMBER	0.5549	0.5550	0.5588	0.5512

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3630
CSTAR, M/SEC	1721.6	1721.6	1721.6
CF	0.1073	0.6842	1.5294

Ivac, M/SEC	6978.1	2141.9	2854.9
Isp, M/SEC	184.7	1177.9	2632.9

MASS FRACTIONS

*CO	0.67686	0.67676	0.67242	0.60429
*CO2	0.10274	0.10290	0.10973	0.21679
*H	0.00066	0.00065	0.00033	0.00000
HCO	0.00002	0.00001	0.00001	0.00000
*H2	0.03038	0.03039	0.03093	0.03610
H2O	0.18678	0.18676	0.18562	0.14281
*O	0.00006	0.00006	0.00001	0.00000
*OH	0.00247	0.00243	0.00094	0.00000
*O2	0.00003	0.00003	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013368
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0273	1.8121	50.000
P, BAR	30.398	29.591	16.774	0.60795
T, K	2881.67	2874.73	2605.10	1342.45
RHO, KG/CU M	2.4083 0	2.3502 0	1.4752 0	1.0407-1
H, KJ/KG	-910.41	-927.57	-1607.32	-4378.18
U, KJ/KG	-2172.61	-2186.64	-2744.42	-4962.36
G, KJ/KG	-36988.8	-36935.7	-34238.2	-21193.4
S, KJ/(KG)(K)	12.5200	12.5258	12.5258	12.5258
M, (1/n)	18.982	18.984	19.049	19.107
MW, MOL WT	18.982	18.984	19.049	19.107
(dLV/dLP)t	-1.00328	-1.00325	-1.00153	-1.00001
(dLV/dLT)p	1.0656	1.0651	1.0334	1.0001
Cp, KJ/(KG)(K)	2.7933	2.7889	2.5099	2.1138
GAMMAS	1.2118	1.2120	1.2258	1.2593
SON VEL,M/SEC	1236.7	1235.3	1180.6	857.7

MACH NUMBER 0.000 0.150 1.000 3.070

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.87513 0.87360 0.81391 0.51334

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.7933	2.7889	2.5099	2.1138
CONDUCTIVITY	5.9043	5.8793	4.4920	1.9365
PRANDTL NUMBER	0.4140	0.4144	0.4548	0.5604

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2002	2.1996	2.1722	1.9594
CONDUCTIVITY	3.4670	3.4594	3.1625	1.8250
PRANDTL NUMBER	0.5554	0.5555	0.5590	0.5511

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3547
CSTAR, M/SEC	1722.3	1722.3	1722.3
CF	0.1076	0.6855	1.5291
Ivac, M/SEC	6981.4	2143.8	2855.4
Isp, M/SEC	185.3	1180.6	2633.5

MASS FRACTIONS

*CO	0.67705	0.67695	0.67255	0.60418
*CO2	0.10244	0.10260	0.10953	0.21696
*H	0.00056	0.00055	0.00027	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.03044	0.03045	0.03097	0.03611
H2O	0.18729	0.18726	0.18586	0.14274
*O	0.00004	0.00004	0.00001	0.00000
*OH	0.00213	0.00210	0.00079	0.00000
*O2	0.00002	0.00002	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013389

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0273	1.8136	50.000
P, BAR	40.530	39.453	22.348	0.81060
T, K	2889.82	2882.78	2608.40	1341.97
RHO, KG/CU M	3.2043 0	3.1270 0	1.9636 0	1.3881-1
H, KJ/KG	-910.41	-927.63	-1609.33	-4379.21
U, KJ/KG	-2175.27	-2189.33	-2747.44	-4963.19
G, KJ/KG	-36726.8	-36673.5	-33953.0	-21019.4
S, KJ/(KG)(K)	12.3940	12.3998	12.3998	12.3998
M, (1/n)	18.996	18.997	19.056	19.107
MW, MOL WT	18.996	18.997	19.056	19.107
(dLV/dLP)t	-1.00293	-1.00289	-1.00135	-1.00001
(dLV/dLT)p	1.0583	1.0578	1.0293	1.0001
Cp, KJ/(KG)(K)	2.7269	2.7228	2.4701	2.1141
GAMMAS	1.2148	1.2150	1.2282	1.2593
SON VEL,M/SEC	1239.6	1238.1	1182.3	857.5
MACH NUMBER	0.000	0.150	1.000	3.072

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.87688	0.87533	0.81463	0.51322
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.7269	2.7228	2.4701	2.1141
CONDUCTIVITY	5.6390	5.6155	4.3332	1.9362
PRANDTL NUMBER	0.4240	0.4244	0.4644	0.5604

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2008	2.2002	2.1725	1.9592
CONDUCTIVITY	3.4731	3.4655	3.1648	1.8245
PRANDTL NUMBER	0.5557	0.5557	0.5592	0.5511

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3497
CSTAR, M/SEC	1722.8	1722.8	1722.8
CF	0.1077	0.6863	1.5289
Ivac, M/SEC	6983.4	2144.9	2855.6
Isp, M/SEC	185.6	1182.3	2633.9

MASS FRACTIONS

*CO	0.67716	0.67706	0.67262	0.60412
*CO2	0.10225	0.10241	0.10941	0.21706
*H	0.00050	0.00049	0.00024	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.03048	0.03049	0.03099	0.03612
H2O	0.18761	0.18758	0.18602	0.14270
*O	0.00003	0.00003	0.00001	0.00000
*OH	0.00191	0.00188	0.00070	0.00000
*O2	0.00002	0.00002	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013405

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0273	1.8147	50.000
P, BAR	50.663	49.314	27.918	1.0132
T, K	2895.63	2888.51	2610.69	1341.64
RHO, KG/CU M	3.9994 0	3.9028 0	2.4515 0	1.7355-1
H, KJ/KG	-910.41	-927.68	-1610.74	-4379.93
U, KJ/KG	-2177.17	-2191.25	-2749.57	-4963.76
G, KJ/KG	-36516.1	-36462.6	-33727.9	-20885.1
S, KJ/(KG)(K)	12.2963	12.3022	12.3022	12.3022
M, (1/n)	19.006	19.007	19.061	19.107
MW, MOL WT	19.006	19.007	19.061	19.107
(dLV/dLP)t	-1.00267	-1.00264	-1.00122	-1.00002
(dLV/dLT)p	1.0530	1.0526	1.0264	1.0002
Cp, KJ/(KG)(K)	2.6800	2.6762	2.4425	2.1145
GAMMAS	1.2171	1.2172	1.2299	1.2592
SON VEL,M/SEC	1241.7	1240.2	1183.5	857.4
MACH NUMBER	0.000	0.150	1.000	3.072

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.87812 0.87656 0.81513 0.51313

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.6800	2.6762	2.4425	2.1145
CONDUCTIVITY	5.4506	5.4282	4.2225	1.9360
PRANDTL NUMBER	0.4318	0.4322	0.4715	0.5604

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2013	2.2006	2.1727	1.9592
CONDUCTIVITY	3.4775	3.4698	3.1664	1.8242

PRANDTL NUMBER 0.5559 0.5559 0.5593 0.5511

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3463
CSTAR, M/SEC	1723.1	1723.1	1723.1
CF	0.1079	0.6869	1.5288
Ivac, M/SEC	6984.7	2145.8	2855.8
Isp, M/SEC	185.9	1183.5	2634.2

MASS FRACTIONS

*CO	0.67724	0.67714	0.67268	0.60407
*CO2	0.10212	0.10228	0.10932	0.21714
*H	0.00045	0.00045	0.00022	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.03051	0.03052	0.03100	0.03612
H2O	0.18785	0.18781	0.18612	0.14267
*O	0.00003	0.00003	0.00000	0.00000
*OH	0.00175	0.00172	0.00063	0.00000
*O2	0.00002	0.00001	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013417

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0274	1.8155	50.000
P, BAR	60.795	59.176	33.487	1.2159
T, K	2900.06	2892.88	2612.41	1341.40
RHO, KG/CU M	4.7938 0	4.6780 0	2.9391 0	2.0830-1
H, KJ/KG	-910.41	-927.71	-1611.82	-4380.47
U, KJ/KG	-2178.61	-2192.70	-2751.17	-4964.19
G, KJ/KG	-36339.3	-36285.8	-33541.8	-20775.6
S, KJ/(KG)(K)	12.2166	12.2224	12.2224	12.2224

M, (1/n)	19.013	19.014	19.064	19.107
MW, MOL WT	19.013	19.014	19.064	19.107
(dLV/dLP)t	-1.00248	-1.00245	-1.00112	-1.00002
(dLV/dLT)p	1.0491	1.0486	1.0243	1.0003
Cp, KJ/(KG)(K)	2.6445	2.6409	2.4218	2.1149
GAMMAS	1.2188	1.2189	1.2313	1.2592
SON VEL,M/SEC	1243.2	1241.8	1184.4	857.3
MACH NUMBER	0.000	0.150	1.000	3.073

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.87907	0.87750	0.81551	0.51307
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.6445	2.6409	2.4218	2.1149
CONDUCTIVITY	5.3075	5.2859	4.1395	1.9360
PRANDTL NUMBER	0.4380	0.4384	0.4771	0.5605

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2016	2.2010	2.1728	1.9591
CONDUCTIVITY	3.4809	3.4731	3.1676	1.8240
PRANDTL NUMBER	0.5560	0.5561	0.5594	0.5511

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3437
CSTAR, M/SEC	1723.3	1723.3	1723.3
CF	0.1080	0.6873	1.5287
Ivac, M/SEC	6985.6	2146.4	2856.0
Isp, M/SEC	186.0	1184.4	2634.4

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00001
*CO	0.67730	0.67720	0.67271	0.60403
*CO2	0.10202	0.10217	0.10926	0.21719
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00042	0.00042	0.00020	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.03053	0.03054	0.03101	0.03612
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00000	0.00000	0.00000
H2O	0.18802	0.18799	0.18620	0.14265
*O	0.00002	0.00002	0.00000	0.00000
*OH	0.00163	0.00160	0.00058	0.00000
*O2	0.00001	0.00001	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013427

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0274	1.8161	50.000
P, BAR	70.927	69.037	39.054	1.4185
T, K	2903.59	2896.37	2613.76	1341.21
RHO, KG/CU M	5.5877 0	5.4526 0	3.4265 0	2.4305-1
H, KJ/KG	-910.41	-927.74	-1612.68	-4380.90
U, KJ/KG	-2179.75	-2193.86	-2752.44	-4964.54
G, KJ/KG	-36186.7	-36133.2	-33383.0	-20683.4
S, KJ/(KG)(K)	12.1492	12.1550	12.1550	12.1550
M, (1/n)	19.019	19.020	19.067	19.107
MW, MOL WT	19.019	19.020	19.067	19.107
(dLV/dLP)t	-1.00232	-1.00230	-1.00104	-1.00003
(dLV/dLT)p	1.0459	1.0455	1.0226	1.0004
Cp, KJ/(KG)(K)	2.6164	2.6130	2.4056	2.1153
GAMMAS	1.2202	1.2204	1.2323	1.2592
SON VEL,M/SEC	1244.5	1243.0	1185.1	857.3
MACH NUMBER	0.000	0.150	1.000	3.073

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.87983 0.87825 0.81580 0.51302

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.6164	2.6130	2.4056	2.1153
CONDUCTIVITY	5.1937	5.1729	4.0742	1.9361
PRANDTL NUMBER	0.4432	0.4436	0.4817	0.5605

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2019	2.2012	2.1729	1.9591
CONDUCTIVITY	3.4835	3.4757	3.1685	1.8238
PRANDTL NUMBER	0.5561	0.5562	0.5595	0.5511

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3417
CSTAR, M/SEC	1723.5	1723.5	1723.5
CF	0.1080	0.6877	1.5287
Ivac, M/SEC	6986.4	2146.8	2856.1
Isp, M/SEC	186.2	1185.1	2634.6

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00001
*CO	0.67735	0.67725	0.67274	0.60400
*CO2	0.10194	0.10209	0.10921	0.21723
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00039	0.00039	0.00019	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.03054	0.03055	0.03102	0.03612
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.18817	0.18813	0.18626	0.14264
*O	0.00002	0.00002	0.00000	0.00000
*OH	0.00153	0.00150	0.00054	0.00000
*O2	0.00001	0.00001	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013435

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0274	1.8167	50.000
P, BAR	81.060	78.898	44.620	1.6212
T, K	2906.50	2899.23	2614.85	1341.06
RHO, KG/CU M	6.3812 0	6.2269 0	3.9137 0	2.7781-1
H, KJ/KG	-910.41	-927.76	-1613.38	-4381.25
U, KJ/KG	-2180.70	-2194.82	-2753.47	-4964.81
G, KJ/KG	-36052.4	-35998.8	-33244.4	-20603.6
S, KJ/(KG)(K)	12.0908	12.0967	12.0967	12.0967
M, (1/n)	19.024	19.025	19.070	19.107
MW, MOL WT	19.024	19.025	19.070	19.107
(dLV/dLP)t	-1.00220	-1.00217	-1.00098	-1.00004
(dLV/dLT)p	1.0433	1.0429	1.0212	1.0005
Cp, KJ/(KG)(K)	2.5934	2.5901	2.3924	2.1159
GAMMAS	1.2214	1.2215	1.2332	1.2592
SON VEL,M/SEC	1245.6	1244.1	1185.7	857.2
MACH NUMBER	0.000	0.150	1.000	3.074

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.88045 0.87886 0.81604 0.51298

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.5934	2.5901	2.3924	2.1159
CONDUCTIVITY	5.1002	5.0800	4.0211	1.9363
PRANDTL NUMBER	0.4477	0.4481	0.4855	0.5606

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2021	2.2014	2.1730	1.9590
CONDUCTIVITY	3.4857	3.4779	3.1692	1.8236
PRANDTL NUMBER	0.5562	0.5563	0.5595	0.5511

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3402
CSTAR, M/SEC	1723.6	1723.6	1723.6
CF	0.1081	0.6879	1.5286
Ivac, M/SEC	6987.0	2147.2	2856.2
Isp, M/SEC	186.3	1185.7	2634.7

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00001
*CO	0.67739	0.67729	0.67277	0.60397
*CO2	0.10187	0.10203	0.10917	0.21727
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00037	0.00037	0.00018	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.03056	0.03057	0.03103	0.03612
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.18828	0.18824	0.18632	0.14263
*O	0.00002	0.00002	0.00000	0.00000
*OH	0.00145	0.00142	0.00051	0.00000
*O2	0.00001	0.00001	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013441

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0274	1.8171	50.000
P, BAR	91.192	88.760	50.186	1.8238
T, K	2908.94	2901.64	2615.77	1340.94
RHO, KG/CU M	7.1744 0	7.0009 0	4.4008 0	3.1256-1
H, KJ/KG	-910.41	-927.78	-1613.97	-4381.54
U, KJ/KG	-2181.49	-2195.62	-2754.34	-4965.05
G, KJ/KG	-35932.2	-35878.6	-33121.4	-20533.5
S, KJ/(KG)(K)	12.0394	12.0452	12.0452	12.0452
M, (1/n)	19.028	19.029	19.072	19.107
MW, MOL WT	19.028	19.029	19.072	19.107
(dLV/dLP)t	-1.00209	-1.00207	-1.00093	-1.00006
(dLV/dLT)p	1.0411	1.0407	1.0201	1.0006
Cp, KJ/(KG)(K)	2.5741	2.5710	2.3814	2.1165
GAMMAS	1.2224	1.2225	1.2339	1.2591
SON VEL,M/SEC	1246.5	1245.0	1186.2	857.2
MACH NUMBER	0.000	0.150	1.000	3.074

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.88098	0.87938	0.81624	0.51295
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.5741	2.5710	2.3814	2.1165
CONDUCTIVITY	5.0217	5.0020	3.9767	1.9365
PRANDTL NUMBER	0.4516	0.4520	0.4888	0.5606

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2023	2.2016	2.1731	1.9590
CONDUCTIVITY	3.4876	3.4797	3.1699	1.8235
PRANDTL NUMBER	0.5563	0.5564	0.5596	0.5511

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3388
CSTAR, M/SEC	1723.7	1723.7	1723.7
CF	0.1081	0.6882	1.5286
Ivac, M/SEC	6987.5	2147.6	2856.3
Isp, M/SEC	186.4	1186.2	2634.8

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00001
*CO	0.67742	0.67732	0.67279	0.60395
*CO2	0.10182	0.10197	0.10914	0.21730
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00035	0.00035	0.00017	0.00000
HCO	0.00004	0.00003	0.00001	0.00000
*H2	0.03057	0.03058	0.03104	0.03612
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
HC00H	0.00001	0.00001	0.00000	0.00000

H2O	0.18838	0.18834	0.18636	0.14262
*O	0.00002	0.00002	0.00000	0.00000
*OH	0.00138	0.00136	0.00048	0.00000
*O2	0.00001	0.00001	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013447

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.70000 %FUEL= 37.037037 R,EQ.RATIO= 2.003333 PHI,EQ.RATIO= 2.003333

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0274	1.8175	50.000
P, BAR	101.33	98.621	55.750	2.0265
T, K	2911.04	2903.71	2616.54	1340.85
RHO, KG/CU M	7.9673 0	7.7746 0	4.8878 0	3.4732-1
H, KJ/KG	-910.41	-927.80	-1614.47	-4381.79
U, KJ/KG	-2182.17	-2196.30	-2755.08	-4965.25
G, KJ/KG	-35823.5	-35769.9	-33010.8	-20470.8
S, KJ/(KG)(K)	11.9933	11.9992	11.9992	11.9992
M, (1/n)	19.032	19.033	19.073	19.107
MW, MOL WT	19.032	19.033	19.073	19.107
(dLV/dLP)t	-1.00200	-1.00198	-1.00089	-1.00007
(dLV/dLT)p	1.0393	1.0389	1.0191	1.0008
Cp, KJ/(KG)(K)	2.5576	2.5546	2.3720	2.1172
GAMMAS	1.2232	1.2234	1.2345	1.2591
SON VEL,M/SEC	1247.3	1245.7	1186.6	857.1
MACH NUMBER	0.000	0.150	1.000	3.074

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.88143 0.87982 0.81641 0.51292

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.5576	2.5546	2.3720	2.1172
CONDUCTIVITY	4.9543	4.9351	3.9390	1.9368

PRANDTL NUMBER 0.4550 0.4554 0.4916 0.5607

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.2024	2.2018	2.1731	1.9590
CONDUCTIVITY	3.4891	3.4813	3.1704	1.8234
PRANDTL NUMBER	0.5564	0.5565	0.5596	0.5511

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.3377
CSTAR, M/SEC	1723.8	1723.8	1723.8
CF	0.1082	0.6884	1.5286
Ivac, M/SEC	6987.9	2147.9	2856.3
Isp, M/SEC	186.5	1186.6	2634.9

MASS FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00001
*CO	0.67744	0.67734	0.67280	0.60393
*CO2	0.10177	0.10193	0.10911	0.21732
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00034	0.00033	0.00016	0.00000
HCO	0.00004	0.00004	0.00001	0.00000
*H2	0.03058	0.03059	0.03104	0.03612
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.18847	0.18842	0.18639	0.14261
*O	0.00002	0.00002	0.00000	0.00000
*OH	0.00132	0.00130	0.00046	0.00000
*O2	0.00001	0.00001	0.00000	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013119
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7920	50.000
P, BAR	10.133	9.8686	5.6542	0.20265
T, K	2981.19	2974.90	2743.23	1476.76
RHO, KG/CU M	7.9708-1	7.7805-1	4.8673-1	3.2702-2
H, KJ/KG	-892.38	-909.34	-1585.89	-4489.79
U, KJ/KG	-2163.58	-2177.70	-2747.56	-5109.47
G, KJ/KG	-39290.7	-39243.2	-36934.5	-23518.9
S, KJ/(KG)(K)	12.8802	12.8858	12.8858	12.8858

M, (1/n)	19.499	19.501	19.634	19.814
MW, MOL WT	19.499	19.501	19.634	19.814
(dLV/dLP)t	-1.00817	-1.00811	-1.00460	-1.00000
(dLV/dLT)p	1.1609	1.1599	1.0973	1.0002
Cp, KJ/(KG)(K)	3.5555	3.5491	3.0518	2.0849
GAMMAS	1.1813	1.1814	1.1940	1.2521
SON VEL,M/SEC	1225.4	1224.1	1177.7	880.8
MACH NUMBER	0.000	0.150	1.000	3.045

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.90695	0.90556	0.85414	0.55355
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.5555	3.5491	3.0518	2.0849
CONDUCTIVITY	8.7958	8.7655	6.6779	2.0025
PRANDTL NUMBER	0.3666	0.3667	0.3903	0.5763

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1784	2.1779	2.1561	1.9599
CONDUCTIVITY	3.4795	3.4727	3.2166	1.8982
PRANDTL NUMBER	0.5678	0.5679	0.5725	0.5715

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.5350
CSTAR, M/SEC	1744.7	1744.7	1744.7
CF	0.1056	0.6750	1.5374
Ivac, M/SEC	7070.4	2164.1	2913.3
Isp, M/SEC	184.2	1177.7	2682.3

MASS FRACTIONS

*CO	0.63780	0.63769	0.63352	0.57313
*CO2	0.12248	0.12264	0.12921	0.22410
*H	0.00121	0.00120	0.00073	0.00000
HCO	0.00001	0.00001	0.00001	0.00000
*H2	0.02560	0.02561	0.02614	0.03100
H2O	0.20586	0.20588	0.20706	0.17176
*O	0.00032	0.00032	0.00010	0.00000
*OH	0.00649	0.00642	0.00317	0.00000
*O2	0.00023	0.00023	0.00007	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013187

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0269	1.7974	50.000
P, BAR	20.265	19.734	11.275	0.40530
T, K	3018.42	3011.80	2763.54	1473.81
RHO, KG/CU M	1.5797 0	1.5419 0	9.6550-1	6.5535-2
H, KJ/KG	-892.38	-909.58	-1594.51	-4495.98
U, KJ/KG	-2175.23	-2189.49	-2762.25	-5114.42
G, KJ/KG	-38879.6	-38830.3	-36389.5	-23052.3
S, KJ/(KG)(K)	12.5851	12.5907	12.5907	12.5907
M, (1/n)	19.563	19.565	19.677	19.814
MW, MOL WT	19.563	19.565	19.677	19.814
(dLV/dLP)t	-1.00648	-1.00643	-1.00351	-1.00000
(dLV/dLT)p	1.1261	1.1253	1.0737	1.0001
Cp, KJ/(KG)(K)	3.2472	3.2418	2.8330	2.0843
GAMMAS	1.1898	1.1899	1.2025	1.2521
SON VEL,M/SEC	1235.4	1234.1	1185.0	880.0
MACH NUMBER	0.000	0.150	1.000	3.051

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.91499 0.91354 0.85859 0.55279

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.2472	3.2418	2.8330	2.0843
CONDUCTIVITY	7.6850	7.6579	5.8601	1.9978
PRANDTL NUMBER	0.3866	0.3867	0.4151	0.5767

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1811	2.1805	2.1576	1.9592
CONDUCTIVITY	3.5069	3.4999	3.2306	1.8953
PRANDTL NUMBER	0.5691	0.5692	0.5734	0.5714

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.5030
CSTAR, M/SEC	1748.2	1748.2	1748.2
CF	0.1061	0.6779	1.5357

Ivac, M/SEC	7084.9	2170.4	2915.0
Isp, M/SEC	185.5	1185.0	2684.6

MASS FRACTIONS

*CO	0.63824	0.63814	0.63391	0.57280
*CO2	0.12176	0.12192	0.12859	0.22462
*H	0.00096	0.00095	0.00056	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.02572	0.02573	0.02623	0.03103
H2O	0.20762	0.20762	0.20814	0.17155
*O	0.00021	0.00021	0.00006	0.00000
*OH	0.00532	0.00525	0.00247	0.00000
*O2	0.00015	0.00015	0.00004	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013225
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0270	1.8003	50.000
P, BAR	30.398	29.599	16.885	0.60795
T, K	3037.68	3030.88	2773.45	1472.39
RHO, KG/CU M	2.3585 0	2.3019 0	1.4423 0	9.8398-2
H, KJ/KG	-892.38	-909.71	-1598.97	-4498.96
U, KJ/KG	-2181.22	-2195.55	-2769.65	-5116.81
G, KJ/KG	-38599.1	-38548.8	-36041.2	-22783.9
S, KJ/(KG)(K)	12.4130	12.4185	12.4185	12.4185
M, (1/n)	19.596	19.598	19.698	19.814
MW, MOL WT	19.596	19.598	19.698	19.814
(dLV/dLP)t	-1.00561	-1.00557	-1.00297	-1.00000
(dLV/dLT)p	1.1085	1.1078	1.0622	1.0001
Cp, KJ/(KG)(K)	3.0941	3.0893	2.7279	2.0841
GAMMAs	1.1946	1.1947	1.2071	1.2522
SON VEL,M/SEC	1240.8	1239.4	1188.8	879.6

MACH NUMBER	0.000	0.150	1.000	3.053
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TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.91914	0.91765	0.86076	0.55243
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.0941	3.0893	2.7279	2.0841
CONDUCTIVITY	7.1207	7.0954	5.4610	1.9957
PRANDTL NUMBER	0.3994	0.3995	0.4300	0.5769

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1824	2.1819	2.1584	1.9589
CONDUCTIVITY	3.5210	3.5138	3.2374	1.8939
PRANDTL NUMBER	0.5697	0.5698	0.5739	0.5714

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4879
CSTAR, M/SEC	1749.8	1749.8	1749.8
CF	0.1064	0.6794	1.5349
Ivac, M/SEC	7091.6	2173.6	2915.8
Isp, M/SEC	186.2	1188.8	2685.7

MASS FRACTIONS

*CO	0.63846	0.63836	0.63410	0.57264
*CO2	0.12141	0.12157	0.12828	0.22488
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00083	0.00082	0.00047	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.02578	0.02579	0.02628	0.03104
H2O	0.20854	0.20854	0.20867	0.17144
*O	0.00016	0.00016	0.00004	0.00000
*OH	0.00468	0.00462	0.00211	0.00000
*O2	0.00011	0.00011	0.00003	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013250

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0270	1.8022	50.000
P, BAR	40.530	39.464	22.489	0.81060
T, K	3050.21	3043.28	2779.66	1471.50
RHO, KG/CU M	3.1352 0	3.0600 0	1.9180 0	1.3128-1
H, KJ/KG	-892.38	-909.80	-1601.86	-4500.83
U, KJ/KG	-2185.10	-2199.48	-2774.38	-5118.31
G, KJ/KG	-38382.4	-38331.7	-35782.2	-22595.2
S, KJ/(KG)(K)	12.2910	12.2966	12.2966	12.2966
M, (1/n)	19.618	19.620	19.711	19.814
MW, MOL WT	19.618	19.620	19.711	19.814
(dLV/dLP)t	-1.00505	-1.00500	-1.00264	-1.00000
(dLV/dLT)p	1.0971	1.0965	1.0549	1.0001
Cp, KJ/(KG)(K)	2.9968	2.9923	2.6625	2.0840
GAMMAS	1.1979	1.1980	1.2102	1.2522
SON VEL,M/SEC	1244.4	1243.0	1191.2	879.3
MACH NUMBER	0.000	0.150	1.000	3.055

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.92184	0.92032	0.86212	0.55220
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.9968	2.9923	2.6625	2.0840
CONDUCTIVITY	6.7574	6.7334	5.2104	1.9944
PRANDTL NUMBER	0.4088	0.4090	0.4405	0.5770

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1833	2.1827	2.1589	1.9587
CONDUCTIVITY	3.5301	3.5229	3.2416	1.8930
PRANDTL NUMBER	0.5701	0.5702	0.5742	0.5714

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4785
CSTAR, M/SEC	1750.7	1750.7	1750.7
CF	0.1066	0.6804	1.5345
Ivac, M/SEC	7095.8	2175.5	2916.3
Isp, M/SEC	186.7	1191.2	2686.4

MASS FRACTIONS

*CO	0.63860	0.63850	0.63422	0.57253
*CO2	0.12118	0.12134	0.12810	0.22504
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00074	0.00074	0.00042	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.02583	0.02583	0.02631	0.03105
H2O	0.20914	0.20913	0.20900	0.17138
*O	0.00013	0.00013	0.00003	0.00000
*OH	0.00425	0.00420	0.00188	0.00000
*O2	0.00009	0.00009	0.00002	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013269

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0271	1.8036	50.000
P, BAR	50.663	49.328	28.090	1.0132
T, K	3059.28	3052.25	2784.05	1470.88
RHO, KG/CU M	3.9106 0	3.8166 0	2.3930 0	1.6417-1
H, KJ/KG	-892.38	-909.86	-1603.95	-4502.15
U, KJ/KG	-2187.91	-2202.31	-2777.76	-5119.36
G, KJ/KG	-38204.7	-38153.6	-35575.0	-22449.8
S, KJ/(KG)(K)	12.1964	12.2020	12.2020	12.2020
M, (1/n)	19.634	19.636	19.720	19.814
MW, MOL WT	19.634	19.636	19.720	19.814
(dLV/dLP)t	-1.00464	-1.00460	-1.00240	-1.00000
(dLV/dLT)p	1.0890	1.0884	1.0499	1.0001
Cp, KJ/(KG)(K)	2.9275	2.9233	2.6166	2.0839
GAMMAS	1.2003	1.2005	1.2124	1.2522
SON VEL,M/SEC	1247.0	1245.6	1193.0	879.1
MACH NUMBER	0.000	0.150	1.000	3.056

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.92379 0.92225 0.86307 0.55203

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.9275	2.9233	2.6166	2.0839
CONDUCTIVITY	6.4961	6.4732	5.0334	1.9935
PRANDTL NUMBER	0.4163	0.4165	0.4487	0.5771

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1839	2.1834	2.1592	1.9586
CONDUCTIVITY	3.5367	3.5294	3.2445	1.8924
PRANDTL NUMBER	0.5704	0.5705	0.5744	0.5713

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4720
CSTAR, M/SEC	1751.4	1751.4	1751.4
CF	0.1068	0.6811	1.5342
Ivac, M/SEC	7098.6	2176.9	2916.6
Isp, M/SEC	187.0	1193.0	2686.9

MASS FRACTIONS

*CO	0.63869	0.63859	0.63430	0.57246
*CO2	0.12102	0.12118	0.12797	0.22515
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00068	0.00068	0.00038	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.02586	0.02586	0.02633	0.03105
H2O	0.20957	0.20957	0.20924	0.17133
*O	0.00011	0.00011	0.00003	0.00000
*OH	0.00393	0.00388	0.00172	0.00000
*O2	0.00008	0.00008	0.00002	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013283
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0271	1.8047	50.000
P, BAR	60.795	59.192	33.688	1.2159
T, K	3066.27	3059.17	2787.36	1470.40
RHO, KG/CU M	4.6849 0	4.5723 0	2.8676 0	1.9706-1
H, KJ/KG	-892.38	-909.91	-1605.56	-4503.14
U, KJ/KG	-2190.06	-2204.49	-2780.34	-5120.15

G, KJ/KG	-38053.3	-38001.9	-35401.9	-22331.6
S, KJ/(KG)(K)	12.1193	12.1248	12.1248	12.1248
M, (1/n)	19.646	19.648	19.728	19.814
MW, MOL WT	19.646	19.648	19.728	19.814
(dLV/dLP)t	-1.00433	-1.00429	-1.00222	-1.00000
(dLV/dLT)p	1.0827	1.0821	1.0460	1.0001
Cp, KJ/(KG)(K)	2.8747	2.8707	2.5820	2.0839
GAMMAS	1.2023	1.2024	1.2142	1.2522
SON VEL,M/SEC	1249.1	1247.6	1194.3	879.0
MACH NUMBER	0.000	0.150	1.000	3.057

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.92529	0.92374	0.86380	0.55191
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.8747	2.8707	2.5820	2.0839
CONDUCTIVITY	6.2957	6.2735	4.8995	1.9929
PRANDTL NUMBER	0.4225	0.4227	0.4552	0.5771

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1844	2.1838	2.1595	1.9584
CONDUCTIVITY	3.5418	3.5344	3.2468	1.8920
PRANDTL NUMBER	0.5707	0.5708	0.5745	0.5713

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4671
CSTAR, M/SEC	1751.9	1751.9	1751.9
CF	0.1069	0.6817	1.5339
Ivac, M/SEC	7100.7	2178.0	2916.9
Isp, M/SEC	187.3	1194.3	2687.3

MASS FRACTIONS

*CO	0.63877	0.63867	0.63436	0.57241
*CO2	0.12090	0.12106	0.12787	0.22524
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00064	0.00063	0.00035	0.00000
HCO	0.00004	0.00003	0.00001	0.00000
*H2	0.02588	0.02589	0.02635	0.03106
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.20991	0.20990	0.20942	0.17130
*O	0.00010	0.00009	0.00002	0.00000
*OH	0.00369	0.00364	0.00159	0.00000
*O2	0.00007	0.00007	0.00002	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013295

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0271	1.8055	50.000
P, BAR	70.927	69.055	39.283	1.4185
T, K	3071.90	3064.74	2789.98	1470.03
RHO, KG/CU M	5.4584 0	5.3271 0	3.3417 0	2.2996-1
H, KJ/KG	-892.38	-909.95	-1606.85	-4503.93
U, KJ/KG	-2191.79	-2206.24	-2782.40	-5120.78
G, KJ/KG	-37921.2	-37869.6	-35253.0	-22231.9
S, KJ/(KG)(K)	12.0540	12.0596	12.0596	12.0596
M, (1/n)	19.656	19.657	19.733	19.814
MW, MOL WT	19.656	19.657	19.733	19.814
(dLV/dLP)t	-1.00408	-1.00404	-1.00207	-1.00000
(dLV/dLT)p	1.0777	1.0772	1.0430	1.0001
Cp, KJ/(KG)(K)	2.8325	2.8287	2.5547	2.0838
GAMMAS	1.2039	1.2040	1.2156	1.2522
SON VEL,M/SEC	1250.8	1249.3	1195.4	878.9
MACH NUMBER	0.000	0.150	1.000	3.058

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.92649 0.92493 0.86437 0.55182

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.8325	2.8287	2.5547	2.0838
CONDUCTIVITY	6.1350	6.1135	4.7934	1.9924
PRANDTL NUMBER	0.4278	0.4280	0.4607	0.5772

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1848	2.1842	2.1597	1.9584
CONDUCTIVITY	3.5459	3.5384	3.2485	1.8916
PRANDTL NUMBER	0.5709	0.5709	0.5746	0.5713

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4633
CSTAR, M/SEC	1752.3	1752.3	1752.3
CF	0.1070	0.6822	1.5338
Ivac, M/SEC	7102.3	2178.8	2917.1
Isp, M/SEC	187.5	1195.4	2687.6

MASS FRACTIONS

*CO	0.63882	0.63872	0.63441	0.57236
*CO2	0.12080	0.12096	0.12779	0.22530
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00060	0.00060	0.00033	0.00000
HCO	0.00004	0.00004	0.00002	0.00000
*H2	0.02590	0.02591	0.02636	0.03106
HCHO, formaldehy	0.00001	0.00000	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.21018	0.21017	0.20957	0.17127
*O	0.00009	0.00008	0.00002	0.00000
*OH	0.00349	0.00344	0.00149	0.00000
*O2	0.00006	0.00006	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013305

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0271	1.8063	50.000
P, BAR	81.060	78.919	44.877	1.6212
T, K	3076.56	3069.35	2792.13	1469.73
RHO, KG/CU M	6.2313 0	6.0814 0	3.8155 0	2.6287-1
H, KJ/KG	-892.38	-909.98	-1607.92	-4504.57
U, KJ/KG	-2193.22	-2207.69	-2784.10	-5121.30
G, KJ/KG	-37803.6	-37751.9	-35122.3	-22145.9
S, KJ/(KG)(K)	11.9976	12.0032	12.0032	12.0032
M, (1/n)	19.664	19.666	19.738	19.814
MW, MOL WT	19.664	19.666	19.738	19.814
(dLV/dLP)t	-1.00387	-1.00383	-1.00195	-1.00001
(dLV/dLT)p	1.0736	1.0730	1.0405	1.0001
Cp, KJ/(KG)(K)	2.7979	2.7942	2.5324	2.0839
GAMMAS	1.2053	1.2054	1.2167	1.2522
SON VEL,M/SEC	1252.1	1250.7	1196.3	878.8
MACH NUMBER	0.000	0.150	1.000	3.059

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.92749 0.92592 0.86484 0.55174

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.7979	2.7942	2.5324	2.0839
CONDUCTIVITY	6.0022	5.9812	4.7065	1.9920
PRANDTL NUMBER	0.4323	0.4326	0.4653	0.5772

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1851	2.1845	2.1598	1.9583
CONDUCTIVITY	3.5492	3.5418	3.2500	1.8913
PRANDTL NUMBER	0.5710	0.5711	0.5747	0.5713

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4601
CSTAR, M/SEC	1752.6	1752.6	1752.6
CF	0.1071	0.6826	1.5336
Ivac, M/SEC	7103.7	2179.5	2917.3
Isp, M/SEC	187.6	1196.3	2687.8

MASS FRACTIONS

*CO	0.63887	0.63877	0.63444	0.57233
*CO2	0.12072	0.12088	0.12773	0.22536
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00057	0.00057	0.00031	0.00000
HCO	0.00004	0.00004	0.00002	0.00000
*H2	0.02591	0.02592	0.02637	0.03106
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.21041	0.21039	0.20968	0.17125
*O	0.00008	0.00008	0.00002	0.00000
*OH	0.00332	0.00328	0.00141	0.00000
*O2	0.00005	0.00005	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013314

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0271	1.8069	50.000
P, BAR	91.192	88.782	50.470	1.8238
T, K	3080.52	3073.27	2793.93	1469.47
RHO, KG/CU M	7.0037 0	6.8351 0	4.2891 0	2.9578-1
H, KJ/KG	-892.38	-910.01	-1608.82	-4505.11
U, KJ/KG	-2194.44	-2208.92	-2785.52	-5121.73
G, KJ/KG	-37697.7	-37645.9	-35005.7	-22070.2
S, KJ/(KG)(K)	11.9478	11.9534	11.9534	11.9534
M, (1/n)	19.671	19.672	19.742	19.814
MW, MOL WT	19.671	19.672	19.742	19.814
(dLV/dLP)t	-1.00369	-1.00366	-1.00186	-1.00001
(dLV/dLT)p	1.0701	1.0696	1.0384	1.0001
Cp, KJ/(KG)(K)	2.7687	2.7651	2.5137	2.0839
GAMMAS	1.2064	1.2066	1.2177	1.2522
SON VEL,M/SEC	1253.3	1251.9	1197.0	878.7
MACH NUMBER	0.000	0.150	1.000	3.059

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.92834	0.92676	0.86523	0.55167
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.7687	2.7651	2.5137	2.0839
CONDUCTIVITY	5.8899	5.8694	4.6336	1.9917
PRANDTL NUMBER	0.4364	0.4366	0.4694	0.5772

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1854	2.1848	2.1600	1.9582
CONDUCTIVITY	3.5521	3.5446	3.2512	1.8910
PRANDTL NUMBER	0.5712	0.5712	0.5748	0.5713

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4575
CSTAR, M/SEC	1752.9	1752.9	1752.9
CF	0.1071	0.6829	1.5335
Ivac, M/SEC	7104.8	2180.0	2917.4
Isp, M/SEC	187.8	1197.0	2688.0

MASS FRACTIONS

*CO	0.63891	0.63881	0.63448	0.57230
*CO2	0.12065	0.12081	0.12767	0.22541
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00054	0.00054	0.00029	0.00000
HCO	0.00004	0.00004	0.00002	0.00000
*H2	0.02593	0.02593	0.02638	0.03106
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.21060	0.21058	0.20978	0.17123
*O	0.00007	0.00007	0.00002	0.00000

*OH 0.00318 0.00314 0.00134 0.00000
 *O2 0.00005 0.00005 0.00001 0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013322
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.80000 %FUEL= 35.714286 R,EQ.RATIO= 1.892037 PHI,EQ.RATIO= 1.892037

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0272	1.8074	50.000
P, BAR	101.33	98.645	56.061	2.0265
T, K	3083.93	3076.64	2795.47	1469.25
RHO, KG/CU M	7.7757 0	7.5884 0	4.7624 0	3.2870-1
H, KJ/KG	-892.38	-910.03	-1609.60	-4505.57
U, KJ/KG	-2195.48	-2209.98	-2786.75	-5122.10
G, KJ/KG	-37601.2	-37549.3	-34900.4	-22002.7
S, KJ/(KG)(K)	11.9032	11.9088	11.9088	11.9088
M, (1/n)	19.677	19.678	19.745	19.814
MW, MOL WT	19.677	19.678	19.745	19.814
(dLV/dLP)t	-1.00354	-1.00350	-1.00177	-1.00001
(dLV/dLT)p	1.0671	1.0666	1.0366	1.0001
Cp, KJ/(KG)(K)	2.7436	2.7401	2.4977	2.0839
GAMMAS	1.2075	1.2076	1.2186	1.2522
SON VEL,M/SEC	1254.4	1252.9	1197.7	878.6
MACH NUMBER	0.000	0.150	1.000	3.059

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.92907 0.92748 0.86557 0.55162

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.7436	2.7401	2.4977	2.0839
CONDUCTIVITY	5.7931	5.7731	4.5712	1.9914
PRANDTL NUMBER	0.4400	0.4402	0.4730	0.5772

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1856	2.1851	2.1601	1.9582
CONDUCTIVITY	3.5546	3.5470	3.2522	1.8908
PRANDTL NUMBER	0.5713	0.5714	0.5749	0.5713

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.4553
CSTAR, M/SEC	1753.1	1753.1	1753.1
CF	0.1072	0.6832	1.5334
Ivac, M/SEC	7105.7	2180.5	2917.5
Isp, M/SEC	187.9	1197.7	2688.2

MASS FRACTIONS

*CO	0.63894	0.63884	0.63450	0.57227
*CO2	0.12060	0.12075	0.12763	0.22544
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00052	0.00052	0.00028	0.00000
HCO	0.00005	0.00005	0.00002	0.00000
*H2	0.02594	0.02595	0.02638	0.03107
HCHO, formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.21077	0.21075	0.20987	0.17121
*O	0.00006	0.00006	0.00001	0.00000
*OH	0.00305	0.00301	0.00128	0.00000
*O2	0.00005	0.00005	0.00001	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012987
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0265	1.7804	50.000
P, BAR	10.133	9.8712	5.6910	0.20265

T, K	3093.32	3087.23	2873.32	1609.75
RHO, KG/CU M	7.8955-1	7.7082-1	4.8162-1	3.1071-2
H, KJ/KG	-875.59	-892.54	-1570.41	-4584.24
U, KJ/KG	-2158.92	-2173.16	-2752.06	-5236.45
G, KJ/KG	-40335.0	-40290.8	-38238.8	-25127.3
S, KJ/(KG)(K)	12.7563	12.7617	12.7617	12.7617

M, (1/n)	20.041	20.044	20.218	20.521
MW, MOL WT	20.041	20.044	20.218	20.521
(dLV/dLP)t	-1.01234	-1.01226	-1.00767	-1.00002
(dLV/dLT)p	1.2381	1.2370	1.1577	1.0006
Cp, KJ/(KG)(K)	4.0970	4.0908	3.5031	2.0668
GAMMAS	1.1667	1.1667	1.1760	1.2442
SON VEL,M/SEC	1223.6	1222.3	1178.8	900.8
MACH NUMBER	0.000	0.151	1.000	3.023

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.94143	0.94009	0.89268	0.59351
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.0970	4.0908	3.5031	2.0668
CONDUCTIVITY	10.4457	10.4186	8.2296	2.0821
PRANDTL NUMBER	0.3692	0.3691	0.3800	0.5892

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1585	2.1580	2.1397	1.9604
CONDUCTIVITY	3.4996	3.4933	3.2607	1.9688
PRANDTL NUMBER	0.5806	0.5807	0.5858	0.5910

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7092
CSTAR, M/SEC	1761.8	1761.8	1761.8
CF	0.1045	0.6691	1.5458
Ivac, M/SEC	7138.8	2181.2	2963.0
Isp, M/SEC	184.1	1178.8	2723.5

MASS FRACTIONS

*CO	0.60032	0.60020	0.59566	0.54211
*CO2	0.14258	0.14277	0.14991	0.23405
*H	0.00153	0.00152	0.00103	0.00000
HCO	0.00001	0.00001	0.00001	0.00000
*H2	0.02156	0.02157	0.02198	0.02640
H2O	0.22100	0.22106	0.22429	0.19743
*O	0.00085	0.00084	0.00033	0.00000
*OH	0.01138	0.01128	0.00649	0.00000
*O2	0.00076	0.00075	0.00030	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013055

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0266	1.7860	50.000
P, BAR	20.265	19.740	11.347	0.40530
T, K	3142.48	3136.04	2904.30	1605.12
RHO, KG/CU M	1.5612 0	1.5240 0	9.5303-1	6.2322-2
H, KJ/KG	-875.59	-892.83	-1580.87	-4594.02
U, KJ/KG	-2173.64	-2188.06	-2771.44	-5244.36
G, KJ/KG	-40060.4	-40014.2	-37811.3	-24617.5
S, KJ/(KG)(K)	12.4694	12.4747	12.4747	12.4747
M, (1/n)	20.129	20.131	20.282	20.521
MW, MOL WT	20.129	20.131	20.282	20.521
(dLV/dLP)t	-1.01002	-1.00995	-1.00600	-1.00001
(dLV/dLT)p	1.1905	1.1896	1.1221	1.0004
Cp, KJ/(KG)(K)	3.6869	3.6815	3.1873	2.0641
GAMMAS	1.1748	1.1748	1.1848	1.2445
SON VEL,M/SEC	1234.9	1233.6	1187.7	899.6
MACH NUMBER	0.000	0.151	1.000	3.031

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.95213 0.95072 0.89951 0.59233

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.6869	3.6815	3.1873	2.0641
CONDUCTIVITY	9.1106	9.0857	7.1493	2.0691
PRANDTL NUMBER	0.3853	0.3852	0.4010	0.5909

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1618	2.1613	2.1420	1.9595
CONDUCTIVITY	3.5349	3.5284	3.2819	1.9643
PRANDTL NUMBER	0.5823	0.5824	0.5871	0.5909

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.6598
CSTAR, M/SEC	1767.3	1767.3	1767.3
CF	0.1051	0.6720	1.5431
Ivac, M/SEC	7161.6	2190.1	2965.5
Isp, M/SEC	185.7	1187.7	2727.1

MASS FRACTIONS

*CO	0.60067	0.60056	0.59609	0.54168
*CO2	0.14201	0.14218	0.14922	0.23473
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00124	0.00124	0.00081	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
*H2	0.02165	0.02166	0.02206	0.02643
H2O	0.22365	0.22369	0.22615	0.19715
*O	0.00058	0.00057	0.00021	0.00000
*OH	0.00964	0.00955	0.00525	0.00000
*O2	0.00052	0.00052	0.00019	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013094
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7891	50.000
P, BAR	30.398	29.607	16.990	0.60795
T, K	3168.70	3162.07	2920.00	1602.83
RHO, KG/CU M	2.3278 0	2.2723 0	1.4217 0	9.3617-2
H, KJ/KG	-875.59	-892.98	-1586.47	-4598.84
U, KJ/KG	-2181.43	-2195.94	-2781.53	-5248.24
G, KJ/KG	-39857.3	-39810.0	-37524.3	-24325.6
S, KJ/(KG)(K)	12.3021	12.3075	12.3075	12.3075
M, (1/n)	20.176	20.178	20.316	20.522
MW, MOL WT	20.176	20.178	20.316	20.522
(dLV/dLP)t	-1.00879	-1.00873	-1.00515	-1.00001
(dLV/dLT)p	1.1658	1.1649	1.1043	1.0003
Cp, KJ/(KG)(K)	3.4794	3.4745	3.0320	2.0629
GAMMAS	1.1795	1.1795	1.1897	1.2446
SON VEL,M/SEC	1241.1	1239.7	1192.4	899.0
MACH NUMBER	0.000	0.150	1.000	3.035

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.95781 0.95636 0.90297 0.59174

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.4794	3.4745	3.0320	2.0629
CONDUCTIVITY	8.4164	8.3928	6.6058	2.0634
PRANDTL NUMBER	0.3960	0.3959	0.4145	0.5916

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1635	2.1630	2.1431	1.9590
CONDUCTIVITY	3.5537	3.5469	3.2925	1.9620
PRANDTL NUMBER	0.5831	0.5832	0.5878	0.5908

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.6357
CSTAR, M/SEC	1770.0	1770.0	1770.0
CF	0.1054	0.6737	1.5417
Ivac, M/SEC	7172.7	2194.6	2966.8
Isp, M/SEC	186.5	1192.4	2728.8

MASS FRACTIONS

*CO	0.60084	0.60073	0.59630	0.54147
*CO2	0.14172	0.14190	0.14889	0.23507
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00109	0.00109	0.00070	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.02170	0.02171	0.02211	0.02645
H2O	0.22507	0.22511	0.22711	0.19701
*O	0.00045	0.00045	0.00015	0.00000
*OH	0.00865	0.00857	0.00458	0.00000
*O2	0.00041	0.00041	0.00014	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013121
CASE = _____

REACTANT	WT FRACTION	ENERGY	TEMP
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FUEL	RP-1	(SEE NOTE)	KJ/KG-MOL	K
OXIDANT	O2(L)	1.0000000	-24717.700	298.150
		1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0268	1.7913	50.000
P, BAR	40.530	39.474	22.626	0.81060
T, K	3186.09	3179.31	2930.08	1601.38
RHO, KG/CU M	3.0916 0	3.0178 0	1.8888 0	1.2494-1
H, KJ/KG	-875.59	-893.09	-1590.20	-4601.89
U, KJ/KG	-2186.56	-2201.13	-2788.11	-5250.70
G, KJ/KG	-39693.8	-39645.8	-37304.9	-24121.1
S, KJ/(KG)(K)	12.1836	12.1890	12.1890	12.1890
M, (1/n)	20.207	20.209	20.337	20.522
MW, MOL WT	20.207	20.209	20.337	20.522
(dLV/dLP)t	-1.00798	-1.00792	-1.00461	-1.00001
(dLV/dLT)p	1.1497	1.1489	1.0929	1.0003
Cp, KJ/(KG)(K)	3.3459	3.3413	2.9340	2.0622
GAMMAS	1.1828	1.1829	1.1931	1.2447
SON VEL,M/SEC	1245.2	1243.9	1195.5	898.6
MACH NUMBER	0.000	0.150	1.000	3.038

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.96158	0.96010	0.90518	0.59137
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.3459	3.3413	2.9340	2.0622
CONDUCTIVITY	7.9627	7.9401	6.2582	2.0600
PRANDTL NUMBER	0.4041	0.4040	0.4244	0.5920

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1647	2.1642	2.1439	1.9587
CONDUCTIVITY	3.5660	3.5592	3.2993	1.9606
PRANDTL NUMBER	0.5837	0.5838	0.5882	0.5908

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.6206
CSTAR, M/SEC	1771.7	1771.7	1771.7
CF	0.1056	0.6748	1.5409
Ivac, M/SEC	7179.6	2197.5	2967.6
Isp, M/SEC	187.1	1195.5	2729.9

MASS FRACTIONS

*CO	0.60095	0.60084	0.59644	0.54133
*CO2	0.14155	0.14172	0.14868	0.23529
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00099	0.00099	0.00063	0.00000
HCO	0.00003	0.00003	0.00001	0.00000
*H2	0.02174	0.02174	0.02214	0.02646
H2O	0.22603	0.22605	0.22772	0.19692
*O	0.00038	0.00037	0.00012	0.00000
*OH	0.00797	0.00789	0.00414	0.00000
*O2	0.00034	0.00034	0.00011	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013141

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0268	1.7929	50.000
P, BAR	50.663	49.341	28.258	1.0132
T, K	3198.86	3191.98	2937.30	1600.35
RHO, KG/CU M	3.8535 0	3.7614 0	2.3549 0	1.5627-1
H, KJ/KG	-875.59	-893.17	-1592.94	-4604.06
U, KJ/KG	-2190.32	-2204.93	-2792.89	-5252.45
G, KJ/KG	-39555.8	-39507.3	-37126.1	-23963.9
S, KJ/(KG)(K)	12.0919	12.0972	12.0972	12.0972
M, (1/n)	20.230	20.232	20.353	20.522
MW, MOL WT	20.230	20.232	20.353	20.522
(dLV/dLP)t	-1.00738	-1.00733	-1.00422	-1.00001
(dLV/dLT)p	1.1379	1.1372	1.0848	1.0002
Cp, KJ/(KG)(K)	3.2500	3.2457	2.8646	2.0618
GAMMAS	1.1854	1.1854	1.1956	1.2447
SON VEL,M/SEC	1248.4	1247.0	1197.8	898.4
MACH NUMBER	0.000	0.150	1.000	3.040

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.96433 0.96283 0.90676 0.59111

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.2500	3.2457	2.8646	2.0618
CONDUCTIVITY	7.6328	7.6109	6.0095	2.0577
PRANDTL NUMBER	0.4106	0.4106	0.4322	0.5923

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1656	2.1650	2.1444	1.9585
CONDUCTIVITY	3.5751	3.5681	3.3042	1.9596

PRANDTL NUMBER 0.5841 0.5842 0.5885 0.5908

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.6098
CSTAR, M/SEC	1772.8	1772.8	1772.8
CF	0.1057	0.6756	1.5403
Ivac, M/SEC	7184.5	2199.6	2968.2
Isp, M/SEC	187.5	1197.8	2730.7

MASS FRACTIONS

*CO	0.60102	0.60092	0.59653	0.54123
*CO2	0.14142	0.14159	0.14853	0.23544
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00092	0.00091	0.00057	0.00000
HCO	0.00004	0.00004	0.00002	0.00000
*H2	0.02176	0.02177	0.02216	0.02646
H2O	0.22673	0.22675	0.22817	0.19686
*O	0.00033	0.00032	0.00011	0.00000
*OH	0.00746	0.00738	0.00382	0.00000
*O2	0.00030	0.00029	0.00010	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 881.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013158

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0268	1.7942	50.000
P, BAR	60.795	59.207	33.885	1.2159
T, K	3208.82	3201.85	2942.82	1599.56
RHO, KG/CU M	4.6139 0	4.5036 0	2.8202 0	1.8762-1
H, KJ/KG	-875.59	-893.23	-1595.07	-4605.71
U, KJ/KG	-2193.24	-2207.89	-2796.58	-5253.78
G, KJ/KG	-39435.9	-39387.0	-36974.7	-23836.2
S, KJ/(KG)(K)	12.0170	12.0223	12.0223	12.0223

M, (1/n)	20.248	20.250	20.365	20.522
MW, MOL WT	20.248	20.250	20.365	20.522
(dLV/dLP)t	-1.00692	-1.00687	-1.00392	-1.00001
(dLV/dLT)p	1.1289	1.1282	1.0786	1.0002
Cp, KJ/(KG)(K)	3.1764	3.1722	2.8118	2.0615
GAMMAS	1.1874	1.1875	1.1976	1.2447
SON VEL,M/SEC	1250.8	1249.4	1199.6	898.2
MACH NUMBER	0.000	0.150	1.000	3.041

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.96648	0.96496	0.90797	0.59091
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.1764	3.1722	2.8118	2.0615
CONDUCTIVITY	7.3773	7.3561	5.8194	2.0560
PRANDTL NUMBER	0.4161	0.4161	0.4387	0.5925

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1662	2.1657	2.1448	1.9583
CONDUCTIVITY	3.5821	3.5751	3.3079	1.9589
PRANDTL NUMBER	0.5845	0.5846	0.5887	0.5907

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.6017
CSTAR, M/SEC	1773.7	1773.7	1773.7
CF	0.1059	0.6763	1.5399
Ivac, M/SEC	7188.2	2201.2	2968.6
Isp, M/SEC	187.8	1199.6	2731.3

MASS FRACTIONS

*CO	0.60108	0.60097	0.59660	0.54116
*CO2	0.14133	0.14149	0.14841	0.23556
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00086	0.00086	0.00053	0.00000
HCO	0.00004	0.00004	0.00002	0.00000
*H2	0.02178	0.02179	0.02218	0.02647
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.22728	0.22730	0.22851	0.19681
*O	0.00029	0.00029	0.00009	0.00000
*OH	0.00705	0.00698	0.00357	0.00000
*O2	0.00026	0.00026	0.00008	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013171

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0269	1.7952	50.000
P, BAR	70.927	69.073	39.510	1.4185
T, K	3216.91	3209.87	2947.24	1598.94
RHO, KG/CU M	5.3732 0	5.2447 0	3.2850 0	2.1897-1
H, KJ/KG	-875.59	-893.28	-1596.80	-4607.02
U, KJ/KG	-2195.61	-2210.29	-2799.55	-5254.84
G, KJ/KG	-39329.5	-39280.4	-36843.0	-23728.8
S, KJ/(KG)(K)	11.9537	11.9591	11.9591	11.9591
M, (1/n)	20.263	20.264	20.374	20.522
MW, MOL WT	20.263	20.264	20.374	20.522
(dLV/dLP)t	-1.00654	-1.00650	-1.00368	-1.00001
(dLV/dLT)p	1.1215	1.1209	1.0737	1.0002
Cp, KJ/(KG)(K)	3.1174	3.1134	2.7700	2.0612
GAMMAS	1.1891	1.1892	1.1993	1.2448
SON VEL,M/SEC	1252.8	1251.5	1201.0	898.0
MACH NUMBER	0.000	0.150	1.000	3.042

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.96822 0.96669 0.90894 0.59075

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.1174	3.1134	2.7700	2.0612
CONDUCTIVITY	7.1711	7.1504	5.6676	2.0546
PRANDTL NUMBER	0.4209	0.4209	0.4442	0.5927

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1668	2.1662	2.1451	1.9582
CONDUCTIVITY	3.5878	3.5808	3.3108	1.9583
PRANDTL NUMBER	0.5847	0.5848	0.5889	0.5907

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.5953
CSTAR, M/SEC	1774.4	1774.4	1774.4
CF	0.1060	0.6769	1.5396
Ivac, M/SEC	7191.1	2202.5	2969.0
Isp, M/SEC	188.1	1201.0	2731.8

MASS FRACTIONS

*CO 0.60112 0.60101 0.59665 0.54110

*CO2	0.14125	0.14142	0.14832	0.23565
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00081	0.00081	0.00050	0.00000
HCO	0.00004	0.00004	0.00002	0.00000
*H2	0.02180	0.02180	0.02219	0.02647
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.22773	0.22775	0.22878	0.19678
*O	0.00026	0.00026	0.00008	0.00000
*OH	0.00671	0.00664	0.00336	0.00000
*O2	0.00024	0.00023	0.00007	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013182

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0269	1.7961	50.000
P, BAR	81.060	78.938	45.132	1.6212
T, K	3223.66	3216.57	2950.88	1598.42
RHO, KG/CU M	6.1317 0	5.9849 0	3.7493 0	2.5034-1
H, KJ/KG	-875.59	-893.32	-1598.25	-4608.09
U, KJ/KG	-2197.58	-2212.28	-2802.01	-5255.70
G, KJ/KG	-39233.7	-39184.3	-36726.4	-23636.2
S, KJ/(KG)(K)	11.8989	11.9043	11.9043	11.9043
M, (1/n)	20.275	20.277	20.382	20.522
MW, MOL WT	20.275	20.277	20.382	20.522
(dLV/dLP)t	-1.00623	-1.00618	-1.00348	-1.00001
(dLV/dLT)p	1.1155	1.1148	1.0696	1.0002
Cp, KJ/(KG)(K)	3.0686	3.0648	2.7356	2.0610
GAMMAS	1.1905	1.1906	1.2007	1.2448
SON VEL,M/SEC	1254.5	1253.1	1202.2	897.9
MACH NUMBER	0.000	0.150	1.000	3.043

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.96968 0.96814 0.90974 0.59062

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.0686	3.0648	2.7356	2.0610
CONDUCTIVITY	6.9995	6.9793	5.5424	2.0535
PRANDTL NUMBER	0.4251	0.4251	0.4490	0.5928

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1672	2.1667	2.1454	1.9581
CONDUCTIVITY	3.5926	3.5855	3.3132	1.9578
PRANDTL NUMBER	0.5850	0.5850	0.5891	0.5907

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.5901
CSTAR, M/SEC	1775.0	1775.0	1775.0
CF	0.1061	0.6773	1.5393
Ivac, M/SEC	7193.5	2203.5	2969.2
Isp, M/SEC	188.3	1202.2	2732.2

MASS FRACTIONS

*CO	0.60115	0.60105	0.59670	0.54105
*CO2	0.14119	0.14135	0.14825	0.23573
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00078	0.00077	0.00047	0.00000
HCO	0.00005	0.00005	0.00002	0.00000
*H2	0.02181	0.02182	0.02220	0.02648
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.22811	0.22812	0.22901	0.19674
*O	0.00024	0.00023	0.00007	0.00000
*OH	0.00643	0.00636	0.00319	0.00000
*O2	0.00022	0.00021	0.00007	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013192

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150

OXIDANT O2(L) 1.0000000 -12979.000 90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0269	1.7968	50.000
P, BAR	91.192	88.804	50.752	1.8238
T, K	3229.43	3222.29	2953.95	1597.99
RHO, KG/CU M	6.8893 0	6.7243 0	4.2132 0	2.8170-1
H, KJ/KG	-875.59	-893.35	-1599.49	-4609.00
U, KJ/KG	-2199.27	-2213.99	-2804.11	-5256.44
G, KJ/KG	-39146.4	-39096.8	-36621.6	-23554.8
S, KJ/(KG)(K)	11.8506	11.8560	11.8560	11.8560
M, (1/n)	20.285	20.287	20.389	20.522
MW, MOL WT	20.285	20.287	20.389	20.522
(dLV/dLP)t	-1.00597	-1.00592	-1.00331	-1.00001
(dLV/dLT)p	1.1103	1.1097	1.0662	1.0002
Cp, KJ/(KG)(K)	3.0273	3.0236	2.7067	2.0609
GAMMAS	1.1918	1.1919	1.2019	1.2448
SON VEL,M/SEC	1256.0	1254.6	1203.2	897.7
MACH NUMBER	0.000	0.150	1.000	3.044

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.97092 0.96937 0.91041 0.59051

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.0273	3.0236	2.7067	2.0609
CONDUCTIVITY	6.8537	6.8338	5.4368	2.0526
PRANDTL NUMBER	0.4289	0.4289	0.4532	0.5929

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1676	2.1671	2.1456	1.9580
CONDUCTIVITY	3.5966	3.5895	3.3153	1.9573
PRANDTL NUMBER	0.5851	0.5852	0.5892	0.5907

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.5857
CSTAR, M/SEC	1775.4	1775.4	1775.4
CF	0.1062	0.6777	1.5391
Ivac, M/SEC	7195.5	2204.4	2969.5
Isp, M/SEC	188.5	1203.2	2732.5

MASS FRACTIONS

*CO	0.60118	0.60108	0.59673	0.54101
*CO2	0.14114	0.14130	0.14818	0.23579
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00074	0.00074	0.00045	0.00000
HCO	0.00005	0.00005	0.00002	0.00000
*H2	0.02182	0.02183	0.02221	0.02648
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.22843	0.22844	0.22920	0.19672
*O	0.00022	0.00022	0.00007	0.00000
*OH	0.00618	0.00612	0.00305	0.00000
*O2	0.00020	0.00020	0.00006	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013201

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 1.90000 %FUEL= 34.482759 R,EQ.RATIO= 1.792456 PHI,EQ.RATIO= 1.792456

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0269	1.7975	50.000
P, BAR	101.33	98.669	56.371	2.0265
T, K	3234.44	3227.25	2956.59	1597.62
RHO, KG/CU M	7.6464 0	7.4632 0	4.6767 0	3.1308-1
H, KJ/KG	-875.59	-893.38	-1600.56	-4609.78
U, KJ/KG	-2200.72	-2215.46	-2805.92	-5257.06
G, KJ/KG	-39066.1	-39016.4	-36526.3	-23482.2
S, KJ/(KG)(K)	11.8075	11.8128	11.8128	11.8128
M, (1/n)	20.294	20.296	20.394	20.522
MW, MOL WT	20.294	20.296	20.394	20.522
(dLV/dLP)t	-1.00573	-1.00569	-1.00317	-1.00001
(dLV/dLT)p	1.1058	1.1052	1.0633	1.0002
Cp, KJ/(KG)(K)	2.9918	2.9882	2.6819	2.0607
GAMMAS	1.1929	1.1930	1.2029	1.2448
SON VEL,M/SEC	1257.3	1255.9	1204.1	897.6
MACH NUMBER	0.000	0.150	1.000	3.044

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.97200 0.97043 0.91099 0.59041

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	2.9918	2.9882	2.6819	2.0607
CONDUCTIVITY	6.7274	6.7079	5.3460	2.0519
PRANDTL NUMBER	0.4323	0.4323	0.4570	0.5930

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1679	2.1674	2.1458	1.9579
CONDUCTIVITY	3.6001	3.5930	3.3170	1.9570

PRANDTL NUMBER 0.5853 0.5854 0.5893 0.5907

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.5819
CSTAR, M/SEC	1775.8	1775.8	1775.8
CF	0.1062	0.6781	1.5389
Ivac, M/SEC	7197.2	2205.1	2969.7
Isp, M/SEC	188.6	1204.1	2732.8

MASS FRACTIONS

*CO	0.60120	0.60110	0.59677	0.54097
*CO2	0.14109	0.14126	0.14813	0.23585
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00071	0.00071	0.00043	0.00000
HCO	0.00006	0.00005	0.00002	0.00000
*H2	0.02183	0.02184	0.02222	0.02648
HCHO,formaldehy	0.00001	0.00001	0.00000	0.00000
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.22871	0.22872	0.22937	0.19669
*O	0.00020	0.00020	0.00006	0.00000
*OH	0.00597	0.00590	0.00293	0.00000
*O2	0.00019	0.00018	0.00006	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

SINGULAR MATRIX, ITERATION 1 VARIABLE 4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012879

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.333333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0263	1.7706	50.000
P, BAR	10.133	9.8733	5.7225	0.20265
T, K	3182.03	3176.13	2979.17	1743.93
RHO, KG/CU M	7.8685-1	7.6827-1	4.7961-1	2.9667-2
H, KJ/KG	-859.93	-876.79	-1552.48	-4657.50
U, KJ/KG	-2147.65	-2161.92	-2745.63	-5340.59

G, KJ/KG	-41056.7	-41015.4	-39202.0	-26696.6
S, KJ/(KG)(K)	12.6324	12.6376	12.6376	12.6376
M, (1/n)	20.545	20.549	20.760	21.227
MW, MOL WT	20.545	20.549	20.760	21.227
(dLV/dLP)t	-1.01752	-1.01743	-1.01179	-1.00006
(dLV/dLT)p	1.3331	1.3320	1.2378	1.0020
Cp, KJ/(KG)(K)	4.7409	4.7356	4.0801	2.0643
GAMMAS	1.1550	1.1550	1.1609	1.2352
SON VEL,M/SEC	1219.6	1218.3	1176.9	918.6
MACH NUMBER	0.000	0.151	1.000	3.000

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.97061	0.96931	0.92584	0.63397
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.7409	4.7356	4.0801	2.0643
CONDUCTIVITY	12.0662	12.0436	9.8569	2.2029
PRANDTL NUMBER	0.3814	0.3811	0.3832	0.5941

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1378	2.1374	2.1221	1.9613
CONDUCTIVITY	3.5028	3.4968	3.2863	2.0410
PRANDTL NUMBER	0.5924	0.5925	0.5979	0.6092

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.9039
CSTAR, M/SEC	1772.3	1772.3	1772.3
CF	0.1036	0.6641	1.5550
Ivac, M/SEC	7180.3	2190.7	3003.8
Isp, M/SEC	183.7	1176.9	2755.9

MASS FRACTIONS

*CO	0.56425	0.56411	0.55876	0.51090
*CO2	0.16306	0.16327	0.17169	0.24690
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00178	0.00177	0.00131	0.00001
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01816	0.01816	0.01841	0.02226
H2O	0.23148	0.23156	0.23673	0.21991
*O	0.00178	0.00177	0.00085	0.00000
*OH	0.01747	0.01735	0.01127	0.00001
*O2	0.00199	0.00197	0.00097	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 FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012942

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7760	50.000
P, BAR	20.265	19.744	11.411	0.40530
T, K	3242.61	3236.35	3021.58	1737.33
RHO, KG/CU M	1.5526 0	1.5159 0	9.4699-1	5.9561-2
H, KJ/KG	-859.93	-877.11	-1564.33	-4671.86
U, KJ/KG	-2165.11	-2179.59	-2769.28	-5352.34
G, KJ/KG	-40914.8	-40871.5	-38904.6	-26141.6
S, KJ/(KG)(K)	12.3527	12.3579	12.3579	12.3579

M, (1/n)	20.657	20.660	20.850	21.228
MW, MOL WT	20.657	20.660	20.850	21.228
(dLV/dLP)t	-1.01454	-1.01446	-1.00945	-1.00004
(dLV/dLT)p	1.2719	1.2709	1.1882	1.0013
Cp, KJ/(KG)(K)	4.2227	4.2179	3.6518	2.0558
GAMMAS	1.1623	1.1623	1.1692	1.2361
SON VEL,M/SEC	1231.7	1230.4	1186.9	917.1
MACH NUMBER	0.000	0.151	1.000	3.011

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.98395	0.98258	0.93530	0.63230
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.2227	4.2179	3.6518	2.0558
CONDUCTIVITY	10.5459	10.5246	8.5444	2.1685
PRANDTL NUMBER	0.3940	0.3938	0.3997	0.5994

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1418	2.1414	2.1251	1.9600
CONDUCTIVITY	3.5456	3.5395	3.3153	2.0346
PRANDTL NUMBER	0.5944	0.5945	0.5995	0.6091

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8347
CSTAR, M/SEC	1779.9	1779.9	1779.9
CF	0.1041	0.6669	1.5513
Ivac, M/SEC	7211.7	2202.1	3007.6
Isp, M/SEC	185.4	1186.9	2761.1

MASS FRACTIONS

*CO	0.56430	0.56418	0.55903	0.51040
*CO2	0.16295	0.16315	0.17125	0.24770
COOH	0.00001	0.00001	0.00000	0.00000

*H	0.00148	0.00147	0.00106	0.00001
HCO	0.00002	0.00002	0.00001	0.00000
H02	0.00001	0.00001	0.00000	0.00000
*H2	0.01820	0.01820	0.01846	0.02230
H20	0.23501	0.23507	0.23949	0.21959
*O	0.00129	0.00127	0.00057	0.00000
*OH	0.01529	0.01518	0.00946	0.00001
*O2	0.00145	0.00143	0.00066	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 FINITE AREA COMBUSTOR

Pin = 440.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012980

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0265	1.7791	50.000
P, BAR	30.398	29.614	17.086	0.60795
T, K	3275.79	3269.32	3043.86	1733.98
RHO, KG/CU M	2.3122 0	2.2574 0	1.4108 0	8.9516-2
H, KJ/KG	-859.93	-877.28	-1570.86	-4679.07
U, KJ/KG	-2174.57	-2189.16	-2781.94	-5358.22
G, KJ/KG	-40790.9	-40746.4	-38690.4	-25824.8
S, KJ/(KG)(K)	12.1897	12.1949	12.1949	12.1949
M, (1/n)	20.718	20.721	20.897	21.228
MW, MOL WT	20.718	20.721	20.897	21.228
(dLV/dLP)t	-1.01291	-1.01284	-1.00822	-1.00003
(dLV/dLT)p	1.2393	1.2384	1.1627	1.0011
Cp, KJ/(KG)(K)	3.9556	3.9512	3.4367	2.0523
GAMMAS	1.1667	1.1667	1.1741	1.2364
SON VEL,M/SEC	1238.5	1237.2	1192.4	916.4
MACH NUMBER	0.000	0.151	1.000	3.016

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.99122 0.98981 0.94025 0.63144

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.9556	3.9512	3.4367	2.0523
CONDUCTIVITY	9.7408	9.7202	7.8673	2.1537

PRANDTL NUMBER 0.4025 0.4023 0.4107 0.6017

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K) 2.1440 2.1435 2.1267 1.9594
 CONDUCTIVITY 3.5690 3.5626 3.3304 2.0313
 PRANDTL NUMBER 0.5955 0.5955 0.6004 0.6091

PERFORMANCE PARAMETERS

Ae/At 4.0000 1.0000 6.8000
 CSTAR, M/SEC 1783.7 1783.7 1783.7
 CF 0.1045 0.6685 1.5494
 Ivac, M/SEC 7227.6 2208.1 3009.5
 Isp, M/SEC 186.3 1192.4 2763.7

MASS FRACTIONS

*CO 0.56431 0.56418 0.55916 0.51014
 *CO2 0.16293 0.16313 0.17105 0.24810
 COOH 0.00001 0.00001 0.00001 0.00000
 *H 0.00131 0.00131 0.00092 0.00001
 HCO 0.00003 0.00003 0.00001 0.00000
 HO2 0.00001 0.00001 0.00000 0.00000
 *H2 0.01822 0.01822 0.01849 0.02232
 H2O 0.23697 0.23703 0.24097 0.21943
 *O 0.00104 0.00103 0.00044 0.00000
 *OH 0.01398 0.01388 0.00843 0.00001
 *O2 0.00118 0.00117 0.00051 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 FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013006
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0265	1.7813	50.000
P, BAR	40.530	39.483	22.754	0.81060
T, K	3298.17	3291.56	3058.47	1731.83
RHO, KG/CU M	3.0682 0	2.9953 0	1.8726 0	1.1950-1
H, KJ/KG	-859.93	-877.40	-1575.29	-4683.68

U, KJ/KG	-2180.91	-2195.57	-2790.35	-5361.98
G, KJ/KG	-40683.3	-40638.1	-38520.2	-25603.4
S, KJ/(KG)(K)	12.0744	12.0796	12.0796	12.0796
M, (1/n)	20.759	20.762	20.929	21.228
MW, MOL WT	20.759	20.762	20.929	21.228
(dLV/dLP)t	-1.01182	-1.01175	-1.00742	-1.00003
(dLV/dLT)p	1.2177	1.2169	1.1462	1.0009
Cp, KJ/(KG)(K)	3.7818	3.7776	3.2991	2.0502
GAMMAS	1.1699	1.1699	1.1775	1.2366
SON VEL,M/SEC	1243.1	1241.8	1196.2	915.9
MACH NUMBER	0.000	0.151	1.000	3.019

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.99611	0.99467	0.94349	0.63090
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.7818	3.7776	3.2991	2.0502
CONDUCTIVITY	9.2080	9.1881	7.4271	2.1450
PRANDTL NUMBER	0.4091	0.4089	0.4191	0.6030

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1454	2.1450	2.1278	1.9590
CONDUCTIVITY	3.5846	3.5782	3.3403	2.0292
PRANDTL NUMBER	0.5962	0.5963	0.6010	0.6090

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7778	
CSTAR, M/SEC	1786.2	1786.2	1786.2	
CF	0.1047	0.6696	1.5482	
Ivac, M/SEC	7237.8	2212.0	3010.7	
Isp, M/SEC	187.0	1196.1	2765.4	

MASS FRACTIONS

*CO	0.56429	0.56417	0.55924	0.50997
*CO2	0.16294	0.16313	0.17092	0.24836
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00120	0.00120	0.00083	0.00001
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01823	0.01824	0.01851	0.02233
H2O	0.23831	0.23836	0.24194	0.21932
*O	0.00089	0.00088	0.00037	0.00000
*OH	0.01306	0.01296	0.00774	0.00001
*O2	0.00101	0.00100	0.00042	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 FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013027
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0266	1.7829	50.000
P, BAR	50.663	49.352	28.415	1.0133
T, K	3314.83	3308.11	3069.10	1730.28
RHO, KG/CU M	3.8216 0	3.7308 0	2.3330 0	1.4951-1
H, KJ/KG	-859.93	-877.49	-1578.59	-4686.98
U, KJ/KG	-2185.60	-2200.32	-2796.54	-5364.67
G, KJ/KG	-40588.4	-40542.6	-38377.9	-25433.5
S, KJ/(KG)(K)	11.9851	11.9903	11.9903	11.9903
M, (1/n)	20.790	20.793	20.952	21.229
MW, MOL WT	20.790	20.793	20.952	21.229
(dLV/dLP)t	-1.01101	-1.01095	-1.00684	-1.00003
(dLV/dLT)p	1.2019	1.2011	1.1342	1.0008
Cp, KJ/(KG)(K)	3.6558	3.6518	3.2007	2.0488
GAMMAS	1.1723	1.1723	1.1802	1.2368
SON VEL,M/SEC	1246.7	1245.3	1198.9	915.5
MACH NUMBER	0.000	0.151	1.000	3.022

TRANSPORT PROPERTIES (GASES ONLY) CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 0.99974 0.99828 0.94584 0.63050

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.6558	3.6518	3.2007	2.0488
CONDUCTIVITY	8.8170	8.7975	7.1083	2.1391
PRANDTL NUMBER	0.4145	0.4144	0.4259	0.6039

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1465	2.1460	2.1285	1.9587
CONDUCTIVITY	3.5963	3.5897	3.3474	2.0277
PRANDTL NUMBER	0.5967	0.5968	0.6014	0.6090

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7619
CSTAR, M/SEC	1788.0	1788.0	1788.0
CF	0.1048	0.6705	1.5473
Ivac, M/SEC	7245.1	2214.8	3011.6
Isp, M/SEC	187.4	1198.9	2766.6

MASS FRACTIONS

*CO	0.56428	0.56416	0.55930	0.50985
*CO2	0.16295	0.16314	0.17083	0.24855

COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00112	0.00112	0.00077	0.00000
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01824	0.01825	0.01852	0.02234
H2O	0.23931	0.23936	0.24266	0.21925
*O	0.00078	0.00077	0.00032	0.00000
*OH	0.01234	0.01225	0.00721	0.00001
*O2	0.00089	0.00088	0.00036	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 FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.013043
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0266	1.7843	50.000
P, BAR	60.795	59.220	34.073	1.2159
T, K	3327.96	3321.15	3077.35	1729.09
RHO, KG/CU M	4.5732 0	4.4644 0	2.7924 0	1.7954-1
H, KJ/KG	-859.93	-877.56	-1581.20	-4689.51
U, KJ/KG	-2189.29	-2204.05	-2801.38	-5366.73
G, KJ/KG	-40503.3	-40457.0	-38255.1	-25295.8
S, KJ/(KG)(K)	11.9122	11.9174	11.9174	11.9174
M, (1/n)	20.815	20.817	20.970	21.229
MW, MOL WT	20.815	20.817	20.970	21.229
(dLV/dLP)t	-1.01038	-1.01032	-1.00639	-1.00002
(dLV/dLT)p	1.1895	1.1887	1.1250	1.0007
Cp, KJ/(KG)(K)	3.5584	3.5545	3.1254	2.0478
GAMMAS	1.1743	1.1743	1.1823	1.2369
SON VEL,M/SEC	1249.5	1248.1	1201.1	915.2
MACH NUMBER	0.000	0.150	1.000	3.024

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0026 1.0011 0.94766 0.63020

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K) 3.5584 3.5545 3.1254 2.0478

CONDUCTIVITY	8.5118	8.4928	6.8623	2.1347
PRANDTL NUMBER	0.4191	0.4190	0.4316	0.6045

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1473	2.1469	2.1291	1.9584
CONDUCTIVITY	3.6054	3.5988	3.3530	2.0266
PRANDTL NUMBER	0.5971	0.5972	0.6018	0.6090

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7498
CSTAR, M/SEC	1789.3	1789.3	1789.3
CF	0.1050	0.6712	1.5467
Ivac, M/SEC	7250.7	2217.0	3012.2
Isp, M/SEC	187.8	1201.1	2767.5

MASS FRACTIONS

*CO	0.56427	0.56415	0.55934	0.50976
*CO2	0.16296	0.16315	0.17076	0.24870
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00106	0.00105	0.00072	0.00000
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01825	0.01826	0.01854	0.02235
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.24011	0.24015	0.24322	0.21919
*O	0.00070	0.00070	0.00028	0.00000
*OH	0.01177	0.01167	0.00680	0.00000
*O2	0.00080	0.00079	0.00032	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 FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.013057
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0266	1.7854	50.000
P, BAR	70.927	69.089	39.727	1.4185
T, K	3338.71	3331.82	3084.00	1728.14

RHO, KG/CU M	5.3234 0	5.1967 0	3.2510 0	2.0958-1
H, KJ/KG	-859.93	-877.62	-1583.34	-4691.53
U, KJ/KG	-2192.30	-2207.10	-2805.32	-5368.38
G, KJ/KG	-40425.9	-40379.2	-38146.8	-25180.1
S, KJ/(KG)(K)	11.8507	11.8558	11.8558	11.8558

M, (1/n)	20.835	20.837	20.984	21.229
MW, MOL WT	20.835	20.837	20.984	21.229
(dLV/dLP)t	-1.00986	-1.00980	-1.00602	-1.00002
(dLV/dLT)p	1.1795	1.1787	1.1176	1.0007
Cp, KJ/(KG)(K)	3.4799	3.4762	3.0652	2.0470
GAMMAS	1.1760	1.1760	1.1841	1.2370
SON VEL,M/SEC	1251.8	1250.4	1202.9	915.0
MACH NUMBER	0.000	0.150	1.000	3.025

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0049	1.0034	0.94913	0.62996
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.4799	3.4762	3.0652	2.0470
CONDUCTIVITY	8.2639	8.2452	6.6643	2.1314
PRANDTL NUMBER	0.4232	0.4231	0.4366	0.6050

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1480	2.1476	2.1296	1.9582
CONDUCTIVITY	3.6129	3.6062	3.3574	2.0257
PRANDTL NUMBER	0.5975	0.5976	0.6020	0.6090

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7401
CSTAR, M/SEC	1790.4	1790.4	1790.4
CF	0.1051	0.6718	1.5461
Ivac, M/SEC	7255.2	2218.7	3012.8
Isp, M/SEC	188.1	1202.8	2768.3

MASS FRACTIONS

*CO	0.56425	0.56414	0.55937	0.50968
*CO2	0.16298	0.16316	0.17070	0.24882
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00101	0.00100	0.00068	0.00000
HCO	0.00005	0.00005	0.00002	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01826	0.01826	0.01855	0.02235
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.24076	0.24080	0.24367	0.21914
*O	0.00064	0.00063	0.00025	0.00000
*OH	0.01129	0.01119	0.00646	0.00000
*O2	0.00073	0.00072	0.00029	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 FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013069

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0266	1.7863	50.000
P, BAR	81.060	78.956	45.378	1.6212
T, K	3347.77	3340.81	3089.54	1727.35
RHO, KG/CU M	6.0724 0	5.9277 0	3.7089 0	2.3963-1
H, KJ/KG	-859.93	-877.67	-1585.14	-4693.20
U, KJ/KG	-2194.83	-2209.66	-2808.60	-5369.74
G, KJ/KG	-40354.8	-40307.9	-38049.6	-25080.4
S, KJ/(KG)(K)	11.7974	11.8026	11.8026	11.8026
M, (1/n)	20.852	20.854	20.996	21.229
MW, MOL WT	20.852	20.854	20.996	21.229
(dLV/dLP)t	-1.00942	-1.00936	-1.00572	-1.00002
(dLV/dLT)p	1.1711	1.1703	1.1115	1.0006
Cp, KJ/(KG)(K)	3.4147	3.4111	3.0156	2.0464
GAMMAS	1.1775	1.1775	1.1856	1.2370
SON VEL,M/SEC	1253.7	1252.4	1204.4	914.8
MACH NUMBER	0.000	0.150	1.000	3.027

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0069	1.0054	0.95035	0.62976
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.4147	3.4111	3.0156	2.0464
CONDUCTIVITY	8.0565	8.0382	6.5000	2.1287
PRANDTL NUMBER	0.4268	0.4267	0.4409	0.6054

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1486	2.1482	2.1299	1.9581
CONDUCTIVITY	3.6192	3.6125	3.3611	2.0249
PRANDTL NUMBER	0.5978	0.5979	0.6022	0.6090

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7321
CSTAR, M/SEC	1791.3	1791.3	1791.3
CF	0.1052	0.6723	1.5457
Ivac, M/SEC	7258.9	2220.2	3013.2
Isp, M/SEC	188.4	1204.3	2768.9

MASS FRACTIONS

*CO	0.56424	0.56412	0.55939	0.50962
*CO2	0.16299	0.16317	0.17066	0.24892
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00096	0.00096	0.00065	0.00000
HCO	0.00005	0.00005	0.00002	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01826	0.01827	0.01855	0.02236
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.24132	0.24135	0.24405	0.21910
*O	0.00059	0.00058	0.00023	0.00000
*OH	0.01087	0.01078	0.00617	0.00000
*O2	0.00068	0.00067	0.00026	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 FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013079

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7872	50.000
P, BAR	91.192	88.824	51.026	1.8238
T, K	3355.55	3348.54	3094.24	1726.68
RHO, KG/CU M	6.8203 0	6.6578 0	4.1663 0	2.6969-1
H, KJ/KG	-859.93	-877.71	-1586.69	-4694.61
U, KJ/KG	-2196.99	-2211.85	-2811.42	-5370.89
G, KJ/KG	-40289.1	-40241.8	-37961.4	-24992.9
S, KJ/(KG)(K)	11.7504	11.7556	11.7556	11.7556
M, (1/n)	20.866	20.869	21.006	21.229
MW, MOL WT	20.866	20.869	21.006	21.229
(dLV/dLP)t	-1.00905	-1.00899	-1.00546	-1.00002
(dLV/dLT)p	1.1639	1.1632	1.1063	1.0006
Cp, KJ/(KG)(K)	3.3593	3.3558	2.9737	2.0459
GAMMAS	1.1787	1.1787	1.1869	1.2371
SON VEL,M/SEC	1255.4	1254.0	1205.6	914.7
MACH NUMBER	0.000	0.150	1.000	3.028

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0086	1.0071	0.95139	0.62959
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.3593	3.3558	2.9737	2.0459
CONDUCTIVITY	7.8793	7.8613	6.3606	2.1264
PRANDTL NUMBER	0.4300	0.4299	0.4448	0.6058

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1491	2.1486	2.1303	1.9580
CONDUCTIVITY	3.6246	3.6178	3.3643	2.0243
PRANDTL NUMBER	0.5980	0.5981	0.6024	0.6090

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7254
CSTAR, M/SEC	1792.1	1792.1	1792.1
CF	0.1052	0.6728	1.5454
Ivac, M/SEC	7262.0	2221.5	3013.6
Isp, M/SEC	188.6	1205.6	2769.4

MASS FRACTIONS

*CO	0.56422	0.56411	0.55942	0.50957
*CO2	0.16300	0.16318	0.17062	0.24900
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00092	0.00092	0.00062	0.00000
HCO	0.00006	0.00005	0.00003	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01827	0.01827	0.01856	0.02236
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.24179	0.24183	0.24437	0.21907
*O	0.00055	0.00054	0.00021	0.00000
*OH	0.01051	0.01043	0.00592	0.00000
*O2	0.00063	0.00062	0.00024	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 FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.013088

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.00000 %FUEL= 33.33333 R,EQ.RATIO= 1.702833 PHI,EQ.RATIO= 1.702833

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0267	1.7879	50.000
P, BAR	101.33	98.692	56.673	2.0265
T, K	3362.34	3355.28	3098.31	1726.11
RHO, KG/CU M	7.5675 0	7.3870 0	4.6232 0	2.9976-1
H, KJ/KG	-859.93	-877.75	-1588.04	-4695.83
U, KJ/KG	-2198.88	-2213.76	-2813.86	-5371.88
G, KJ/KG	-40227.8	-40180.3	-37880.6	-24914.9
S, KJ/(KG)(K)	11.7085	11.7137	11.7137	11.7137
M, (1/n)	20.879	20.881	21.015	21.229
MW, MOL WT	20.879	20.881	21.015	21.229
(dLV/dLP)t	-1.00872	-1.00867	-1.00524	-1.00002
(dLV/dLT)p	1.1576	1.1569	1.1018	1.0005
Cp, KJ/(KG)(K)	3.3114	3.3080	2.9377	2.0455
GAMMAS	1.1799	1.1799	1.1880	1.2371
SON VEL,M/SEC	1256.9	1255.5	1206.8	914.5
MACH NUMBER	0.000	0.150	1.000	3.029

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0101	1.0085	0.95229	0.62944
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.3114	3.3080	2.9377	2.0455
CONDUCTIVITY	7.7253	7.7075	6.2402	2.1245
PRANDTL NUMBER	0.4330	0.4329	0.4483	0.6060

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1496	2.1491	2.1306	1.9578
CONDUCTIVITY	3.6293	3.6225	3.3670	2.0237
PRANDTL NUMBER	0.5983	0.5983	0.6026	0.6090

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.7196
CSTAR, M/SEC	1792.7	1792.7	1792.7
CF	0.1053	0.6731	1.5450
Ivac, M/SEC	7264.7	2222.5	3013.9
Isp, M/SEC	188.8	1206.7	2769.8

MASS FRACTIONS

*CO	0.56421	0.56410	0.55943	0.50952
*CO2	0.16301	0.16319	0.17059	0.24907
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00089	0.00089	0.00059	0.00000
HCO	0.00006	0.00006	0.00003	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01827	0.01828	0.01857	0.02236
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.24221	0.24224	0.24465	0.21904
*O	0.00051	0.00051	0.00019	0.00000
*OH	0.01019	0.01011	0.00571	0.00000
*O2	0.00059	0.00058	0.00022	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 FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012793
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0261	1.7628	50.000
P, BAR	10.133	9.8750	5.7480	0.20265
T, K	3250.21	3244.46	3062.30	1878.73
RHO, KG/CU M	7.8786-1	7.6934-1	4.7999-1	2.8449-2
H, KJ/KG	-845.27	-862.00	-1533.14	-4710.44
U, KJ/KG	-2131.35	-2145.58	-2730.66	-5422.78
G, KJ/KG	-41505.6	-41466.8	-39858.1	-28223.0
S, KJ/(KG)(K)	12.5101	12.5151	12.5151	12.5151
M, (1/n)	21.013	21.016	21.262	21.929
MW, MOL WT	21.013	21.016	21.262	21.929
(dLV/dLP)t	-1.02356	-1.02346	-1.01701	-1.00019
(dLV/dLT)p	1.4432	1.4422	1.3385	1.0056
Cp, KJ/(KG)(K)	5.4608	5.4575	4.7805	2.0884
GAMMAS	1.1460	1.1459	1.1488	1.2246
SON VEL,M/SEC	1214.0	1212.8	1172.9	934.0
MACH NUMBER	0.000	0.151	1.000	2.977

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	0.99489	0.99363	0.95372	0.67484
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.4608	5.4575	4.7805	2.0884
CONDUCTIVITY	13.6231	13.6058	11.4998	2.4093
PRANDTL NUMBER	0.3988	0.3986	0.3965	0.5850

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1169	2.1165	2.1036	1.9622
CONDUCTIVITY	3.4928	3.4872	3.2963	2.1159
PRANDTL NUMBER	0.6030	0.6031	0.6087	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.1177
CSTAR, M/SEC	1777.0	1777.0	1777.0
CF	0.1029	0.6600	1.5646
Ivac, M/SEC	7199.1	2193.9	3036.6

Isp, M/SEC 182.9 1172.9 2780.4

MASS FRACTIONS

*CO	0.52990	0.52974	0.52322	0.47906
*CO2	0.18317	0.18341	0.19367	0.26307
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00194	0.00194	0.00152	0.00003
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00001	0.00001	0.00001	0.00000
*H2	0.01536	0.01537	0.01544	0.01856
H2O	0.23793	0.23803	0.24471	0.23921
*O	0.00317	0.00315	0.00178	0.00000
*OH	0.02421	0.02408	0.01715	0.00007
*O2	0.00428	0.00425	0.00249	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 FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012849
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7676	50.000
P, BAR	20.265	19.748	11.465	0.40530
T, K	3321.01	3314.91	3115.90	1870.25
RHO, KG/CU M	1.5519 0	1.5153 0	9.4598-1	5.7163-2
H, KJ/KG	-845.27	-862.34	-1545.94	-4730.34
U, KJ/KG	-2151.07	-2165.53	-2757.90	-5439.37
G, KJ/KG	-41483.3	-41442.4	-39689.8	-27625.4
S, KJ/(KG)(K)	12.2367	12.2417	12.2417	12.2417
M, (1/n)	21.146	21.150	21.376	21.932
MW, MOL WT	21.146	21.150	21.376	21.932
(dLV/dLP)t	-1.01999	-1.01990	-1.01397	-1.00013
(dLV/dLT)p	1.3692	1.3682	1.2740	1.0037
Cp, KJ/(KG)(K)	4.8409	4.8376	4.2333	2.0664
GAMMAS	1.1524	1.1524	1.1563	1.2266
SON VEL,M/SEC	1226.7	1225.5	1183.8	932.6
MACH NUMBER	0.000	0.151	1.000	2.989

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0107 1.0094 0.96585 0.67270

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.8409	4.8376	4.2333	2.0664
CONDUCTIVITY	11.9577	11.9407	9.9933	2.3258
PRANDTL NUMBER	0.4092	0.4089	0.4091	0.5977

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1215	2.1211	2.1074	1.9607
CONDUCTIVITY	3.5425	3.5367	3.3332	2.1076
PRANDTL NUMBER	0.6053	0.6054	0.6107	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.0279
CSTAR, M/SEC	1786.7	1786.7	1786.7
CF	0.1034	0.6626	1.5601
Ivac, M/SEC	7238.6	2207.6	3041.9
Isp, M/SEC	184.7	1183.8	2787.5

MASS FRACTIONS

*CO	0.52945	0.52930	0.52308	0.47854
*CO2	0.18386	0.18409	0.19389	0.26388
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00164	0.00163	0.00126	0.00002
HCO	0.00002	0.00002	0.00001	0.00000
HO2	0.00001	0.00001	0.00001	0.00000
*H2	0.01533	0.01533	0.01544	0.01861
H2O	0.24220	0.24229	0.24834	0.23890
*O	0.00240	0.00238	0.00127	0.00000
*OH	0.02178	0.02165	0.01491	0.00004
*O2	0.00329	0.00327	0.00180	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 FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012884
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0263	1.7705	50.000
P, BAR	30.398	29.620	17.169	0.60795
T, K	3360.66	3354.35	3144.93	1865.79
RHO, KG/CU M	2.3086 0	2.2541 0	1.4077 0	8.5954-2
H, KJ/KG	-845.27	-862.52	-1553.15	-4740.50
U, KJ/KG	-2161.97	-2176.55	-2772.83	-5447.79
G, KJ/KG	-41433.7	-41391.6	-39551.9	-27284.0
S, KJ/(KG)(K)	12.0775	12.0825	12.0825	12.0825
M, (1/n)	21.221	21.225	21.439	21.933
MW, MOL WT	21.221	21.225	21.439	21.933
(dLV/dLP)t	-1.01799	-1.01791	-1.01233	-1.00010
(dLV/dLT)p	1.3289	1.3279	1.2398	1.0030
Cp, KJ/(KG)(K)	4.5153	4.5121	3.9522	2.0572
GAMMAS	1.1564	1.1563	1.1608	1.2274
SON VEL,M/SEC	1233.9	1232.7	1189.9	931.7
MACH NUMBER	0.000	0.151	1.000	2.996

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0195	1.0181	0.97239	0.67157
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.5153	4.5121	3.9522	2.0572
CONDUCTIVITY	11.0624	11.0458	9.1996	2.2902
PRANDTL NUMBER	0.4161	0.4159	0.4177	0.6032

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1240	2.1236	2.1094	1.9599
CONDUCTIVITY	3.5702	3.5642	3.3530	2.1032
PRANDTL NUMBER	0.6065	0.6066	0.6117	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.9816
CSTAR, M/SEC	1791.8	1791.8	1791.8
CF	0.1037	0.6641	1.5578
Ivac, M/SEC	7259.4	2214.9	3044.5
Isp, M/SEC	185.8	1189.9	2791.1

MASS FRACTIONS

*CO	0.52914	0.52900	0.52297	0.47827
*CO2	0.18432	0.18454	0.19405	0.26432
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00147	0.00147	0.00111	0.00002
HCO	0.00003	0.00003	0.00001	0.00000
HO2	0.00001	0.00001	0.00001	0.00000
*H2	0.01531	0.01532	0.01543	0.01863
H2O	0.24464	0.24472	0.25035	0.23873
*O	0.00200	0.00199	0.00102	0.00000
*OH	0.02026	0.02014	0.01358	0.00003
*O2	0.00278	0.00275	0.00146	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 FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012908
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0263	1.7725	50.000
P, BAR	40.530	39.491	22.865	0.81060
T, K	3387.82	3381.37	3164.37	1862.86
RHO, KG/CU M	3.0609 0	2.9886 0	1.8669 0	1.1479-1
H, KJ/KG	-845.27	-862.65	-1558.11	-4747.06
U, KJ/KG	-2169.38	-2184.05	-2782.92	-5453.23
G, KJ/KG	-41380.4	-41337.5	-39435.5	-27045.5
S, KJ/(KG)(K)	11.9649	11.9700	11.9700	11.9700
M, (1/n)	21.273	21.276	21.481	21.934
MW, MOL WT	21.273	21.276	21.481	21.934
(dLV/dLP)t	-1.01662	-1.01654	-1.01123	-1.00008
(dLV/dLT)p	1.3017	1.3009	1.2173	1.0025
Cp, KJ/(KG)(K)	4.3008	4.2977	3.7698	2.0519
GAMMAS	1.1592	1.1592	1.1640	1.2279
SON VEL,M/SEC	1238.9	1237.6	1194.0	931.2
MACH NUMBER	0.000	0.151	1.000	3.000

TRANSPORT PROPERTIES (GASES ONLY) CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0255 1.0241 0.97676 0.67083

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.3008	4.2977	3.7698	2.0519
CONDUCTIVITY	10.4639	10.4475	8.6763	2.2695
PRANDTL NUMBER	0.4215	0.4213	0.4244	0.6065

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1258	2.1253	2.1108	1.9594
CONDUCTIVITY	3.5891	3.5830	3.3663	2.1004
PRANDTL NUMBER	0.6074	0.6075	0.6125	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.9515
CSTAR, M/SEC	1795.1	1795.1	1795.1
CF	0.1039	0.6652	1.5562

Ivac, M/SEC	7273.0	2219.8	3046.3
Isp, M/SEC	186.5	1194.0	2793.5

MASS FRACTIONS

*CO	0.52892	0.52878	0.52289	0.47808
*CO2	0.18466	0.18488	0.19417	0.26461
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00136	0.00136	0.00102	0.00001
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00001	0.00001	0.00001	0.00000
*H2	0.01530	0.01530	0.01543	0.01865
H2O	0.24634	0.24641	0.25171	0.23862
*O	0.00175	0.00173	0.00087	0.00000
*OH	0.01916	0.01904	0.01264	0.00003
*O2	0.00244	0.00242	0.00124	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 FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012928
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7742	50.000
P, BAR	50.663	49.362	28.556	1.0132
T, K	3408.27	3401.70	3178.74	1860.73
RHO, KG/CU M	3.8102 0	3.7201 0	2.3243 0	1.4365-1
H, KJ/KG	-845.27	-862.75	-1561.86	-4751.81
U, KJ/KG	-2174.92	-2189.66	-2790.44	-5457.15
G, KJ/KG	-41328.1	-41284.6	-39334.3	-26862.5
S, KJ/(KG)(K)	11.8778	11.8828	11.8828	11.8828
M, (1/n)	21.312	21.315	21.512	21.934
MW, MOL WT	21.312	21.315	21.512	21.934
(dLV/dLP)t	-1.01560	-1.01552	-1.01042	-1.00007
(dLV/dLT)p	1.2816	1.2807	1.2009	1.0022
Cp, KJ/(KG)(K)	4.1438	4.1408	3.6380	2.0484
GAMMAS	1.1615	1.1614	1.1666	1.2282
SON VEL,M/SEC	1242.7	1241.4	1197.2	930.8
MACH NUMBER	0.000	0.151	1.000	3.003

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0300 1.0286 0.97999 0.67029

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K) 4.1438 4.1408 3.6380 2.0484
CONDUCTIVITY 10.0209 10.0048 8.2933 2.2555
PRANDTL NUMBER 0.4259 0.4257 0.4299 0.6087

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K) 2.1270 2.1266 2.1118 1.9590
CONDUCTIVITY 3.6033 3.5971 3.3760 2.0983
PRANDTL NUMBER 0.6080 0.6081 0.6130 0.6258

PERFORMANCE PARAMETERS

Ae/At 4.0000 1.0000 6.9297
CSTAR, M/SEC 1797.5 1797.5 1797.5
CF 0.1040 0.6660 1.5551
Ivac, M/SEC 7282.9 2223.4 3047.5
Isp, M/SEC 187.0 1197.2 2795.2

MASS FRACTIONS

*CO 0.52873 0.52860 0.52282 0.47795
*CO2 0.18494 0.18515 0.19427 0.26482
COOH 0.00002 0.00002 0.00001 0.00000
*H 0.00128 0.00127 0.00095 0.00001
HCO 0.00004 0.00004 0.00002 0.00000
HO2 0.00001 0.00001 0.00001 0.00000
*H2 0.01529 0.01530 0.01543 0.01866
H2O 0.24762 0.24769 0.25273 0.23853
*O 0.00157 0.00155 0.00076 0.00000
*OH 0.01830 0.01818 0.01191 0.00003
*O2 0.00219 0.00217 0.00109 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 FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012943
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7755	50.000
P, BAR	60.795	59.232	34.241	1.2159
T, K	3424.54	3417.89	3190.02	1859.08
RHO, KG/CU M	4.5572 0	4.4493 0	2.7804 0	1.7254-1
H, KJ/KG	-845.27	-862.83	-1564.85	-4755.46
U, KJ/KG	-2179.32	-2194.11	-2796.37	-5460.17
G, KJ/KG	-41278.0	-41234.0	-39244.5	-26714.4
S, KJ/(KG)(K)	11.8067	11.8117	11.8117	11.8117
M, (1/n)	21.344	21.346	21.537	21.934
MW, MOL WT	21.344	21.346	21.537	21.934
(dLV/dLP)t	-1.01478	-1.01471	-1.00979	-1.00007
(dLV/dLT)p	1.2657	1.2649	1.1880	1.0020
Cp, KJ/(KG)(K)	4.0216	4.0186	3.5363	2.0458
GAMMAS	1.1633	1.1633	1.1686	1.2284
SON VEL,M/SEC	1245.8	1244.5	1199.7	930.4
MACH NUMBER	0.000	0.151	1.000	3.006

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0336	1.0322	0.98251	0.66987
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.0216	4.0186	3.5363	2.0458
CONDUCTIVITY	9.6730	9.6571	7.9953	2.2453
PRANDTL NUMBER	0.4297	0.4295	0.4346	0.6103

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1281	2.1277	2.1126	1.9587
CONDUCTIVITY	3.6146	3.6083	3.3837	2.0967
PRANDTL NUMBER	0.6085	0.6086	0.6134	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.9129
CSTAR, M/SEC	1799.4	1799.4	1799.4
CF	0.1042	0.6667	1.5542
Ivac, M/SEC	7290.6	2226.2	3048.5
Isp, M/SEC	187.4	1199.6	2796.5

MASS FRACTIONS

*CO	0.52859	0.52845	0.52277	0.47784
*CO2	0.18516	0.18537	0.19434	0.26499
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00121	0.00121	0.00089	0.00001
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00001	0.00001	0.00001	0.00000
*H2	0.01529	0.01529	0.01543	0.01867
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.24865	0.24872	0.25353	0.23847
*O	0.00143	0.00141	0.00068	0.00000
*OH	0.01758	0.01747	0.01133	0.00002
*O2	0.00200	0.00199	0.00098	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 FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012957

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7766	50.000
P, BAR	70.927	69.102	39.923	1.4185
T, K	3437.98	3431.24	3199.21	1857.74
RHO, KG/CU M	5.3024 0	5.1767 0	3.2355 0	2.0144-1
H, KJ/KG	-845.27	-862.90	-1567.32	-4758.40
U, KJ/KG	-2182.93	-2197.77	-2801.23	-5462.59
G, KJ/KG	-41230.3	-41186.0	-39163.5	-26590.0
S, KJ/(KG)(K)	11.7467	11.7517	11.7517	11.7517
M, (1/n)	21.370	21.372	21.557	21.935
MW, MOL WT	21.370	21.372	21.557	21.935
(dLV/dLP)t	-1.01411	-1.01404	-1.00927	-1.00006
(dLV/dLT)p	1.2527	1.2519	1.1777	1.0018
Cp, KJ/(KG)(K)	3.9224	3.9195	3.4545	2.0438
GAMMAS	1.1649	1.1649	1.1704	1.2286
SON VEL,M/SEC	1248.3	1247.0	1201.7	930.2
MACH NUMBER	0.000	0.151	1.000	3.008

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0366	1.0351	0.98457	0.66953
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.9224	3.9195	3.4545	2.0438
CONDUCTIVITY	9.3887	9.3730	7.7536	2.2375
PRANDTL NUMBER	0.4331	0.4329	0.4387	0.6116

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1289	2.1285	2.1132	1.9584
CONDUCTIVITY	3.6239	3.6176	3.3899	2.0954
PRANDTL NUMBER	0.6090	0.6091	0.6138	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8994
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CSTAR, M/SEC	1800.9	1800.9	1800.9
CF	0.1043	0.6673	1.5534
Ivac, M/SEC	7296.8	2228.5	3049.3
Isp, M/SEC	187.8	1201.7	2797.5

MASS FRACTIONS

*CO	0.52846	0.52833	0.52273	0.47775
*CO2	0.18535	0.18555	0.19441	0.26512
COOH	0.00003	0.00002	0.00001	0.00000
*H	0.00116	0.00115	0.00084	0.00001
HCO	0.00005	0.00005	0.00002	0.00000
HO2	0.00001	0.00001	0.00001	0.00000
*H2	0.01528	0.01528	0.01543	0.01868
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.24951	0.24957	0.25418	0.23842
*O	0.00131	0.00130	0.00062	0.00000
*OH	0.01698	0.01687	0.01085	0.00002
*O2	0.00185	0.00184	0.00089	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 FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012968
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0264	1.7776	50.000
P, BAR	81.060	78.972	45.602	1.6212
T, K	3449.37	3442.57	3206.91	1856.63
RHO, KG/CU M	6.0460 0	5.9027 0	3.6897 0	2.3036-1
H, KJ/KG	-845.27	-862.95	-1569.42	-4760.84
U, KJ/KG	-2185.98	-2200.86	-2805.33	-5464.60
G, KJ/KG	-41185.0	-41140.3	-39089.7	-26483.0
S, KJ/(KG)(K)	11.6948	11.6998	11.6998	11.6998
M, (1/n)	21.391	21.394	21.574	21.935
MW, MOL WT	21.391	21.394	21.574	21.935
(dLV/dLP)t	-1.01354	-1.01347	-1.00884	-1.00006
(dLV/dLT)p	1.2418	1.2410	1.1690	1.0017
Cp, KJ/(KG)(K)	3.8396	3.8367	3.3867	2.0423
GAMMA _s	1.1663	1.1662	1.1719	1.2288

SON VEL,M/SEC	1250.5	1249.1	1203.5	929.9
MACH NUMBER	0.000	0.151	1.000	3.009

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0391	1.0376	0.98629	0.66925
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.8396	3.8367	3.3867	2.0423
CONDUCTIVITY	9.1498	9.1343	7.5520	2.2312
PRANDTL NUMBER	0.4360	0.4358	0.4423	0.6126

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1296	2.1292	2.1137	1.9582
CONDUCTIVITY	3.6317	3.6254	3.3951	2.0943
PRANDTL NUMBER	0.6093	0.6094	0.6140	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8882
CSTAR, M/SEC	1802.1	1802.1	1802.1
CF	0.1044	0.6678	1.5528
Ivac, M/SEC	7302.0	2230.4	3049.9
Isp, M/SEC	188.1	1203.5	2798.4

MASS FRACTIONS

*CO	0.52835	0.52822	0.52269	0.47768
*CO2	0.18551	0.18572	0.19446	0.26524
COOH	0.00003	0.00003	0.00001	0.00000
*H	0.00111	0.00111	0.00081	0.00001
HCO	0.00005	0.00005	0.00003	0.00000
H02	0.00001	0.00001	0.00000	0.00000
*H2	0.01528	0.01528	0.01543	0.01868
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25024	0.25030	0.25474	0.23837
*O	0.00122	0.00121	0.00057	0.00000
*OH	0.01646	0.01635	0.01043	0.00002
*O2	0.00173	0.00171	0.00082	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 FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012979
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0265	1.7784	50.000
P, BAR	91.192	88.842	51.278	1.8238
T, K	3459.22	3452.36	3213.51	1855.68
RHO, KG/CU M	6.7885 0	6.6274 0	4.1433 0	2.5929-1
H, KJ/KG	-845.27	-863.00	-1571.23	-4762.91
U, KJ/KG	-2188.62	-2203.52	-2808.85	-5466.31
G, KJ/KG	-41141.9	-41097.0	-39021.7	-26389.1
S, KJ/(KG)(K)	11.6490	11.6540	11.6540	11.6540
M, (1/n)	21.411	21.413	21.589	21.935
MW, MOL WT	21.411	21.413	21.589	21.935
(dLV/dLP)t	-1.01304	-1.01298	-1.00847	-1.00005
(dLV/dLT)p	1.2324	1.2316	1.1616	1.0016
Cp, KJ/(KG)(K)	3.7689	3.7661	3.3292	2.0410
GAMMAS	1.1675	1.1674	1.1732	1.2289
SON VEL,M/SEC	1252.3	1251.0	1205.0	929.7
MACH NUMBER	0.000	0.151	1.000	3.011

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0413	1.0398	0.98777	0.66901
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.7689	3.7661	3.3292	2.0410
CONDUCTIVITY	8.9448	8.9294	7.3799	2.2260
PRANDTL NUMBER	0.4387	0.4385	0.4456	0.6134

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1302	2.1298	2.1142	1.9581
CONDUCTIVITY	3.6385	3.6321	3.3995	2.0934
PRANDTL NUMBER	0.6096	0.6097	0.6143	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8786
CSTAR, M/SEC	1803.2	1803.2	1803.2
CF	0.1044	0.6682	1.5523
Ivac, M/SEC	7306.4	2232.1	3050.4
Isp, M/SEC	188.3	1205.0	2799.2

MASS FRACTIONS

*CO	0.52825	0.52812	0.52265	0.47762
*CO2	0.18566	0.18586	0.19451	0.26533
COOH	0.00003	0.00003	0.00001	0.00000
*H	0.00107	0.00107	0.00077	0.00001
HCO	0.00006	0.00006	0.00003	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01527	0.01527	0.01543	0.01869
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.25087	0.25093	0.25521	0.23833
*O	0.00114	0.00113	0.00053	0.00000
*OH	0.01600	0.01589	0.01007	0.00002

*O2 0.00162 0.00161 0.00076 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 FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012988

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.10000 %FUEL= 32.258065 R,EQ.RATIO= 1.621746 PHI,EQ.RATIO= 1.621746

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0265	1.7791	50.000
P, BAR	101.33	98.712	56.952	2.0265
T, K	3467.87	3460.96	3219.26	1854.86
RHO, KG/CU M	7.5298 0	7.3511 0	4.5962 0	2.8823-1
H, KJ/KG	-845.27	-863.05	-1572.83	-4764.70
U, KJ/KG	-2190.92	-2205.86	-2811.93	-5467.78
G, KJ/KG	-41100.8	-41055.6	-38958.6	-26305.4
S, KJ/(KG)(K)	11.6081	11.6131	11.6131	11.6131
M, (1/n)	21.427	21.430	21.602	21.935
MW, MOL WT	21.427	21.430	21.602	21.935
(dLV/dLP)t	-1.01261	-1.01255	-1.00815	-1.00005
(dLV/dLT)p	1.2242	1.2234	1.1552	1.0015
Cp, KJ/(KG)(K)	3.7075	3.7047	3.2795	2.0399
GAMMAS	1.1685	1.1685	1.1744	1.2290
SON VEL,M/SEC	1254.0	1252.6	1206.3	929.6
MACH NUMBER	0.000	0.151	1.000	3.012

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0432 1.0417 0.98905 0.66881

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	3.7075	3.7047	3.2795	2.0399
CONDUCTIVITY	8.7659	8.7506	7.2306	2.2216
PRANDTL NUMBER	0.4412	0.4410	0.4486	0.6141

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1308	2.1304	2.1146	1.9579
CONDUCTIVITY	3.6445	3.6381	3.4034	2.0926
PRANDTL NUMBER	0.6099	0.6100	0.6145	0.6258

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	6.8704
CSTAR, M/SEC	1804.1	1804.1	1804.1
CF	0.1045	0.6686	1.5519
Ivac, M/SEC	7310.2	2233.5	3050.9
Isp, M/SEC	188.6	1206.3	2799.8

MASS FRACTIONS

*CO	0.52816	0.52804	0.52262	0.47757
*CO2	0.18578	0.18598	0.19455	0.26541
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00103	0.00103	0.00075	0.00001
HCO	0.00006	0.00006	0.00003	0.00000
HO2	0.00001	0.00001	0.00000	0.00000
*H2	0.01527	0.01527	0.01543	0.01869
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.25143	0.25149	0.25563	0.23830
*O	0.00108	0.00107	0.00049	0.00000
*OH	0.01559	0.01548	0.00975	0.00002
*O2	0.00153	0.00152	0.00071	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 FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012729
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7568	50.000
P, BAR	10.133	9.8763	5.7675	0.20265
T, K	3301.26	3295.63	3125.38	2012.52
RHO, KG/CU M	7.9165-1	7.7310-1	4.8214-1	2.7397-2
H, KJ/KG	-831.53	-848.10	-1513.19	-4743.83
U, KJ/KG	-2111.46	-2125.60	-2709.41	-5483.50
G, KJ/KG	-41735.0	-41697.9	-40252.7	-29689.3
S, KJ/(KG)(K)	12.3902	12.3952	12.3952	12.3952
M, (1/n)	21.445	21.449	21.723	22.622
MW, MOL WT	21.445	21.449	21.723	22.622

(dLV/dLP)t	-1.03008	-1.02998	-1.02314	-1.00050
(dLV/dLT)p	1.5612	1.5604	1.4557	1.0141
Cp, KJ/(KG)(K)	6.2039	6.2035	5.5664	2.1600
GAMMAS	1.1393	1.1392	1.1397	1.2114
SON VEL,M/SEC	1207.5	1206.3	1167.6	946.6
MACH NUMBER	0.000	0.151	1.000	2.955

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0148	1.0136	0.97663	0.71576
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.2039	6.2035	5.5664	2.1600
CONDUCTIVITY	15.0793	15.0679	13.1092	2.7687
PRANDTL NUMBER	0.4175	0.4173	0.4147	0.5584

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0961	2.0957	2.0847	1.9628
CONDUCTIVITY	3.4733	3.4680	3.2935	2.1937
PRANDTL NUMBER	0.6124	0.6125	0.6182	0.6404

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3457
CSTAR, M/SEC	1777.3	1777.3	1777.3
CF	0.1024	0.6570	1.5739
Ivac, M/SEC	7199.6	2192.1	3061.7
Isp, M/SEC	182.0	1167.6	2797.2

MASS FRACTIONS

*CO	0.49754	0.49737	0.48951	0.44624
*CO2	0.20226	0.20254	0.21490	0.28289
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00202	0.00202	0.00166	0.00007
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00002	0.00002	0.00001	0.00000
*H2	0.01310	0.01310	0.01304	0.01530
H2O	0.24120	0.24131	0.24897	0.25522
*O	0.00494	0.00491	0.00313	0.00000
*OH	0.03098	0.03084	0.02352	0.00026
*O2	0.00791	0.00787	0.00525	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 FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012777
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7610	50.000
P, BAR	20.265	19.751	11.508	0.40530
T, K	3380.60	3374.63	3188.96	2002.97
RHO, KG/CU M	1.5572 0	1.5206 0	9.4883-1	5.5075-2
H, KJ/KG	-831.53	-848.44	-1526.55	-4770.11
U, KJ/KG	-2132.90	-2147.29	-2739.42	-5506.02
G, KJ/KG	-41812.7	-41773.8	-40200.2	-29060.8
S, KJ/(KG)(K)	12.1225	12.1274	12.1274	12.1274
M, (1/n)	21.599	21.603	21.861	22.630
MW, MOL WT	21.599	21.603	21.861	22.630
(dLV/dLP)t	-1.02609	-1.02600	-1.01950	-1.00033
(dLV/dLT)p	1.4771	1.4763	1.3777	1.0093
Cp, KJ/(KG)(K)	5.5021	5.5013	4.9118	2.1095
GAMMAS	1.1449	1.1448	1.1461	1.2152
SON VEL,M/SEC	1220.6	1219.4	1179.0	945.7
MACH NUMBER	0.000	0.151	1.000	2.968

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0328	1.0315	0.99125	0.71335
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.5021	5.5013	4.9118	2.1095
CONDUCTIVITY	13.3109	13.2991	11.4527	2.5873
PRANDTL NUMBER	0.4269	0.4267	0.4251	0.5816

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1011	2.1008	2.0891	1.9612
CONDUCTIVITY	3.5288	3.5233	3.3376	2.1839
PRANDTL NUMBER	0.6149	0.6150	0.6204	0.6406

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2371
CSTAR, M/SEC	1788.7	1788.7	1788.7
CF	0.1028	0.6592	1.5691
Ivac, M/SEC	7246.1	2207.7	3068.8
Isp, M/SEC	183.9	1179.0	2806.6

MASS FRACTIONS

*CO	0.49642	0.49625	0.48870	0.44579
*CO2	0.20401	0.20427	0.21616	0.28360
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00173	0.00173	0.00139	0.00005
HCO	0.00002	0.00002	0.00001	0.00000
HO2	0.00002	0.00002	0.00001	0.00000
*H2	0.01300	0.01300	0.01296	0.01535
H2O	0.24599	0.24609	0.25329	0.25504

*O	0.00390	0.00387	0.00236	0.00000
*OH	0.02851	0.02838	0.02108	0.00017
*O2	0.00638	0.00635	0.00403	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 FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012807
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0261	1.7635	50.000
P, BAR	30.398	29.624	17.237	0.60795
T, K	3425.85	3419.68	3224.33	1997.65
RHO, KG/CU M	2.3144 0	2.2599 0	1.4106 0	8.2844-2
H, KJ/KG	-831.53	-848.64	-1534.20	-4783.73
U, KJ/KG	-2144.95	-2159.48	-2756.19	-5517.59
G, KJ/KG	-41827.7	-41787.6	-40134.5	-28698.8
S, KJ/(KG)(K)	11.9667	11.9716	11.9716	11.9716
M, (1/n)	21.687	21.691	21.939	22.633
MW, MOL WT	21.687	21.691	21.939	22.633
(dLV/dLP)t	-1.02381	-1.02372	-1.01748	-1.00026
(dLV/dLT)p	1.4304	1.4297	1.3353	1.0073
Cp, KJ/(KG)(K)	5.1274	5.1263	4.5677	2.0883
GAMMAS	1.1484	1.1483	1.1500	1.2169
SON VEL,M/SEC	1228.1	1226.9	1185.5	945.0
MACH NUMBER	0.000	0.151	1.000	2.975

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0430	1.0416	0.99935	0.71201
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.1274	5.1263	4.5677	2.0883
CONDUCTIVITY	12.3491	12.3371	10.5648	2.5100
PRANDTL NUMBER	0.4330	0.4328	0.4321	0.5924

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1040	2.1036	2.0915	1.9603
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CONDUCTIVITY	3.5604	3.5547	3.3621	2.1786
PRANDTL NUMBER	0.6163	0.6164	0.6217	0.6407

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.1795
CSTAR, M/SEC	1794.8	1794.8	1794.8
CF	0.1031	0.6605	1.5664
Ivac, M/SEC	7271.3	2216.3	3072.5
Isp, M/SEC	185.0	1185.5	2811.5

MASS FRACTIONS

*CO	0.49570	0.49554	0.48820	0.44553
*CO2	0.20512	0.20537	0.21693	0.28400
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00157	0.00156	0.00125	0.00004
HCO	0.00003	0.00003	0.00001	0.00000
HO2	0.00003	0.00003	0.00001	0.00000
*H2	0.01294	0.01294	0.01292	0.01538
H2O	0.24878	0.24888	0.25575	0.25491
*O	0.00334	0.00332	0.00196	0.00000
*OH	0.02693	0.02679	0.01956	0.00013
*O2	0.00554	0.00551	0.00339	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 FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012829
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0261	1.7654	50.000
P, BAR	40.530	39.497	22.959	0.81060
T, K	3457.26	3450.94	3248.44	1994.05
RHO, KG/CU M	3.0665 0	2.9943 0	1.8694 0	1.1067-1
H, KJ/KG	-831.53	-848.78	-1539.52	-4792.64
U, KJ/KG	-2153.24	-2167.86	-2767.67	-5525.12
G, KJ/KG	-41822.8	-41781.9	-40070.7	-28445.0
S, KJ/(KG)(K)	11.8566	11.8614	11.8614	11.8614
M, (1/n)	21.749	21.752	21.992	22.635

MW, MOL WT	21.749	21.752	21.992	22.635
(dLV/dLP)t	-1.02221	-1.02213	-1.01609	-1.00022
(dLV/dLT)p	1.3986	1.3978	1.3069	1.0062
Cp, KJ/(KG)(K)	4.8775	4.8764	4.3411	2.0761
GAMMAS	1.1509	1.1508	1.1529	1.2179
SON VEL,M/SEC	1233.3	1232.1	1190.0	944.5
MACH NUMBER	0.000	0.151	1.000	2.980

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0500	1.0487	1.0049	0.71111
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.8775	4.8764	4.3411	2.0761
CONDUCTIVITY	11.7004	11.6884	9.9723	2.4650
PRANDTL NUMBER	0.4377	0.4375	0.4374	0.5989

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1059	2.1056	2.0932	1.9597
CONDUCTIVITY	3.5822	3.5764	3.3787	2.1750
PRANDTL NUMBER	0.6173	0.6174	0.6225	0.6407

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.1414
CSTAR, M/SEC	1798.9	1798.9	1798.9
CF	0.1032	0.6615	1.5646
Ivac, M/SEC	7288.1	2222.1	3074.9
Isp, M/SEC	185.7	1189.9	2814.6

MASS FRACTIONS

*CO	0.49517	0.49502	0.48785	0.44536
*CO2	0.20594	0.20619	0.21748	0.28429
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00146	0.00145	0.00115	0.00003
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00003	0.00003	0.00001	0.00000
*H2	0.01290	0.01290	0.01290	0.01539
H2O	0.25075	0.25084	0.25744	0.25482
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00297	0.00295	0.00171	0.00000
*OH	0.02574	0.02561	0.01846	0.00011
*O2	0.00498	0.00495	0.00297	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 FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012847
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7668	50.000
P, BAR	50.663	49.370	28.674	1.0132
T, K	3481.14	3474.71	3266.52	1991.38
RHO, KG/CU M	3.8151 0	3.7252 0	2.3261 0	1.3853-1
H, KJ/KG	-831.53	-848.88	-1543.57	-4799.13
U, KJ/KG	-2159.49	-2174.19	-2776.32	-5530.58
G, KJ/KG	-41809.3	-41767.8	-40010.8	-28250.1
S, KJ/(KG)(K)	11.7714	11.7762	11.7762	11.7762
M, (1/n)	21.796	21.799	22.032	22.636
MW, MOL WT	21.796	21.799	22.032	22.636
(dLV/dLP)t	-1.02100	-1.02092	-1.01505	-1.00019
(dLV/dLT)p	1.3746	1.3739	1.2857	1.0054
Cp, KJ/(KG)(K)	4.6930	4.6917	4.1752	2.0680
GAMMAS	1.1529	1.1528	1.1552	1.2186
SON VEL,M/SEC	1237.3	1236.0	1193.4	944.1
MACH NUMBER	0.000	0.151	1.000	2.984

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0554	1.0540	1.0090	0.71043
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.6930	4.6917	4.1752	2.0680
CONDUCTIVITY	11.2171	11.2051	9.5346	2.4349
PRANDTL NUMBER	0.4415	0.4413	0.4418	0.6034

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1074	2.1071	2.0944	1.9592
CONDUCTIVITY	3.5988	3.5929	3.3912	2.1724
PRANDTL NUMBER	0.6180	0.6181	0.6232	0.6407

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.1135
CSTAR, M/SEC	1802.0	1802.0	1802.0
CF	0.1034	0.6622	1.5632
Ivac, M/SEC	7300.6	2226.4	3076.6
Isp, M/SEC	186.3	1193.4	2816.9

MASS FRACTIONS

*CO	0.49475	0.49460	0.48757	0.44522
*CO2	0.20659	0.20683	0.21791	0.28450
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00137	0.00137	0.00108	0.00003
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00003	0.00003	0.00001	0.00000

*H2	0.01287	0.01287	0.01288	0.01541
H2O	0.25226	0.25235	0.25873	0.25475
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00270	0.00268	0.00152	0.00000
*OH	0.02480	0.02467	0.01760	0.00010
*O2	0.00456	0.00453	0.00267	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 FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012861
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7680	50.000
P, BAR	60.795	59.242	34.386	1.2159
T, K	3500.31	3493.78	3280.85	1989.28
RHO, KG/CU M	4.5609 0	4.4534 0	2.7812 0	1.6641-1
H, KJ/KG	-831.53	-848.97	-1546.83	-4804.16
U, KJ/KG	-2164.49	-2179.25	-2783.20	-5534.81
G, KJ/KG	-41791.6	-41749.7	-39954.9	-28092.1
S, KJ/(KG)(K)	11.7019	11.7067	11.7067	11.7067

M, (1/n)	21.834	21.837	22.064	22.637
MW, MOL WT	21.834	21.837	22.064	22.637
(dLV/dLP)t	-1.02003	-1.01995	-1.01423	-1.00017
(dLV/dLT)p	1.3556	1.3548	1.2691	1.0049
Cp, KJ/(KG)(K)	4.5481	4.5468	4.0461	2.0621
GAMMAS	1.1545	1.1544	1.1571	1.2191
SON VEL,M/SEC	1240.5	1239.2	1196.1	943.8
MACH NUMBER	0.000	0.151	1.000	2.987

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0597	1.0583	1.0123	0.70991
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.5481	4.5468	4.0461	2.0621
CONDUCTIVITY	10.8352	10.8232	9.1913	2.4129
PRANDTL NUMBER	0.4448	0.4446	0.4456	0.6067

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1086	2.1082	2.0954	1.9589
CONDUCTIVITY	3.6121	3.6062	3.4011	2.1703
PRANDTL NUMBER	0.6186	0.6187	0.6236	0.6407

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.0917
CSTAR, M/SEC	1804.4	1804.4	1804.4
CF	0.1035	0.6629	1.5622
Ivac, M/SEC	7310.4	2229.8	3077.9
Isp, M/SEC	186.7	1196.1	2818.7

MASS FRACTIONS

*CO	0.49441	0.49426	0.48735	0.44511
*CO2	0.20712	0.20735	0.21826	0.28466
COOH	0.00003	0.00003	0.00001	0.00000
*H	0.00131	0.00130	0.00102	0.00003
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00003	0.00003	0.00001	0.00000
*H2	0.01285	0.01285	0.01286	0.01542
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25349	0.25357	0.25976	0.25469
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00249	0.00247	0.00138	0.00000
*OH	0.02401	0.02388	0.01689	0.00009
*O2	0.00423	0.00420	0.00243	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 FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012873

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7691	50.000
P, BAR	70.927	69.114	40.093	1.4185
T, K	3516.25	3509.64	3292.66	1987.56
RHO, KG/CU M	5.3046 0	5.1794 0	3.2351 0	1.9432-1
H, KJ/KG	-831.53	-849.04	-1549.55	-4808.22

U, KJ/KG	-2168.63	-2183.43	-2788.89	-5538.22
G, KJ/KG	-41771.9	-41729.6	-39902.7	-27959.5
S, KJ/(KG)(K)	11.6432	11.6481	11.6481	11.6481
M, (1/n)	21.865	21.868	22.090	22.638
MW, MOL WT	21.865	21.868	22.090	22.638
(dLV/dLP)t	-1.01922	-1.01914	-1.01355	-1.00016
(dLV/dLT)p	1.3399	1.3391	1.2555	1.0045
Cp, KJ/(KG)(K)	4.4299	4.4285	3.9415	2.0575
GAMMAS	1.1559	1.1558	1.1587	1.2194
SON VEL,M/SEC	1243.2	1241.9	1198.4	943.5
MACH NUMBER	0.000	0.151	1.000	2.989

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0633	1.0618	1.0149	0.70947
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.4299	4.4285	3.9415	2.0575
CONDUCTIVITY	10.5217	10.5097	8.9111	2.3960
PRANDTL NUMBER	0.4477	0.4474	0.4489	0.6092

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1096	2.1092	2.0962	1.9586
CONDUCTIVITY	3.6231	3.6171	3.4092	2.1687
PRANDTL NUMBER	0.6191	0.6192	0.6241	0.6407

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.0740
CSTAR, M/SEC	1806.3	1806.3	1806.3
CF	0.1036	0.6634	1.5613
Ivac, M/SEC	7318.3	2232.6	3079.0
Isp, M/SEC	187.1	1198.3	2820.2

MASS FRACTIONS

*CO	0.49411	0.49396	0.48716	0.44503
*CO2	0.20757	0.20780	0.21855	0.28480
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00125	0.00125	0.00097	0.00002
HCO	0.00005	0.00005	0.00002	0.00000
HO2	0.00003	0.00003	0.00001	0.00000
*H2	0.01283	0.01283	0.01285	0.01543
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25451	0.25459	0.26061	0.25464
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00232	0.00230	0.00127	0.00000
*OH	0.02333	0.02321	0.01629	0.00008
*O2	0.00396	0.00393	0.00225	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 FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012884

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0263	1.7700	50.000
P, BAR	81.060	78.986	45.798	1.6212
T, K	3529.84	3523.17	3302.64	1986.12
RHO, KG/CU M	6.0465 0	5.9038 0	3.6879 0	2.2225-1
H, KJ/KG	-831.53	-849.10	-1551.87	-4811.61
U, KJ/KG	-2172.14	-2186.99	-2793.71	-5541.06
G, KJ/KG	-41751.1	-41708.5	-39853.6	-27845.3
S, KJ/(KG)(K)	11.5925	11.5973	11.5973	11.5973
M, (1/n)	21.892	21.895	22.112	22.638
MW, MOL WT	21.892	21.895	22.112	22.638
(dLV/dLP)t	-1.01853	-1.01845	-1.01298	-1.00015
(dLV/dLT)p	1.3265	1.3258	1.2441	1.0042
Cp, KJ/(KG)(K)	4.3305	4.3291	3.8541	2.0540
GAMMAS	1.1571	1.1571	1.1601	1.2197
SON VEL,M/SEC	1245.5	1244.2	1200.3	943.3
MACH NUMBER	0.000	0.151	1.000	2.991

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0663	1.0649	1.0172	0.70911
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.3305	4.3291	3.8541	2.0540
CONDUCTIVITY	10.2570	10.2450	8.6759	2.3825
PRANDTL NUMBER	0.4502	0.4500	0.4519	0.6113

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1105	2.1101	2.0969	1.9583
CONDUCTIVITY	3.6325	3.6265	3.4160	2.1673
PRANDTL NUMBER	0.6195	0.6196	0.6244	0.6408

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.0593
CSTAR, M/SEC	1808.0	1808.0	1808.0
CF	0.1037	0.6639	1.5605
Ivac, M/SEC	7325.0	2234.9	3079.9
Isp, M/SEC	187.4	1200.3	2821.4

MASS FRACTIONS

*CO	0.49386	0.49371	0.48700	0.44495
*CO2	0.20796	0.20819	0.21879	0.28492
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00121	0.00120	0.00093	0.00002
HCO	0.00005	0.00005	0.00003	0.00000
HO2	0.00003	0.00003	0.00001	0.00000
*H2	0.01281	0.01281	0.01284	0.01543
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25539	0.25547	0.26133	0.25460
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00218	0.00216	0.00118	0.00000
*OH	0.02274	0.02262	0.01577	0.00007
*O2	0.00373	0.00371	0.00209	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 FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012893

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0263	1.7708	50.000
P, BAR	91.192	88.857	51.499	1.8238
T, K	3541.67	3534.94	3311.25	1984.88
RHO, KG/CU M	6.7869 0	6.6266 0	4.1398 0	2.5019-1
H, KJ/KG	-831.53	-849.15	-1553.89	-4814.49
U, KJ/KG	-2175.19	-2190.08	-2797.89	-5543.48
G, KJ/KG	-41729.8	-41686.9	-39807.4	-27745.1
S, KJ/(KG)(K)	11.5477	11.5526	11.5526	11.5526

M, (1/n)	21.916	21.919	22.131	22.639
MW, MOL WT	21.916	21.919	22.131	22.639
(dLV/dLP)t	-1.01792	-1.01785	-1.01249	-1.00014
(dLV/dLT)p	1.3150	1.3143	1.2343	1.0039
Cp, KJ/(KG)(K)	4.2453	4.2439	3.7796	2.0510
GAMMAS	1.1582	1.1581	1.1614	1.2200
SON VEL,M/SEC	1247.5	1246.2	1202.0	943.1
MACH NUMBER	0.000	0.151	1.000	2.993

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0689	1.0675	1.0192	0.70880
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.2453	4.2439	3.7796	2.0510
CONDUCTIVITY	10.0289	10.0169	8.4743	2.3714
PRANDTL NUMBER	0.4525	0.4523	0.4546	0.6130

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1112	2.1108	2.0974	1.9581
CONDUCTIVITY	3.6407	3.6346	3.4219	2.1661
PRANDTL NUMBER	0.6199	0.6199	0.6247	0.6408

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.0467
CSTAR, M/SEC	1809.3	1809.3	1809.3
CF	0.1038	0.6643	1.5599
Ivac, M/SEC	7330.7	2236.9	3080.7
Isp, M/SEC	187.7	1202.0	2822.4

MASS FRACTIONS

*CO	0.49363	0.49349	0.48686	0.44489
*CO2	0.20831	0.20853	0.21901	0.28502
COOH	0.00004	0.00003	0.00002	0.00000
*H	0.00117	0.00116	0.00090	0.00002
HCO	0.00006	0.00005	0.00003	0.00000
HO2	0.00003	0.00003	0.00001	0.00000
*H2	0.01280	0.01280	0.01283	0.01544
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.25616	0.25623	0.26196	0.25457
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00206	0.00204	0.00110	0.00000
*OH	0.02221	0.02209	0.01532	0.00007
*O2	0.00354	0.00351	0.00196	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 FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012902

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.20000 %FUEL= 31.250000 R,EQ.RATIO= 1.548030 PHI,EQ.RATIO= 1.548030

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0263	1.7715	50.000
P, BAR	101.33	98.729	57.198	2.0265
T, K	3552.11	3545.32	3318.79	1983.81
RHO, KG/CU M	7.5260 0	7.3481 0	4.5910 0	2.7814-1
H, KJ/KG	-831.53	-849.20	-1555.67	-4816.99
U, KJ/KG	-2177.87	-2192.79	-2801.55	-5545.57
G, KJ/KG	-41708.4	-41665.2	-39763.8	-27655.9
S, KJ/(KG)(K)	11.5078	11.5127	11.5127	11.5127
M, (1/n)	21.937	21.939	22.148	22.639
MW, MOL WT	21.937	21.939	22.148	22.639
(dLV/dLP)t	-1.01739	-1.01732	-1.01205	-1.00013
(dLV/dLT)p	1.3049	1.3042	1.2257	1.0037
Cp, KJ/(KG)(K)	4.1709	4.1695	3.7149	2.0485
GAMMAS	1.1592	1.1591	1.1625	1.2202
SON VEL,M/SEC	1249.3	1248.0	1203.5	942.9
MACH NUMBER	0.000	0.151	1.000	2.994

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0713	1.0698	1.0209	0.70852
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.1709	4.1695	3.7149	2.0485
CONDUCTIVITY	9.8292	9.8172	8.2985	2.3621
PRANDTL NUMBER	0.4546	0.4544	0.4570	0.6145

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.1118	2.1114	2.0979	1.9580
CONDUCTIVITY	3.6479	3.6418	3.4271	2.1650
PRANDTL NUMBER	0.6202	0.6202	0.6249	0.6408

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.0358
CSTAR, M/SEC	1810.6	1810.6	1810.6
CF	0.1038	0.6647	1.5593
Ivac, M/SEC	7335.7	2238.7	3081.3
Isp, M/SEC	188.0	1203.4	2823.3

MASS FRACTIONS

*CO	0.49343	0.49329	0.48673	0.44483
*CO2	0.20861	0.20884	0.21920	0.28511
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00113	0.00113	0.00087	0.00002
HCO	0.00006	0.00006	0.00003	0.00000
HO2	0.00003	0.00003	0.00001	0.00000
*H2	0.01278	0.01278	0.01282	0.01544
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.25684	0.25691	0.26251	0.25453
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00195	0.00194	0.00104	0.00000
*OH	0.02174	0.02162	0.01491	0.00006
*O2	0.00337	0.00335	0.00185	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 FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012682
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7525	50.000
P, BAR	10.133	9.8772	5.7817	0.20265
T, K	3338.64	3333.09	3171.85	2141.88
RHO, KG/CU M	7.9744-1	7.7880-1	4.8556-1	2.6512-2
H, KJ/KG	-818.62	-835.01	-1493.21	-4758.59
U, KJ/KG	-2089.25	-2103.28	-2683.94	-5522.96
G, KJ/KG	-41796.0	-41760.3	-40438.6	-31057.6
S, KJ/(KG)(K)	12.2737	12.2785	12.2785	12.2785
M, (1/n)	21.847	21.851	22.148	23.299
MW, MOL WT	21.847	21.851	22.148	23.299
(dLV/dLP)t	-1.03656	-1.03647	-1.02969	-1.00117
(dLV/dLT)p	1.6778	1.6773	1.5799	1.0319
Cp, KJ/(KG)(K)	6.9096	6.9127	6.3691	2.3155
GAMMAS	1.1344	1.1343	1.1331	1.1946
SON VEL,M/SEC	1200.6	1199.4	1161.5	955.6
MACH NUMBER	0.000	0.151	1.000	2.938

TRANSPORT PROPERTIES (GASES ONLY) CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0310 1.0297 0.99512 0.75584

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.9096	6.9127	6.3691	2.3155
CONDUCTIVITY	16.3915	16.3862	14.6257	3.3638
PRANDTL NUMBER	0.4346	0.4344	0.4333	0.5203

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0755	2.0752	2.0655	1.9625
CONDUCTIVITY	3.4472	3.4421	3.2809	2.2728
PRANDTL NUMBER	0.6207	0.6208	0.6265	0.6526

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.5783
CSTAR, M/SEC	1774.1	1774.1	1774.1

CF	0.1021	0.6547	1.5823
Ivac, M/SEC	7186.2	2186.7	3079.4
Isp, M/SEC	181.0	1161.5	2807.1

MASS FRACTIONS

*CO	0.46732	0.46712	0.45795	0.41222
*CO2	0.21993	0.22024	0.23467	0.30653
COOH	0.00001	0.00001	0.00000	0.00000
*H	0.00204	0.00204	0.00172	0.00015
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00003	0.00003	0.00002	0.00000
*H2	0.01127	0.01127	0.01111	0.01246
H2O	0.24211	0.24223	0.25041	0.26776
*O	0.00697	0.00694	0.00482	0.00001
*OH	0.03731	0.03717	0.02977	0.00085
*O2	0.01299	0.01294	0.00952	0.00002

* 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 FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012724
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7560	50.000
P, BAR	20.265	19.753	11.540	0.40530
T, K	3424.74	3418.86	3243.64	2133.30
RHO, KG/CU M	1.5669 0	1.5302 0	9.5451-1	5.3279-2
H, KJ/KG	-818.62	-835.36	-1506.88	-4791.81
U, KJ/KG	-2111.91	-2126.19	-2715.91	-5552.52
G, KJ/KG	-41952.7	-41915.2	-40481.4	-30424.8
S, KJ/(KG)(K)	12.0109	12.0157	12.0157	12.0157
M, (1/n)	22.018	22.022	22.307	23.317
MW, MOL WT	22.018	22.022	22.307	23.317
(dLV/dLP)t	-1.03238	-1.03230	-1.02568	-1.00078
(dLV/dLT)p	1.5875	1.5870	1.4924	1.0212
Cp, KJ/(KG)(K)	6.1522	6.1544	5.6342	2.2099
GAMMAS	1.1394	1.1392	1.1385	1.2012
SON VEL,M/SEC	1213.9	1212.7	1173.2	955.9
MACH NUMBER	0.000	0.151	1.000	2.949

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0507 1.0494 1.0119 0.75370

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K) 6.1522 6.1544 5.6342 2.2099
CONDUCTIVITY 14.5615 14.5552 12.8684 3.0150
PRANDTL NUMBER 0.4439 0.4437 0.4430 0.5524

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K) 2.0809 2.0806 2.0705 1.9611
CONDUCTIVITY 3.5074 3.5021 3.3312 2.2631
PRANDTL NUMBER 0.6234 0.6235 0.6289 0.6531

PERFORMANCE PARAMETERS

Ae/At 4.0000 1.0000 7.4565
CSTAR, M/SEC 1786.8 1786.8 1786.8
CF 0.1024 0.6566 1.5776
Ivac, M/SEC 7238.3 2203.7 3088.8
Isp, M/SEC 183.0 1173.2 2818.9

MASS FRACTIONS

*CO 0.46545 0.46527 0.45634 0.41192
*CO2 0.22285 0.22314 0.23718 0.30700
COOH 0.00001 0.00001 0.00001 0.00000
*H 0.00176 0.00176 0.00147 0.00010
HCO 0.00002 0.00002 0.00001 0.00000
HO2 0.00004 0.00004 0.00002 0.00000
*H2 0.01112 0.01112 0.01097 0.01251
H2O 0.24720 0.24731 0.25517 0.26790
H2O2 0.00001 0.00001 0.00000 0.00000
*O 0.00567 0.00564 0.00379 0.00001
*OH 0.03498 0.03484 0.02735 0.00056
*O2 0.01089 0.01085 0.00768 0.00001

* 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 FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012750
CASE = _____

REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
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FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7582	50.000
P, BAR	30.398	29.628	17.289	0.60795
T, K	3474.54	3468.47	3284.43	2127.94
RHO, KG/CU M	2.3272 0	2.2726 0	1.4180 0	8.0145-2
H, KJ/KG	-818.62	-835.56	-1514.77	-4809.32
U, KJ/KG	-2124.80	-2139.23	-2734.04	-5567.88
G, KJ/KG	-42020.2	-41981.6	-40477.6	-30052.9
S, KJ/(KG)(K)	11.8581	11.8629	11.8629	11.8629
M, (1/n)	22.117	22.121	22.397	23.324
MW, MOL WT	22.117	22.121	22.397	23.324
(dLV/dLP)t	-1.02994	-1.02986	-1.02338	-1.00061
(dLV/dLT)p	1.5366	1.5361	1.4437	1.0167
Cp, KJ/(KG)(K)	5.7427	5.7445	5.2405	2.1651
GAMMAS	1.1424	1.1423	1.1419	1.2042
SON VEL,M/SEC	1221.5	1220.3	1180.0	955.8
MACH NUMBER	0.000	0.151	1.000	2.956

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0621	1.0608	1.0214	0.75237
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.7427	5.7445	5.2405	2.1651
CONDUCTIVITY	13.5576	13.5508	11.9136	2.8640
PRANDTL NUMBER	0.4499	0.4497	0.4493	0.5688

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0840	2.0837	2.0732	1.9603
CONDUCTIVITY	3.5422	3.5367	3.3598	2.2574
PRANDTL NUMBER	0.6249	0.6250	0.6303	0.6533

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3896
CSTAR, M/SEC	1793.9	1793.9	1793.9
CF	0.1026	0.6578	1.5749
Ivac, M/SEC	7267.1	2213.3	3093.6
Isp, M/SEC	184.1	1180.0	2825.1

MASS FRACTIONS

*CO	0.46426	0.46408	0.45534	0.41172
*CO2	0.22471	0.22499	0.23874	0.30732
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00160	0.00160	0.00132	0.00008
HCO	0.00003	0.00003	0.00001	0.00000
HO2	0.00004	0.00004	0.00002	0.00000
*H2	0.01103	0.01103	0.01090	0.01253
H2O	0.25021	0.25032	0.25793	0.26790
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00496	0.00494	0.00324	0.00000
*OH	0.03342	0.03329	0.02579	0.00044
*O2	0.00970	0.00966	0.00668	0.00001

* 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 FINITE AREA COMBUSTOR

Pin = 587.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012769

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7598	50.000
P, BAR	40.530	39.502	23.031	0.81060
T, K	3509.46	3503.24	3312.65	2124.12
RHO, KG/CU M	3.0818 0	3.0095 0	1.8781 0	1.0707-1
H, KJ/KG	-818.62	-835.70	-1520.31	-4820.89
U, KJ/KG	-2133.75	-2148.28	-2746.60	-5577.95
G, KJ/KG	-42055.3	-42015.9	-40460.2	-29789.7
S, KJ/(KG)(K)	11.7501	11.7549	11.7549	11.7549
M, (1/n)	22.188	22.191	22.461	23.329
MW, MOL WT	22.188	22.191	22.461	23.329
(dLV/dLP)t	-1.02821	-1.02813	-1.02178	-1.00052
(dLV/dLT)p	1.5015	1.5010	1.4104	1.0141
Cp, KJ/(KG)(K)	5.4673	5.4687	4.9774	2.1392
GAMMAS	1.1446	1.1445	1.1444	1.2060
SON VEL,M/SEC	1226.9	1225.6	1184.6	955.5
MACH NUMBER	0.000	0.151	1.000	2.961

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0701 1.0687 1.0280 0.75141

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.4673	5.4687	4.9774	2.1392
CONDUCTIVITY	12.8761	12.8690	11.2702	2.7757
PRANDTL NUMBER	0.4544	0.4542	0.4540	0.5791

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0862	2.0859	2.0752	1.9597
CONDUCTIVITY	3.5665	3.5610	3.3795	2.2535
PRANDTL NUMBER	0.6259	0.6260	0.6312	0.6534

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3445
CSTAR, M/SEC	1798.7	1798.7	1798.7
CF	0.1028	0.6586	1.5729
Ivac, M/SEC	7286.7	2219.8	3096.8
Isp, M/SEC	184.8	1184.6	2829.2

MASS FRACTIONS

*CO	0.46337	0.46320	0.45462	0.41157
*CO2	0.22609	0.22636	0.23987	0.30755
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00150	0.00150	0.00123	0.00007
HCO	0.00003	0.00003	0.00002	0.00000
H02	0.00004	0.00004	0.00002	0.00000
*H2	0.01096	0.01096	0.01085	0.01255
H2O	0.25236	0.25245	0.25987	0.26789
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00449	0.00446	0.00288	0.00000
*OH	0.03225	0.03211	0.02464	0.00037
*O2	0.00888	0.00884	0.00599	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 FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012784
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0261	1.7611	50.000
P, BAR	50.663	49.376	28.768	1.0132
T, K	3536.23	3529.90	3334.07	2121.18
RHO, KG/CU M	3.8325 0	3.7424 0	2.3359 0	1.3404-1
H, KJ/KG	-818.62	-835.81	-1524.54	-4829.38
U, KJ/KG	-2140.56	-2155.17	-2756.11	-5585.29
G, KJ/KG	-42074.5	-42034.6	-40437.8	-29586.5
S, KJ/(KG)(K)	11.6666	11.6714	11.6714	11.6714
M, (1/n)	22.242	22.245	22.509	23.332
MW, MOL WT	22.242	22.245	22.509	23.332
(dLV/dLP)t	-1.02688	-1.02680	-1.02056	-1.00045
(dLV/dLT)p	1.4748	1.4743	1.3854	1.0124

Cp, KJ/(KG)(K)	5.2622	5.2634	4.7828	2.1219
GAMMAS	1.1463	1.1462	1.1464	1.2072
SON VEL,M/SEC	1231.0	1229.7	1188.2	955.3
MACH NUMBER	0.000	0.151	1.000	2.965

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0762	1.0748	1.0329	0.75067
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.2622	5.2634	4.7828	2.1219
CONDUCTIVITY	12.3656	12.3582	10.7910	2.7163
PRANDTL NUMBER	0.4580	0.4578	0.4578	0.5864

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0879	2.0875	2.0766	1.9592
CONDUCTIVITY	3.5852	3.5796	3.3945	2.2505
PRANDTL NUMBER	0.6267	0.6268	0.6319	0.6535

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.3109
CSTAR, M/SEC	1802.3	1802.3	1802.3
CF	0.1029	0.6593	1.5715
Ivac, M/SEC	7301.3	2224.7	3099.1
Isp, M/SEC	185.4	1188.2	2832.2

MASS FRACTIONS

*CO	0.46267	0.46250	0.45406	0.41146
*CO2	0.22718	0.22745	0.24075	0.30773
COOH	0.00003	0.00003	0.00001	0.00000
*H	0.00142	0.00142	0.00116	0.00006
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00005	0.00005	0.00002	0.00000
*H2	0.01092	0.01091	0.01081	0.01256
H2O	0.25402	0.25411	0.26135	0.26786
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00413	0.00411	0.00261	0.00000
*OH	0.03129	0.03116	0.02371	0.00032
*O2	0.00826	0.00822	0.00549	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 FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012797

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0261	1.7621	50.000
P, BAR	60.795	59.250	34.501	1.2159
T, K	3557.86	3551.44	3351.23	2118.81
RHO, KG/CU M	4.5800 0	4.4724 0	2.7919 0	1.6105-1
H, KJ/KG	-818.62	-835.90	-1527.97	-4836.01
U, KJ/KG	-2146.02	-2160.70	-2763.75	-5591.01
G, KJ/KG	-42084.6	-42044.3	-40413.2	-29421.2
S, KJ/(KG)(K)	11.5985	11.6033	11.6033	11.6033
M, (1/n)	22.286	22.289	22.548	23.334
MW, MOL WT	22.286	22.289	22.548	23.334
(dLV/dLP)t	-1.02580	-1.02573	-1.01958	-1.00041
(dLV/dLT)p	1.4534	1.4529	1.3655	1.0111
Cp, KJ/(KG)(K)	5.1002	5.1012	4.6299	2.1094
GAMMAS	1.1477	1.1476	1.1480	1.2082
SON VEL,M/SEC	1234.3	1233.0	1191.1	955.1
MACH NUMBER	0.000	0.151	1.000	2.968

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0811	1.0797	1.0369	0.75008
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.1002	5.1012	4.6299	2.1094
CONDUCTIVITY	11.9604	11.9528	10.4126	2.6731
PRANDTL NUMBER	0.4610	0.4608	0.4611	0.5919

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0892	2.0889	2.0778	1.9588
CONDUCTIVITY	3.6002	3.5946	3.4065	2.2481
PRANDTL NUMBER	0.6274	0.6274	0.6324	0.6536

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2845
CSTAR, M/SEC	1805.1	1805.1	1805.1
CF	0.1030	0.6598	1.5703
Ivac, M/SEC	7312.9	2228.6	3100.9
Isp, M/SEC	185.9	1191.1	2834.6

MASS FRACTIONS

*CO	0.46208	0.46192	0.45360	0.41136
*CO2	0.22809	0.22835	0.24147	0.30788
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00135	0.00135	0.00110	0.00005
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00005	0.00005	0.00002	0.00000
*H2	0.01088	0.01088	0.01078	0.01258
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25537	0.25546	0.26255	0.26784

H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00385	0.00383	0.00241	0.00000
*OH	0.03049	0.03036	0.02294	0.00029
*O2	0.00776	0.00773	0.00509	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 FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012807
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0261	1.7630	50.000
P, BAR	70.927	69.123	40.231	1.4185
T, K	3575.97	3569.47	3365.47	2116.84
RHO, KG/CU M	5.3251 0	5.1999 0	3.2464 0	1.8808-1
H, KJ/KG	-818.62	-835.97	-1530.84	-4841.39
U, KJ/KG	-2150.58	-2165.30	-2770.10	-5595.63
G, KJ/KG	-42089.1	-42048.4	-40387.9	-29282.1
S, KJ/(KG)(K)	11.5411	11.5458	11.5458	11.5458
M, (1/n)	22.322	22.326	22.580	23.335
MW, MOL WT	22.322	22.326	22.580	23.335
(dLV/dLP)t	-1.02490	-1.02482	-1.01876	-1.00037
(dLV/dLT)p	1.4357	1.4351	1.3490	1.0102
Cp, KJ/(KG)(K)	4.9671	4.9680	4.5050	2.0998
GAMMAS	1.1490	1.1489	1.1494	1.2089
SON VEL,M/SEC	1237.1	1235.8	1193.5	954.9
MACH NUMBER	0.000	0.151	1.000	2.971

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0852	1.0838	1.0402	0.74958
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.9671	4.9680	4.5050	2.0998
CONDUCTIVITY	11.6262	11.6185	10.1020	2.6398
PRANDTL NUMBER	0.4636	0.4634	0.4639	0.5963

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0903	2.0900	2.0787	1.9585
CONDUCTIVITY	3.6129	3.6071	3.4165	2.2461
PRANDTL NUMBER	0.6279	0.6280	0.6329	0.6536

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2628
CSTAR, M/SEC	1807.5	1807.5	1807.5
CF	0.1031	0.6603	1.5693
Ivac, M/SEC	7322.5	2231.8	3102.4
Isp, M/SEC	186.3	1193.5	2836.5

MASS FRACTIONS

*CO	0.46158	0.46142	0.45321	0.41128
*CO2	0.22886	0.22912	0.24207	0.30800
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00130	0.00130	0.00105	0.00005
HCO	0.00005	0.00004	0.00002	0.00000
H02	0.00005	0.00005	0.00002	0.00000
*H2	0.01084	0.01084	0.01075	0.01258
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25651	0.25659	0.26356	0.26782
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00362	0.00360	0.00224	0.00000
*OH	0.02979	0.02966	0.02228	0.00026
*O2	0.00735	0.00732	0.00476	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 FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012817
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0261	1.7638	50.000
P, BAR	81.060	78.997	45.957	1.6212
T, K	3591.49	3584.93	3377.60	2115.16
RHO, KG/CU M	6.0681 0	5.9253 0	3.6996 0	2.1513-1
H, KJ/KG	-818.62	-836.04	-1533.30	-4845.89
U, KJ/KG	-2154.46	-2169.24	-2775.51	-5599.50
G, KJ/KG	-42089.8	-42048.7	-40362.6	-29162.1

S, KJ/(KG)(K)	11.4914	11.4961	11.4961	11.4961
M, (1/n)	22.354	22.357	22.607	23.337
MW, MOL WT	22.354	22.357	22.607	23.337
(dLV/dLP)t	-1.02412	-1.02405	-1.01806	-1.00034
(dLV/dLT)p	1.4205	1.4200	1.3351	1.0094
Cp, KJ/(KG)(K)	4.8547	4.8555	4.3999	2.0922
GAMMAS	1.1501	1.1499	1.1507	1.2094
SON VEL,M/SEC	1239.5	1238.2	1195.6	954.7
MACH NUMBER	0.000	0.151	1.000	2.973

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0887	1.0873	1.0430	0.74916
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.8547	4.8555	4.3999	2.0922
CONDUCTIVITY	11.3431	11.3353	9.8400	2.6132
PRANDTL NUMBER	0.4660	0.4658	0.4664	0.5998

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0913	2.0909	2.0795	1.9583
CONDUCTIVITY	3.6237	3.6179	3.4250	2.2444
PRANDTL NUMBER	0.6283	0.6284	0.6333	0.6537

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2446
CSTAR, M/SEC	1809.4	1809.4	1809.4
CF	0.1031	0.6607	1.5685
Ivac, M/SEC	7330.6	2234.6	3103.6
Isp, M/SEC	186.6	1195.6	2838.1

MASS FRACTIONS

*CO	0.46114	0.46098	0.45287	0.41121
*CO2	0.22954	0.22979	0.24260	0.30811
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00126	0.00125	0.00101	0.00004
HCO	0.00005	0.00005	0.00003	0.00000
HO2	0.00005	0.00005	0.00002	0.00000
*H2	0.01081	0.01081	0.01073	0.01259
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25749	0.25758	0.26441	0.26779
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00343	0.00341	0.00210	0.00000
*OH	0.02917	0.02905	0.02170	0.00024
*O2	0.00700	0.00697	0.00449	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 FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012825

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0261	1.7645	50.000
P, BAR	91.192	88.870	51.681	1.8238
T, K	3605.06	3598.43	3388.14	2113.71
RHO, KG/CU M	6.8094 0	6.6491 0	4.1519 0	2.4220-1
H, KJ/KG	-818.62	-836.09	-1535.45	-4849.74
U, KJ/KG	-2157.85	-2172.66	-2780.22	-5602.79
G, KJ/KG	-42087.8	-42046.5	-40337.5	-29056.6
S, KJ/(KG)(K)	11.4476	11.4523	11.4523	11.4523
M, (1/n)	22.382	22.385	22.631	23.338
MW, MOL WT	22.382	22.385	22.631	23.338
(dLV/dLP)t	-1.02344	-1.02336	-1.01746	-1.00032
(dLV/dLT)p	1.4073	1.4068	1.3230	1.0088
Cp, KJ/(KG)(K)	4.7579	4.7585	4.3098	2.0859
GAMMAS	1.1510	1.1509	1.1518	1.2099
SON VEL,M/SEC	1241.6	1240.3	1197.4	954.5
MACH NUMBER	0.000	0.151	1.000	2.975

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0918	1.0904	1.0455	0.74880
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.7579	4.7585	4.3098	2.0859
CONDUCTIVITY	11.0983	11.0904	9.6142	2.5913
PRANDTL NUMBER	0.4681	0.4678	0.4686	0.6028

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0921	2.0918	2.0803	1.9580
CONDUCTIVITY	3.6331	3.6273	3.4324	2.2429
PRANDTL NUMBER	0.6287	0.6288	0.6336	0.6537

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2290
CSTAR, M/SEC	1811.2	1811.2	1811.2
CF	0.1032	0.6611	1.5677
Ivac, M/SEC	7337.5	2237.0	3104.6
Isp, M/SEC	186.9	1197.4	2839.4

MASS FRACTIONS

*CO	0.46076	0.46060	0.45257	0.41115
*CO2	0.23014	0.23039	0.24305	0.30820

COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00122	0.00121	0.00098	0.00004
HCO	0.00005	0.00005	0.00003	0.00000
HO2	0.00005	0.00005	0.00002	0.00000
*H2	0.01079	0.01079	0.01071	0.01260
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25835	0.25844	0.26516	0.26777
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00327	0.00325	0.00199	0.00000
*OH	0.02862	0.02850	0.02119	0.00023
*O2	0.00670	0.00667	0.00426	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 FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012832

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.30000 %FUEL= 30.303030 R,EQ.RATIO= 1.480724 PHI,EQ.RATIO= 1.480724

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0262	1.7652	50.000
P, BAR	101.33	98.743	57.403	2.0265
T, K	3617.08	3610.41	3397.42	2112.42
RHO, KG/CU M	7.5491 0	7.3713 0	4.6033 0	2.6928-1
H, KJ/KG	-818.62	-836.14	-1537.36	-4853.09
U, KJ/KG	-2160.84	-2175.69	-2784.37	-5605.66
G, KJ/KG	-42084.0	-42042.5	-40312.8	-28962.6
S, KJ/(KG)(K)	11.4085	11.4132	11.4132	11.4132
M, (1/n)	22.406	22.410	22.653	23.339
MW, MOL WT	22.406	22.410	22.653	23.339
(dLV/dLP)t	-1.02283	-1.02276	-1.01692	-1.00030
(dLV/dLT)p	1.3957	1.3951	1.3124	1.0083
Cp, KJ/(KG)(K)	4.6730	4.6736	4.2311	2.0807
GAMMA _s	1.1519	1.1518	1.1527	1.2103
SON VEL,M/SEC	1243.4	1242.1	1199.0	954.4
MACH NUMBER	0.000	0.151	1.000	2.976

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0945	1.0931	1.0476	0.74847
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	4.6730	4.6736	4.2311	2.0807
CONDUCTIVITY	10.8833	10.8753	9.4166	2.5729
PRANDTL NUMBER	0.4700	0.4698	0.4707	0.6053

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0929	2.0925	2.0809	1.9578
CONDUCTIVITY	3.6415	3.6356	3.4389	2.2417
PRANDTL NUMBER	0.6291	0.6291	0.6339	0.6537

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.2153
CSTAR, M/SEC	1812.6	1812.6	1812.6
CF	0.1033	0.6614	1.5671
Ivac, M/SEC	7343.6	2239.0	3105.5
Isp, M/SEC	187.2	1198.9	2840.6

MASS FRACTIONS

*CO	0.46041	0.46025	0.45231	0.41110
*CO2	0.23067	0.23092	0.24346	0.30829
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00118	0.00118	0.00095	0.00004
HCO	0.00006	0.00006	0.00003	0.00000
HO2	0.00005	0.00005	0.00002	0.00000
*H2	0.01077	0.01077	0.01069	0.01260
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.25912	0.25920	0.26583	0.26775
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00312	0.00311	0.00188	0.00000
*OH	0.02812	0.02800	0.02073	0.00021
*O2	0.00643	0.00640	0.00405	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 FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012649
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

INJECTOR COMB END THROAT EXIT

Pinj/P	1.0000	1.0258	1.7495	50.000
P, BAR	10.133	9.8779	5.7917	0.20265
T, K	3365.47	3359.99	3205.32	2261.20
RHO, KG/CU M	8.0463-1	7.8585-1	4.8986-1	2.5808-2
H, KJ/KG	-806.48	-822.68	-1473.55	-4756.14
U, KJ/KG	-2065.75	-2079.64	-2655.89	-5541.34
G, KJ/KG	-41733.0	-41698.3	-40467.6	-32264.6
S, KJ/(KG)(K)	12.1607	12.1654	12.1654	12.1654

M, (1/n)	22.221	22.225	22.541	23.944
MW, MOL WT	22.221	22.225	22.541	23.944
(dLV/dLP)t	-1.04254	-1.04247	-1.03607	-1.00253
(dLV/dLT)p	1.7852	1.7850	1.7005	1.0670
Cp, KJ/(KG)(K)	7.5312	7.5377	7.1166	2.6185
GAMMAS	1.1310	1.1308	1.1284	1.1743
SON VEL,M/SEC	1193.4	1192.2	1155.1	960.3
MACH NUMBER	0.000	0.151	1.000	2.927

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0440	1.0428	1.0099	0.79360
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	7.5312	7.5377	7.1166	2.6185
CONDUCTIVITY	17.5230	17.5235	15.9876	4.2730
PRANDTL NUMBER	0.4487	0.4486	0.4495	0.4863

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0554	2.0551	2.0465	1.9608
CONDUCTIVITY	3.4167	3.4118	3.2613	2.3492
PRANDTL NUMBER	0.6280	0.6281	0.6337	0.6624

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8004
CSTAR, M/SEC	1768.4	1768.4	1768.4
CF	0.1018	0.6532	1.5893
Ivac, M/SEC	7163.2	2178.7	3089.9
Isp, M/SEC	180.0	1155.1	2810.6

MASS FRACTIONS

*CO	0.43923	0.43902	0.42867	0.37714
*CO2	0.23600	0.23633	0.25261	0.33358
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00202	0.00201	0.00173	0.00026
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00005	0.00005	0.00003	0.00000
*H2	0.00979	0.00978	0.00956	0.01003
H2O	0.24139	0.24150	0.24987	0.27650
*O	0.00910	0.00907	0.00670	0.00007
*OH	0.04296	0.04281	0.03550	0.00226
*O2	0.01945	0.01940	0.01531	0.00017

* 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 FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012686
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7525	50.000
P, BAR	20.265	19.754	11.564	0.40530
T, K	3456.68	3450.87	3283.45	2257.14
RHO, KG/CU M	1.5799 0	1.5429 0	9.6220-1	5.1790-2
H, KJ/KG	-806.48	-823.03	-1487.36	-4796.38
U, KJ/KG	-2089.19	-2103.35	-2689.15	-5578.96
G, KJ/KG	-41949.4	-41912.9	-40583.8	-31672.4
S, KJ/(KG)(K)	11.9024	11.9071	11.9071	11.9071
M, (1/n)	22.406	22.410	22.716	23.981
MW, MOL WT	22.406	22.410	22.716	23.981
(dLV/dLP)t	-1.03836	-1.03829	-1.03194	-1.00170
(dLV/dLT)p	1.6920	1.6919	1.6078	1.0451
Cp, KJ/(KG)(K)	6.7419	6.7473	6.3328	2.4123
GAMMAS	1.1354	1.1352	1.1331	1.1838
SON VEL,M/SEC	1206.8	1205.6	1166.9	962.5
MACH NUMBER	0.000	0.151	1.000	2.935

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0652	1.0639	1.0284	0.79265
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.7419	6.7473	6.3328	2.4123
CONDUCTIVITY	15.6659	15.6650	14.1760	3.6792
PRANDTL NUMBER	0.4584	0.4583	0.4594	0.5197

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0612	2.0608	2.0518	1.9600
CONDUCTIVITY	3.4806	3.4755	3.3165	2.3426
PRANDTL NUMBER	0.6308	0.6309	0.6362	0.6632

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.6749
CSTAR, M/SEC	1782.2	1782.2	1782.2
CF	0.1021	0.6548	1.5850
Ivac, M/SEC	7219.3	2196.8	3101.9
Isp, M/SEC	181.9	1166.9	2824.9

MASS FRACTIONS

*CO	0.43661	0.43642	0.42622	0.37693
*CO2	0.24009	0.24040	0.25644	0.33391
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00175	0.00175	0.00149	0.00018
HCO	0.00002	0.00002	0.00001	0.00000
HO2	0.00006	0.00006	0.00003	0.00000
*H2	0.00960	0.00960	0.00939	0.01007
H2O	0.24659	0.24670	0.25484	0.27725
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.00760	0.00757	0.00545	0.00003
*OH	0.04083	0.04069	0.03324	0.00155
*O2	0.01683	0.01678	0.01288	0.00008

* 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 FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012709
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7543	50.000
P, BAR	30.398	29.630	17.327	0.60795
T, K	3510.00	3504.00	3328.55	2253.39
RHO, KG/CU M	2.3452 0	2.2903 0	1.4286 0	7.7867-2
H, KJ/KG	-806.48	-823.23	-1495.37	-4817.98
U, KJ/KG	-2102.66	-2116.96	-2708.20	-5598.73
G, KJ/KG	-42057.1	-42019.7	-40629.1	-31311.0
S, KJ/(KG)(K)	11.7523	11.7570	11.7570	11.7570
M, (1/n)	22.515	22.519	22.819	23.997
MW, MOL WT	22.515	22.519	22.819	23.997
(dLV/dLP)t	-1.03589	-1.03581	-1.02952	-1.00134
(dLV/dLT)p	1.6391	1.6389	1.5555	1.0356
Cp, KJ/(KG)(K)	6.3122	6.3170	5.9074	2.3234
GAMMAS	1.1380	1.1379	1.1360	1.1885
SON VEL,M/SEC	1214.5	1213.3	1173.8	963.3
MACH NUMBER	0.000	0.151	1.000	2.940

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0775 1.0762 1.0391 0.79174

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.3122	6.3170	5.9074	2.3234
CONDUCTIVITY	14.6418	14.6402	13.1826	3.4143
PRANDTL NUMBER	0.4645	0.4644	0.4656	0.5388

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0645	2.0642	2.0549	1.9594
CONDUCTIVITY	3.5179	3.5127	3.3485	2.3378
PRANDTL NUMBER	0.6323	0.6324	0.6377	0.6636

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.6031
CSTAR, M/SEC	1789.9	1789.9	1789.9
CF	0.1023	0.6558	1.5824
Ivac, M/SEC	7250.8	2207.1	3108.1
Isp, M/SEC	183.0	1173.8	2832.5

MASS FRACTIONS

*CO	0.43493	0.43474	0.42469	0.37679
*CO2	0.24272	0.24302	0.25884	0.33414
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00160	0.00160	0.00135	0.00014
HCO	0.00002	0.00002	0.00001	0.00000
H02	0.00006	0.00006	0.00003	0.00000
*H2	0.00948	0.00948	0.00928	0.01009
H20	0.24970	0.24980	0.25776	0.27754
H202	0.00001	0.00001	0.00001	0.00000
*O	0.00676	0.00673	0.00477	0.00002
*OH	0.03938	0.03924	0.03175	0.00123
*O2	0.01531	0.01526	0.01149	0.00005

* 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 FINITE AREA COMBUSTOR

Pin = 587.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012725

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7557	50.000
P, BAR	40.530	39.506	23.085	0.81060
T, K	3547.67	3541.52	3360.11	2250.30
RHO, KG/CU M	3.1044 0	3.0317 0	1.8914 0	1.0401-1
H, KJ/KG	-806.48	-823.37	-1501.01	-4832.41
U, KJ/KG	-2112.06	-2126.47	-2721.49	-5611.78
G, KJ/KG	-42123.6	-42085.4	-40649.4	-31050.6
S, KJ/(KG)(K)	11.6463	11.6509	11.6509	11.6509
M, (1/n)	22.593	22.597	22.891	24.007
MW, MOL WT	22.593	22.597	22.891	24.007
(dLV/dLP)t	-1.03412	-1.03405	-1.02780	-1.00114
(dLV/dLT)p	1.6023	1.6020	1.5192	1.0301
Cp, KJ/(KG)(K)	6.0214	6.0258	5.6203	2.2716
GAMMAS	1.1400	1.1398	1.1381	1.1914
SON VEL,M/SEC	1220.0	1218.7	1178.6	963.6
MACH NUMBER	0.000	0.151	1.000	2.945

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0862	1.0849	1.0465	0.79098
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.0214	6.0258	5.6203	2.2716
CONDUCTIVITY	13.9437	13.9416	12.5084	3.2571
PRANDTL NUMBER	0.4691	0.4689	0.4702	0.5516

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0668	2.0665	2.0570	1.9589
CONDUCTIVITY	3.5443	3.5390	3.3709	2.3342
PRANDTL NUMBER	0.6334	0.6335	0.6386	0.6638

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.5535
CSTAR, M/SEC	1795.3	1795.3	1795.3
CF	0.1024	0.6565	1.5806
Ivac, M/SEC	7272.5	2214.1	3112.2
Isp, M/SEC	183.8	1178.6	2837.6

MASS FRACTIONS

*CO	0.43368	0.43349	0.42357	0.37667
*CO2	0.24467	0.24497	0.26060	0.33432
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00150	0.00150	0.00126	0.00012
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00007	0.00007	0.00004	0.00000
*H2	0.00940	0.00940	0.00921	0.01011
H2O	0.25192	0.25202	0.25983	0.27769
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00619	0.00616	0.00431	0.00001
*OH	0.03827	0.03813	0.03061	0.00105
*O2	0.01423	0.01419	0.01054	0.00004

* 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 FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012738
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7568	50.000
P, BAR	50.663	49.381	28.838	1.0132
T, K	3576.73	3570.48	3384.28	2247.74
RHO, KG/CU M	3.8592 0	3.7687 0	2.3517 0	1.3019-1
H, KJ/KG	-806.48	-823.48	-1505.35	-4843.08
U, KJ/KG	-2119.26	-2133.75	-2731.65	-5621.36
G, KJ/KG	-42168.7	-42130.0	-40657.8	-30847.0
S, KJ/(KG)(K)	11.5643	11.5689	11.5689	11.5689
M, (1/n)	22.653	22.657	22.946	24.013
MW, MOL WT	22.653	22.657	22.946	24.013
(dLV/dLP)t	-1.03275	-1.03268	-1.02649	-1.00100
(dLV/dLT)p	1.5741	1.5739	1.4917	1.0264
Cp, KJ/(KG)(K)	5.8039	5.8079	5.4061	2.2369
GAMMAS	1.1415	1.1413	1.1398	1.1934
SON VEL,M/SEC	1224.1	1222.9	1182.3	963.7
MACH NUMBER	0.000	0.151	1.000	2.948

TRANSPORT PROPERTIES (GASES ONLY) CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0929 1.0916 1.0522 0.79035

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.8039	5.8079	5.4061	2.2369
CONDUCTIVITY	13.4188	13.4163	12.0032	3.1506
PRANDTL NUMBER	0.4727	0.4725	0.4739	0.5611

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0686	2.0683	2.0587	1.9586
CONDUCTIVITY	3.5647	3.5593	3.3880	2.3313
PRANDTL NUMBER	0.6342	0.6343	0.6394	0.6640

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.5159
CSTAR, M/SEC	1799.3	1799.3	1799.3

CF	0.1025	0.6571	1.5791
Ivac, M/SEC	7288.9	2219.5	3115.3
Isp, M/SEC	184.4	1182.3	2841.3

MASS FRACTIONS

*CO	0.43268	0.43249	0.42268	0.37658
*CO2	0.24624	0.24653	0.26199	0.33446
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00142	0.00142	0.00119	0.00011
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00007	0.00007	0.00004	0.00000
*H2	0.00934	0.00934	0.00915	0.01012
H2O	0.25365	0.25375	0.26144	0.27777
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00576	0.00574	0.00397	0.00001
*OH	0.03735	0.03722	0.02970	0.00092
*O2	0.01341	0.01337	0.00981	0.00003

* 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 FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012749
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7577	50.000
P, BAR	60.795	59.256	34.588	1.2159
T, K	3600.34	3594.00	3403.80	2245.57
RHO, KG/CU M	4.6106 0	4.5025 0	2.8099 0	1.5641-1
H, KJ/KG	-806.48	-823.57	-1508.87	-4851.46
U, KJ/KG	-2125.06	-2139.62	-2739.83	-5628.83
G, KJ/KG	-42201.1	-42162.0	-40659.5	-30680.2
S, KJ/(KG)(K)	11.4974	11.5021	11.5021	11.5021
M, (1/n)	22.702	22.706	22.991	24.018
MW, MOL WT	22.702	22.706	22.991	24.018
(dLV/dLP)t	-1.03163	-1.03156	-1.02541	-1.00089
(dLV/dLT)p	1.5515	1.5512	1.4696	1.0237
Cp, KJ/(KG)(K)	5.6312	5.6350	5.2366	2.2117
GAMMAS	1.1427	1.1426	1.1412	1.1949
SON VEL,M/SEC	1227.5	1226.3	1185.2	963.8

MACH NUMBER	0.000	0.151	1.000	2.951
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TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0984	1.0970	1.0568	0.78982
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.6312	5.6350	5.2366	2.2117
CONDUCTIVITY	13.0008	12.9980	11.6023	3.0725
PRANDTL NUMBER	0.4758	0.4756	0.4770	0.5685

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0701	2.0697	2.0600	1.9582
CONDUCTIVITY	3.5813	3.5758	3.4019	2.3290
PRANDTL NUMBER	0.6349	0.6350	0.6399	0.6641

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.4859
CSTAR, M/SEC	1802.5	1802.5	1802.5
CF	0.1026	0.6576	1.5780
Ivac, M/SEC	7302.0	2223.8	3117.6
Isp, M/SEC	184.9	1185.2	2844.3

MASS FRACTIONS

*CO	0.43184	0.43166	0.42194	0.37650
*CO2	0.24754	0.24783	0.26313	0.33458
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00136	0.00136	0.00114	0.00010
HCO	0.00004	0.00004	0.00002	0.00000
H02	0.00007	0.00007	0.00004	0.00000
*H2	0.00929	0.00929	0.00911	0.01013
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25507	0.25517	0.26274	0.27783
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00542	0.00540	0.00370	0.00001
*OH	0.03657	0.03644	0.02893	0.00083
*O2	0.01274	0.01270	0.00923	0.00002

* 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 FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012758

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7585	50.000
P, BAR	70.927	69.130	40.335	1.4185
T, K	3620.19	3613.77	3420.11	2243.70
RHO, KG/CU M	5.3593 0	5.2336 0	3.2664 0	1.8266-1
H, KJ/KG	-806.48	-823.65	-1511.83	-4858.31
U, KJ/KG	-2129.92	-2144.54	-2746.67	-5634.91
G, KJ/KG	-42225.2	-42185.7	-40657.2	-30538.9
S, KJ/(KG)(K)	11.4410	11.4457	11.4457	11.4457
M, (1/n)	22.744	22.747	23.029	24.022
MW, MOL WT	22.744	22.747	23.029	24.022
(dLV/dLP)t	-1.03069	-1.03062	-1.02451	-1.00082
(dLV/dLT)p	1.5325	1.5323	1.4512	1.0217
Cp, KJ/(KG)(K)	5.4889	5.4924	5.0972	2.1924
GAMMAS	1.1438	1.1437	1.1424	1.1961
SON VEL,M/SEC	1230.4	1229.1	1187.7	963.8
MACH NUMBER	0.000	0.151	1.000	2.954

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1030	1.1016	1.0607	0.78935
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.4889	5.4924	5.0972	2.1924
CONDUCTIVITY	12.6551	12.6520	11.2716	3.0123
PRANDTL NUMBER	0.4784	0.4782	0.4796	0.5745

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0713	2.0710	2.0611	1.9580
CONDUCTIVITY	3.5952	3.5897	3.4135	2.3269
PRANDTL NUMBER	0.6354	0.6355	0.6404	0.6642

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.4612
CSTAR, M/SEC	1805.2	1805.2	1805.2
CF	0.1027	0.6580	1.5770
Ivac, M/SEC	7312.8	2227.4	3119.5
Isp, M/SEC	185.3	1187.7	2846.7

MASS FRACTIONS

*CO	0.43112	0.43094	0.42132	0.37644
*CO2	0.24866	0.24894	0.26411	0.33468
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00131	0.00131	0.00109	0.00009
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00008	0.00008	0.00004	0.00000
*H2	0.00924	0.00924	0.00907	0.01014
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25627	0.25637	0.26384	0.27787
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00514	0.00512	0.00348	0.00001

*OH 0.03589 0.03576 0.02826 0.00076
 *O2 0.01218 0.01214 0.00874 0.00002

* 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 FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012766
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7591	50.000
P, BAR	81.060	79.005	46.080	1.6212
T, K	3637.29	3630.81	3434.09	2242.05
RHO, KG/CU M	6.1057 0	5.9625 0	3.7216 0	2.0893-1
H, KJ/KG	-806.48	-823.71	-1514.37	-4864.06
U, KJ/KG	-2134.08	-2148.74	-2752.52	-5640.00
G, KJ/KG	-42243.4	-42203.5	-40652.3	-30416.4
S, KJ/(KG)(K)	11.3922	11.3969	11.3969	11.3969
M, (1/n)	22.780	22.783	23.061	24.024
MW, MOL WT	22.780	22.783	23.061	24.024
(dLV/dLP)t	-1.02987	-1.02980	-1.02374	-1.00076
(dLV/dLT)p	1.5163	1.5160	1.4355	1.0200
Cp, KJ/(KG)(K)	5.3682	5.3715	4.9793	2.1771
GAMMAS	1.1448	1.1446	1.1435	1.1971
SON VEL,M/SEC	1232.8	1231.5	1189.9	963.8
MACH NUMBER	0.000	0.151	1.000	2.956

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.1069 1.1055 1.0639 0.78894

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.3682	5.3715	4.9793	2.1771
CONDUCTIVITY	12.3614	12.3581	10.9914	2.9640
PRANDTL NUMBER	0.4807	0.4805	0.4820	0.5795

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0723	2.0720	2.0620	1.9577
CONDUCTIVITY	3.6072	3.6016	3.4235	2.3252

PRANDTL NUMBER 0.6359 0.6360 0.6408 0.6643

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.4401
CSTAR, M/SEC	1807.4	1807.4	1807.4
CF	0.1027	0.6583	1.5761
Ivac, M/SEC	7322.0	2230.4	3121.1
Isp, M/SEC	185.7	1189.9	2848.7

MASS FRACTIONS

*CO	0.43049	0.43031	0.42078	0.37638
*CO2	0.24964	0.24992	0.26495	0.33477
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00126	0.00126	0.00105	0.00008
HCO	0.00005	0.00004	0.00002	0.00000
HO2	0.00008	0.00008	0.00004	0.00000
*H2	0.00921	0.00921	0.00904	0.01014
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25731	0.25740	0.26478	0.27790
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00490	0.00488	0.00329	0.00001
*OH	0.03529	0.03516	0.02767	0.00070
*O2	0.01171	0.01167	0.00833	0.00002

* 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 FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012773

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7597	50.000
P, BAR	91.192	88.879	51.822	1.8238
T, K	3652.29	3645.75	3446.30	2240.59
RHO, KG/CU M	6.8502 0	6.6894 0	4.1757 0	2.3523-1
H, KJ/KG	-806.48	-823.77	-1516.61	-4869.00
U, KJ/KG	-2137.71	-2152.42	-2757.63	-5644.36
G, KJ/KG	-42257.3	-42217.2	-40645.6	-30308.5
S, KJ/(KG)(K)	11.3493	11.3539	11.3539	11.3539

M, (1/n)	22.811	22.815	23.089	24.027
MW, MOL WT	22.811	22.815	23.089	24.027
(dLV/dLP)t	-1.02915	-1.02908	-1.02306	-1.00070
(dLV/dLT)p	1.5021	1.5018	1.4219	1.0187
Cp, KJ/(KG)(K)	5.2638	5.2669	4.8776	2.1645
GAMMAS	1.1456	1.1455	1.1444	1.1979
SON VEL,M/SEC	1234.9	1233.7	1191.7	963.7
MACH NUMBER	0.000	0.151	1.000	2.958

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1103	1.1089	1.0668	0.78858
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.2638	5.2669	4.8776	2.1645
CONDUCTIVITY	12.1068	12.1033	10.7491	2.9242
PRANDTL NUMBER	0.4828	0.4826	0.4841	0.5837

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0733	2.0729	2.0628	1.9575
CONDUCTIVITY	3.6177	3.6121	3.4322	2.3237
PRANDTL NUMBER	0.6363	0.6364	0.6412	0.6643

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.4219
CSTAR, M/SEC	1809.4	1809.4	1809.4
CF	0.1028	0.6586	1.5754
Ivac, M/SEC	7330.0	2233.1	3122.5
Isp, M/SEC	186.0	1191.7	2850.4

MASS FRACTIONS

*CO	0.42993	0.42975	0.42030	0.37633
*CO2	0.25052	0.25079	0.26570	0.33485
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00123	0.00123	0.00102	0.00008
HCO	0.00005	0.00005	0.00003	0.00000
HO2	0.00008	0.00008	0.00004	0.00000
*H2	0.00917	0.00917	0.00901	0.01015
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25823	0.25832	0.26561	0.27792
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00469	0.00467	0.00314	0.00001
*OH	0.03475	0.03462	0.02714	0.00065
*O2	0.01129	0.01125	0.00798	0.00001

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012780

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.40000 %FUEL= 29.411765 R,EQ.RATIO= 1.419028 PHI,EQ.RATIO= 1.419028

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7603	50.000
P, BAR	101.33	98.753	57.562	2.0265
T, K	3665.63	3659.04	3457.12	2239.28
RHO, KG/CU M	7.5930 0	7.4147 0	4.6287 0	2.6154-1
H, KJ/KG	-806.48	-823.82	-1518.59	-4873.31
U, KJ/KG	-2140.94	-2155.68	-2762.16	-5648.15
G, KJ/KG	-42268.1	-42227.7	-40637.7	-30212.0
S, KJ/(KG)(K)	11.3109	11.3155	11.3155	11.3155
M, (1/n)	22.839	22.843	23.114	24.029
MW, MOL WT	22.839	22.843	23.114	24.029
(dLV/dLP)t	-1.02851	-1.02844	-1.02246	-1.00066
(dLV/dLT)p	1.4895	1.4892	1.4098	1.0176
Cp, KJ/(KG)(K)	5.1720	5.1750	4.7883	2.1540
GAMMAS	1.1463	1.1462	1.1453	1.1986
SON VEL,M/SEC	1236.8	1235.6	1193.4	963.7
MACH NUMBER	0.000	0.151	1.000	2.959

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.1134 1.1120 1.0694 0.78825

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.1720	5.1750	4.7883	2.1540
CONDUCTIVITY	11.8827	11.8790	10.5363	2.8908
PRANDTL NUMBER	0.4846	0.4844	0.4860	0.5873

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0741	2.0738	2.0636	1.9573
CONDUCTIVITY	3.6271	3.6215	3.4399	2.3223
PRANDTL NUMBER	0.6367	0.6368	0.6415	0.6644

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.4059
CSTAR, M/SEC	1811.1	1811.1	1811.1
CF	0.1028	0.6589	1.5747
Ivac, M/SEC	7337.1	2235.4	3123.6
Isp, M/SEC	186.3	1193.4	2852.0

MASS FRACTIONS

*CO	0.42942	0.42925	0.41987	0.37628
*CO2	0.25130	0.25157	0.26637	0.33493
COOH	0.00005	0.00005	0.00003	0.00000
*H	0.00119	0.00119	0.00099	0.00007

HCO	0.00005	0.00005	0.00003	0.00000
H02	0.00008	0.00008	0.00004	0.00000
*H2	0.00914	0.00914	0.00899	0.01015
HCOOH	0.00001	0.00001	0.00001	0.00000
H2O	0.25905	0.25914	0.26635	0.27793
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00451	0.00449	0.00300	0.00001
*OH	0.03425	0.03412	0.02666	0.00061
*O2	0.01092	0.01088	0.00766	0.00001

* 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 FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012625
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0257	1.7473	50.000
P, BAR	10.133	9.8784	5.7988	0.20265
T, K	3384.30	3378.86	3228.95	2363.07
RHO, KG/CU M	8.1278-1	7.9383-1	4.9475-1	2.5311-2
H, KJ/KG	-795.02	-811.03	-1454.39	-4738.65
U, KJ/KG	-2041.67	-2055.42	-2626.46	-5539.30
G, KJ/KG	-41581.2	-41547.3	-40383.3	-33228.3
S, KJ/(KG)(K)	12.0516	12.0562	12.0562	12.0562
M, (1/n)	22.572	22.576	22.906	24.540
MW, MOL WT	22.572	22.576	22.906	24.540
(dLV/dLP)t	-1.04774	-1.04767	-1.04184	-1.00510
(dLV/dLT)p	1.8784	1.8786	1.8089	1.1328
Cp, KJ/(KG)(K)	8.0448	8.0545	7.7598	3.1708
GAMMAS	1.1284	1.1283	1.1251	1.1521
SON VEL,M/SEC	1186.1	1184.9	1148.4	960.4
MACH NUMBER	0.000	0.151	1.000	2.924

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0545	1.0534	1.0217	0.82686
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.0448	8.0545	7.7598	3.1708
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CONDUCTIVITY	18.4540	18.4597	17.1491	5.5529
PRANDTL NUMBER	0.4597	0.4596	0.4623	0.4722

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0359	2.0356	2.0278	1.9567
CONDUCTIVITY	3.3838	3.3790	3.2370	2.4158
PRANDTL NUMBER	0.6345	0.6346	0.6400	0.6697

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9927
CSTAR, M/SEC	1761.2	1761.2	1761.2
CF	0.1016	0.6520	1.5946
Ivac, M/SEC	7133.7	2169.0	3093.5
Isp, M/SEC	178.9	1148.4	2808.4

MASS FRACTIONS

*CO	0.41319	0.41298	0.40164	0.34190
*CO2	0.25045	0.25079	0.26861	0.36249
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00196	0.00196	0.00171	0.00038
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00006	0.00006	0.00004	0.00000
*H2	0.00858	0.00857	0.00832	0.00805
H2O	0.23955	0.23967	0.24801	0.28119
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.01122	0.01119	0.00864	0.00026
*OH	0.04782	0.04767	0.04051	0.00488
*O2	0.02714	0.02708	0.02250	0.00085

* 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 FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012659
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7500	50.000
P, BAR	20.265	19.755	11.580	0.40530
T, K	3479.26	3473.50	3311.77	2368.02

RHO, KG/CU M	1.5950 0	1.5577 0	9.7126-1	5.0653-2
H, KJ/KG	-795.02	-811.38	-1468.23	-4785.36
U, KJ/KG	-2065.58	-2079.59	-2660.50	-5585.50
G, KJ/KG	-41841.1	-41805.4	-40553.6	-32732.7
S, KJ/(KG)(K)	11.7974	11.8020	11.8020	11.8020

M, (1/n)	22.768	22.773	23.095	24.607
MW, MOL WT	22.768	22.773	23.095	24.607
(dLV/dLP)t	-1.04367	-1.04361	-1.03776	-1.00352
(dLV/dLT)p	1.7847	1.7849	1.7147	1.0914
Cp, KJ/(KG)(K)	7.2410	7.2494	6.9523	2.7964
GAMMAS	1.1325	1.1323	1.1293	1.1633
SON VEL,M/SEC	1199.5	1198.3	1160.4	964.8
MACH NUMBER	0.000	0.151	1.000	2.928

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0768	1.0755	1.0415	0.82835
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	7.2410	7.2494	6.9523	2.7964
CONDUCTIVITY	16.5944	16.5985	15.3193	4.6506
PRANDTL NUMBER	0.4699	0.4697	0.4727	0.4981

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0419	2.0416	2.0334	1.9571
CONDUCTIVITY	3.4504	3.4454	3.2960	2.4165
PRANDTL NUMBER	0.6372	0.6373	0.6426	0.6709

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8758
CSTAR, M/SEC	1775.7	1775.7	1775.7
CF	0.1019	0.6535	1.5910
Ivac, M/SEC	7192.5	2187.9	3108.2
Isp, M/SEC	180.9	1160.4	2825.0

MASS FRACTIONS

*CO	0.40988	0.40967	0.39840	0.34140
*CO2	0.25564	0.25597	0.27370	0.36327
COOH	0.00002	0.00001	0.00001	0.00000
*H	0.00170	0.00170	0.00147	0.00028
HCO	0.00002	0.00002	0.00001	0.00000
HO2	0.00008	0.00007	0.00005	0.00000
*H2	0.00836	0.00836	0.00811	0.00804
H2O	0.24474	0.24485	0.25302	0.28284
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00955	0.00952	0.00721	0.00014
*OH	0.04593	0.04578	0.03847	0.00357
*O2	0.02408	0.02403	0.01955	0.00045

* 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 FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012679
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7516	50.000
P, BAR	30.398	29.632	17.354	0.60795
T, K	3535.18	3529.23	3360.09	2368.37
RHO, KG/CU M	2.3667 0	2.3114 0	1.4415 0	7.6065-2
H, KJ/KG	-795.02	-811.58	-1476.29	-4810.91
U, KJ/KG	-2079.39	-2093.56	-2680.14	-5610.16
G, KJ/KG	-41978.7	-41942.1	-40635.7	-32412.5
S, KJ/(KG)(K)	11.6497	11.6543	11.6543	11.6543
M, (1/n)	22.885	22.889	23.207	24.638
MW, MOL WT	22.885	22.889	23.207	24.638
(dLV/dLP)t	-1.04125	-1.04119	-1.03534	-1.00281
(dLV/dLT)p	1.7313	1.7315	1.6610	1.0728
Cp, KJ/(KG)(K)	6.8020	6.8097	6.5111	2.6290
GAMMAS	1.1349	1.1347	1.1318	1.1695
SON VEL,M/SEC	1207.3	1206.1	1167.3	966.8
MACH NUMBER	0.000	0.151	1.000	2.931

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.0899 1.0886 1.0531 0.82854

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.8020	6.8097	6.5111	2.6290
CONDUCTIVITY	15.5665	15.5697	14.3109	4.2303
PRANDTL NUMBER	0.4762	0.4761	0.4791	0.5149

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0454	2.0451	2.0367	1.9571
CONDUCTIVITY	3.4897	3.4846	3.3305	2.4150
PRANDTL NUMBER	0.6388	0.6389	0.6440	0.6714

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8057
CSTAR, M/SEC	1783.9	1783.9	1783.9
CF	0.1020	0.6544	1.5887
Ivac, M/SEC	7226.0	2198.6	3116.1
Isp, M/SEC	182.0	1167.3	2834.0

MASS FRACTIONS

*CO	0.40773	0.40753	0.39634	0.34116
*CO2	0.25899	0.25931	0.27692	0.36366
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00156	0.00156	0.00134	0.00023
HCO	0.00002	0.00002	0.00001	0.00000
HO2	0.00009	0.00008	0.00005	0.00000
*H2	0.00823	0.00823	0.00799	0.00805
H2O	0.24785	0.24795	0.25599	0.28359
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00861	0.00858	0.00642	0.00009
*OH	0.04461	0.04447	0.03709	0.00293
*O2	0.02226	0.02221	0.01782	0.00030

* 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 FINITE AREA COMBUSTOR

Pin = 587.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012693

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7528	50.000
P, BAR	40.530	39.508	23.123	0.81060
T, K	3574.91	3568.83	3394.20	2367.65
RHO, KG/CU M	3.1320 0	3.0588 0	1.9080 0	1.0153-1
H, KJ/KG	-795.02	-811.73	-1481.98	-4828.18
U, KJ/KG	-2089.09	-2103.37	-2693.91	-5626.58
G, KJ/KG	-42068.7	-42031.4	-40684.8	-32174.3
S, KJ/(KG)(K)	11.5453	11.5499	11.5499	11.5499
M, (1/n)	22.969	22.973	23.286	24.657
MW, MOL WT	22.969	22.973	23.286	24.657
(dLV/dLP)t	-1.03953	-1.03946	-1.03363	-1.00238
(dLV/dLT)p	1.6941	1.6942	1.6236	1.0617
Cp, KJ/(KG)(K)	6.5042	6.5113	6.2118	2.5300
GAMMAS	1.1366	1.1365	1.1337	1.1735
SON VEL,M/SEC	1212.8	1211.6	1172.1	967.9
MACH NUMBER	0.000	0.151	1.000	2.934

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0991	1.0978	1.0612	0.82842
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.5042	6.5113	6.2118	2.5300
CONDUCTIVITY	14.8643	14.8669	13.6236	3.9753
PRANDTL NUMBER	0.4809	0.4808	0.4839	0.5272

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0479	2.0476	2.0390	1.9569
CONDUCTIVITY	3.5177	3.5125	3.3550	2.4132
PRANDTL NUMBER	0.6399	0.6400	0.6450	0.6718

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.7557
CSTAR, M/SEC	1789.6	1789.6	1789.6
CF	0.1021	0.6550	1.5870
Ivac, M/SEC	7249.2	2206.1	3121.2
Isp, M/SEC	182.8	1172.1	2840.1

MASS FRACTIONS

*CO	0.40613	0.40593	0.39483	0.34100
*CO2	0.26150	0.26182	0.27929	0.36391
COOH	0.00003	0.00003	0.00001	0.00000
*H	0.00147	0.00147	0.00126	0.00019
HCO	0.00003	0.00003	0.00001	0.00000
HO2	0.00009	0.00009	0.00005	0.00000
*H2	0.00814	0.00814	0.00790	0.00805
H2O	0.25009	0.25019	0.25811	0.28402
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.00796	0.00793	0.00588	0.00007
*OH	0.04358	0.04345	0.03603	0.00253
*O2	0.02097	0.02092	0.01661	0.00023

* 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 FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012705
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7537	50.000
P, BAR	50.663	49.384	28.889	1.0132
T, K	3605.71	3599.52	3420.51	2366.61
RHO, KG/CU M	3.8926 0	3.8015 0	2.3716 0	1.2703-1
H, KJ/KG	-795.02	-811.84	-1486.37	-4841.07
U, KJ/KG	-2096.54	-2110.90	-2704.48	-5638.70
G, KJ/KG	-42133.4	-42095.6	-40717.0	-31984.3
S, KJ/(KG)(K)	11.4647	11.4692	11.4692	11.4692

M, (1/n)	23.034	23.038	23.348	24.670
MW, MOL WT	23.034	23.038	23.348	24.670
(dLV/dLP)t	-1.03818	-1.03812	-1.03229	-1.00209
(dLV/dLT)p	1.6655	1.6656	1.5950	1.0542
Cp, KJ/(KG)(K)	6.2807	6.2874	5.9873	2.4631
GAMMAS	1.1380	1.1378	1.1351	1.1764
SON VEL,M/SEC	1217.0	1215.8	1175.9	968.7
MACH NUMBER	0.000	0.151	1.000	2.937

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1063	1.1050	1.0675	0.82821
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.2807	6.2874	5.9873	2.4631
CONDUCTIVITY	14.3353	14.3374	13.1068	3.8001
PRANDTL NUMBER	0.4847	0.4846	0.4876	0.5368

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0498	2.0495	2.0408	1.9568
CONDUCTIVITY	3.5394	3.5341	3.3739	2.4114
PRANDTL NUMBER	0.6407	0.6408	0.6457	0.6720

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.00000	7.7172
CSTAR, M/SEC	1793.9	1793.9	1793.9
CF	0.1022	0.6555	1.5857
Ivac, M/SEC	7266.8	2211.8	3125.1
Isp, M/SEC	183.4	1175.9	2844.7

MASS FRACTIONS

*CO	0.40484	0.40465	0.39362	0.34088
*CO2	0.26352	0.26382	0.28119	0.36410
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00139	0.00139	0.00119	0.00017
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00010	0.00010	0.00006	0.00000
*H2	0.00807	0.00807	0.00784	0.00806
H2O	0.25184	0.25193	0.25976	0.28431
H2O2	0.00002	0.00001	0.00001	0.00000
*O	0.00747	0.00744	0.00547	0.00005
*OH	0.04273	0.04260	0.03517	0.00225
*O2	0.01996	0.01991	0.01567	0.00018

* 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 FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012714
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7545	50.000
P, BAR	60.795	59.260	34.651	1.2159
T, K	3630.83	3624.55	3441.86	2365.50
RHO, KG/CU M	4.6495 0	4.5407 0	2.8331 0	1.5257-1
H, KJ/KG	-795.02	-811.93	-1489.94	-4851.25
U, KJ/KG	-2102.57	-2117.00	-2713.03	-5648.20
G, KJ/KG	-42182.7	-42144.5	-40739.2	-31826.2
S, KJ/(KG)(K)	11.3990	11.4035	11.4035	11.4035
M, (1/n)	23.088	23.092	23.398	24.679
MW, MOL WT	23.088	23.092	23.398	24.679
(dLV/dLP)t	-1.03707	-1.03701	-1.03120	-1.00188
(dLV/dLT)p	1.6425	1.6425	1.5720	1.0487
Cp, KJ/(KG)(K)	6.1030	6.1094	5.8089	2.4143
GAMMAS	1.1391	1.1389	1.1363	1.1787
SON VEL,M/SEC	1220.4	1219.2	1178.9	969.2
MACH NUMBER	0.000	0.151	1.000	2.939

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1122	1.1108	1.0726	0.82796
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.1030	6.1094	5.8089	2.4143
CONDUCTIVITY	13.9132	13.9149	12.6951	3.6704
PRANDTL NUMBER	0.4879	0.4877	0.4908	0.5446

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0513	2.0510	2.0422	1.9566
CONDUCTIVITY	3.5571	3.5518	3.3893	2.4099
PRANDTL NUMBER	0.6414	0.6414	0.6463	0.6722

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.6859
CSTAR, M/SEC	1797.4	1797.4	1797.4
CF	0.1023	0.6559	1.5846
Ivac, M/SEC	7281.0	2216.4	3128.0

Isp, M/SEC 183.9 1178.9 2848.2

MASS FRACTIONS

*CO	0.40376	0.40357	0.39261	0.34078
*CO2	0.26521	0.26551	0.28276	0.36425
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00133	0.00133	0.00114	0.00016
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00010	0.00010	0.00006	0.00000
*H2	0.00801	0.00801	0.00778	0.00807
HCOOH	0.00001	0.00000	0.00000	0.00000
H2O	0.25327	0.25337	0.26110	0.28452
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00708	0.00705	0.00515	0.00005
*OH	0.04201	0.04187	0.03443	0.00204
*O2	0.01914	0.01910	0.01491	0.00015

* 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 FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012722

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7552	50.000
P, BAR	70.927	69.135	40.411	1.4185
T, K	3652.03	3645.67	3459.81	2364.39
RHO, KG/CU M	5.4035 0	5.2770 0	3.2928 0	1.7813-1
H, KJ/KG	-795.02	-812.01	-1492.94	-4859.62
U, KJ/KG	-2107.63	-2122.12	-2720.20	-5655.96
G, KJ/KG	-42221.8	-42183.2	-40755.0	-31690.9
S, KJ/(KG)(K)	11.3435	11.3480	11.3480	11.3480
M, (1/n)	23.133	23.137	23.440	24.687
MW, MOL WT	23.133	23.137	23.440	24.687
(dLV/dLP)t	-1.03613	-1.03607	-1.03027	-1.00172
(dLV/dLT)p	1.6231	1.6232	1.5527	1.0445
Cp, KJ/(KG)(K)	5.9561	5.9622	5.6615	2.3768
GAMMAS	1.1401	1.1399	1.1374	1.1805
SON VEL,M/SEC	1223.3	1222.0	1181.5	969.6
MACH NUMBER	0.000	0.151	1.000	2.941

VISC,MILLIPOISE	1.1171	1.1158	1.0769	0.82770
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Cp, KJ/(KG)(K)	5.9561	5.9622	5.6615	2.3768
CONDUCTIVITY	13.5636	13.5649	12.3546	3.5696
PRANDTL NUMBER	0.4906	0.4904	0.4935	0.5511

Cp, KJ/(KG)(K)	2.0526	2.0523	2.0435	1.9564
CONDUCTIVITY	3.5721	3.5668	3.4023	2.4084
PRANDTL NUMBER	0.6419	0.6420	0.6468	0.6724

Ae/At	4.0000	1.0000	7.6596
CSTAR, M/SEC	1800.3	1800.3	1800.3
CF	0.1024	0.6563	1.5837
Ivac, M/SEC	7292.8	2220.2	3130.5
Isp, M/SEC	184.3	1181.5	2851.2

*CO	0.40282	0.40264	0.39175	0.34070
*CO2	0.26666	0.26696	0.28411	0.36437
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00129	0.00129	0.00109	0.00014
HCO	0.00004	0.00004	0.00002	0.00000
H02	0.00011	0.00011	0.00006	0.00000
*H2	0.00796	0.00796	0.00774	0.00807
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25449	0.25458	0.26224	0.28468
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00675	0.00673	0.00488	0.00004
*OH	0.04137	0.04124	0.03379	0.00187
*O2	0.01845	0.01840	0.01428	0.00013

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

Pin = 1175.7 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012729
CASE =

TEMP

FUEL	RP-1	(SEE NOTE)	KJ/KG-MOL	K
OXIDANT	O2(L)	1.0000000	-24717.700	298.150
		1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7557	50.000
P, BAR	81.060	79.010	46.169	1.6212
T, K	3670.34	3663.92	3475.27	2363.33
RHO, KG/CU M	6.1551 0	6.0109 0	3.7510 0	2.0372-1
H, KJ/KG	-795.02	-812.07	-1495.53	-4866.69
U, KJ/KG	-2111.98	-2126.52	-2726.36	-5662.48
G, KJ/KG	-42253.5	-42214.6	-40766.3	-31572.5
S, KJ/(KG)(K)	11.2955	11.3001	11.3001	11.3001
M, (1/n)	23.172	23.176	23.476	24.692
MW, MOL WT	23.172	23.176	23.476	24.692
(dLV/dLP)t	-1.03532	-1.03526	-1.02947	-1.00159
(dLV/dLT)p	1.6065	1.6065	1.5361	1.0412
Cp, KJ/(KG)(K)	5.8313	5.8372	5.5364	2.3469
GAMMAS	1.1409	1.1407	1.1383	1.1820
SON VEL,M/SEC	1225.8	1224.5	1183.6	969.8
MACH NUMBER	0.000	0.151	1.000	2.942

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1214	1.1200	1.0806	0.82746
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.8313	5.8372	5.5364	2.3469
CONDUCTIVITY	13.2660	13.2671	12.0652	3.4883
PRANDTL NUMBER	0.4929	0.4928	0.4958	0.5567

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0538	2.0534	2.0445	1.9563
CONDUCTIVITY	3.5850	3.5797	3.4134	2.4071
PRANDTL NUMBER	0.6424	0.6425	0.6472	0.6725

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.6371
CSTAR, M/SEC	1802.8	1802.8	1802.8
CF	0.1024	0.6566	1.5829
Ivac, M/SEC	7302.9	2223.5	3132.5
Isp, M/SEC	184.7	1183.6	2853.7

MASS FRACTIONS

*CO	0.40200	0.40182	0.39099	0.34064
*CO2	0.26794	0.26824	0.28529	0.36447
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00125	0.00124	0.00106	0.00013
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00011	0.00011	0.00006	0.00000
*H2	0.00791	0.00791	0.00770	0.00807
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25555	0.25564	0.26323	0.28480
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00647	0.00645	0.00466	0.00003
*OH	0.04080	0.04067	0.03322	0.00174

*O2 0.01785 0.01781 0.01373 0.00011

* 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 FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012735

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7563	50.000
P, BAR	91.192	88.886	51.925	1.8238
T, K	3686.45	3679.97	3488.82	2362.32
RHO, KG/CU M	6.9045 0	6.7428 0	4.2080 0	2.2933-1
H, KJ/KG	-795.02	-812.13	-1497.80	-4872.78
U, KJ/KG	-2115.79	-2130.37	-2731.74	-5668.07
G, KJ/KG	-42279.8	-42240.7	-40774.4	-31467.4
S, KJ/(KG)(K)	11.2533	11.2578	11.2578	11.2578
M, (1/n)	23.207	23.211	23.508	24.697
MW, MOL WT	23.207	23.211	23.508	24.697
(dLV/dLP)t	-1.03460	-1.03454	-1.02877	-1.00148
(dLV/dLT)p	1.5919	1.5920	1.5216	1.0384
Cp, KJ/(KG)(K)	5.7231	5.7289	5.4281	2.3223
GAMMAS	1.1416	1.1415	1.1391	1.1832
SON VEL,M/SEC	1227.9	1226.7	1185.6	970.0
MACH NUMBER	0.000	0.151	1.000	2.944

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.1251 1.1237 1.0838 0.82722

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.7231	5.7289	5.4281	2.3223
CONDUCTIVITY	13.0077	13.0085	11.8144	3.4212
PRANDTL NUMBER	0.4950	0.4949	0.4980	0.5615

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0548	2.0544	2.0454	1.9561
CONDUCTIVITY	3.5964	3.5910	3.4233	2.4058
PRANDTL NUMBER	0.6428	0.6429	0.6476	0.6726

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.6174
CSTAR, M/SEC	1804.9	1804.9	1804.9
CF	0.1025	0.6568	1.5822
Ivac, M/SEC	7311.7	2226.4	3134.3
Isp, M/SEC	185.0	1185.6	2855.8

MASS FRACTIONS

*CO	0.40127	0.40108	0.39032	0.34058
*CO2	0.26909	0.26938	0.28634	0.36456
COOH	0.00005	0.00005	0.00003	0.00000
*H	0.00121	0.00121	0.00103	0.00013
HCO	0.00005	0.00004	0.00002	0.00000
HO2	0.00012	0.00011	0.00007	0.00000
*H2	0.00788	0.00787	0.00766	0.00808
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25648	0.25657	0.26409	0.28490
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00623	0.00621	0.00446	0.00003
*OH	0.04028	0.04015	0.03271	0.00163
*O2	0.01732	0.01728	0.01325	0.00010

* 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 FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012741
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.50000 %FUEL= 28.571429 R,EQ.RATIO= 1.362267 PHI,EQ.RATIO= 1.362267

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0260	1.7567	50.000
P, BAR	101.33	98.761	57.679	2.0265
T, K	3700.83	3694.29	3500.87	2361.36
RHO, KG/CU M	7.6521 0	7.4728 0	4.6639 0	2.5496-1
H, KJ/KG	-795.02	-812.18	-1499.82	-4878.12
U, KJ/KG	-2119.17	-2133.79	-2736.53	-5672.95
G, KJ/KG	-42302.0	-42262.6	-40780.1	-31372.8
S, KJ/(KG)(K)	11.2156	11.2201	11.2201	11.2201
M, (1/n)	23.238	23.242	23.537	24.701

MW, MOL WT	23.238	23.242	23.537	24.701
(dLV/dLP)t	-1.03395	-1.03389	-1.02814	-1.00139
(dLV/dLT)p	1.5790	1.5790	1.5088	1.0361
Cp, KJ/(KG)(K)	5.6279	5.6334	5.3327	2.3017
GAMMAS	1.1423	1.1421	1.1398	1.1843
SON VEL,M/SEC	1229.9	1228.6	1187.3	970.2
MACH NUMBER	0.000	0.151	1.000	2.945

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1285	1.1271	1.0867	0.82699
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	5.6279	5.6334	5.3327	2.3017
CONDUCTIVITY	12.7799	12.7805	11.5934	3.3645
PRANDTL NUMBER	0.4970	0.4968	0.4998	0.5658

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0556	2.0553	2.0462	1.9560
CONDUCTIVITY	3.6066	3.6012	3.4320	2.4047
PRANDTL NUMBER	0.6432	0.6433	0.6479	0.6727

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.6000
CSTAR, M/SEC	1806.9	1806.9	1806.9
CF	0.1025	0.6571	1.5816
Ivac, M/SEC	7319.5	2228.9	3135.8
Isp, M/SEC	185.2	1187.3	2857.7

MASS FRACTIONS

*CO	0.40060	0.40042	0.38972	0.34053
*CO2	0.27012	0.27041	0.28728	0.36464
COOH	0.00005	0.00005	0.00003	0.00000
*H	0.00118	0.00118	0.00100	0.00012
HCO	0.00005	0.00005	0.00003	0.00000
HO2	0.00012	0.00012	0.00007	0.00000
*H2	0.00784	0.00784	0.00763	0.00808
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25732	0.25741	0.26487	0.28498
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00602	0.00600	0.00429	0.00003
*OH	0.03981	0.03968	0.03224	0.00154
*O2	0.01685	0.01681	0.01283	0.00008

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 147.0 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012608

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0257	1.7458	50.000
P, BAR	10.133	9.8787	5.8038	0.20265
T, K	3397.07	3391.67	3245.23	2441.25
RHO, KG/CU M	8.2156-1	8.0242-1	5.0003-1	2.5031-2
H, KJ/KG	-784.21	-800.02	-1435.82	-4709.30
U, KJ/KG	-2017.53	-2031.14	-2596.50	-5518.91
G, KJ/KG	-41366.9	-41333.6	-40219.4	-33884.5
S, KJ/(KG)(K)	11.9464	11.9509	11.9509	11.9509
M, (1/n)	22.901	22.906	23.247	25.071
MW, MOL WT	22.901	22.906	23.247	25.071
(dLV/dLP)t	-1.05203	-1.05197	-1.04672	-1.00943
(dLV/dLT)p	1.9556	1.9562	1.9008	1.2422
Cp, KJ/(KG)(K)	8.4469	8.4591	8.2782	4.0578
GAMMAS	1.1266	1.1264	1.1228	1.1321
SON VEL,M/SEC	1178.7	1177.6	1141.6	957.4
MACH NUMBER	0.000	0.151	1.000	2.927

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0630	1.0618	1.0311	0.85359
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.4469	8.4591	8.2782	4.0578
CONDUCTIVITY	19.1831	19.1932	18.0899	7.2033
PRANDTL NUMBER	0.4681	0.4680	0.4718	0.4808

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0172	2.0169	2.0095	1.9497
CONDUCTIVITY	3.3495	3.3449	3.2096	2.4650
PRANDTL NUMBER	0.6402	0.6403	0.6455	0.6751

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1394
CSTAR, M/SEC	1752.9	1752.9	1752.9
CF	0.1015	0.6512	1.5984
Ivac, M/SEC	7100.2	2158.3	3090.8
Isp, M/SEC	177.8	1141.6	2801.8

MASS FRACTIONS

*CO	0.38908	0.38885	0.37672	0.30820
*CO2	0.26335	0.26371	0.28277	0.39045
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00189	0.00189	0.00166	0.00049
HCO	0.00001	0.00001	0.00001	0.00000

H2	0.00008	0.00007	0.00005	0.00000
*H2	0.00758	0.00758	0.00730	0.00650
H2O	0.23699	0.23710	0.24530	0.28212
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.01326	0.01322	0.01054	0.00073
*OH	0.05190	0.05176	0.04475	0.00859
*O2	0.03586	0.03580	0.03088	0.00293

* 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 FINITE AREA COMBUSTOR

Pin = 293.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012639
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7482	50.000
P, BAR	20.265	19.756	11.592	0.40530
T, K	3494.70	3488.98	3331.40	2458.39
RHO, KG/CU M	1.6116 0	1.5740 0	9.8126-1	4.9919-2
H, KJ/KG	-784.21	-800.37	-1449.63	-4761.20
U, KJ/KG	-2041.66	-2055.53	-2630.94	-5573.11
G, KJ/KG	-41657.7	-41622.7	-40428.2	-33525.3
S, KJ/(KG)(K)	11.6958	11.7004	11.7004	11.7004
M, (1/n)	23.108	23.112	23.448	25.175
MW, MOL WT	23.108	23.112	23.448	25.175
(dLV/dLP)t	-1.04813	-1.04808	-1.04280	-1.00685
(dLV/dLT)p	1.8628	1.8633	1.8071	1.1748
Cp, KJ/(KG)(K)	7.6390	7.6499	7.4632	3.4652
GAMMAS	1.1303	1.1302	1.1266	1.1425
SON VEL,M/SEC	1192.2	1191.0	1153.6	963.1
MACH NUMBER	0.000	0.151	1.000	2.928

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0861	1.0848	1.0519	0.85847
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	7.6390	7.6499	7.4632	3.4652
CONDUCTIVITY	17.3363	17.3447	16.2653	5.9814
PRANDTL NUMBER	0.4786	0.4785	0.4826	0.4973

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0233	2.0230	2.0155	1.9516
CONDUCTIVITY	3.4181	3.4133	3.2714	2.4766
PRANDTL NUMBER	0.6429	0.6430	0.6480	0.6765

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0406
CSTAR, M/SEC	1767.9	1767.9	1767.9
CF	0.1017	0.6526	1.5953
Ivac, M/SEC	7160.8	2177.6	3108.2
Isp, M/SEC	179.8	1153.6	2820.3

MASS FRACTIONS

*CO	0.38513	0.38491	0.37277	0.30674
*CO2	0.26954	0.26988	0.28898	0.39274
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00164	0.00164	0.00143	0.00037
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00010	0.00010	0.00006	0.00000
*H2	0.00735	0.00735	0.00708	0.00643
H2O	0.24207	0.24218	0.25024	0.28469
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.01145	0.01142	0.00897	0.00044
*OH	0.05023	0.05009	0.04294	0.00678
*O2	0.03245	0.03239	0.02751	0.00180

* 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 FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012657
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7497	50.000
P, BAR	30.398	29.633	17.373	0.60795
T, K	3552.51	3546.60	3382.07	2465.34
RHO, KG/CU M	2.3907 0	2.3349 0	1.4560 0	7.4822-2
H, KJ/KG	-784.21	-800.57	-1457.69	-4790.14

U, KJ/KG	-2055.67	-2069.69	-2650.91	-5602.67
G, KJ/KG	-41816.9	-41781.0	-40537.0	-33276.7
S, KJ/(KG)(K)	11.5503	11.5548	11.5548	11.5548
M, (1/n)	23.231	23.235	23.567	25.227
MW, MOL WT	23.231	23.235	23.567	25.227
(dLV/dLP)t	-1.04582	-1.04577	-1.04047	-1.00557
(dLV/dLT)p	1.8099	1.8103	1.7537	1.1420
Cp, KJ/(KG)(K)	7.1977	7.2078	7.0170	3.1813
GAMMAS	1.1326	1.1324	1.1289	1.1488
SON VEL,M/SEC	1200.0	1198.8	1160.6	966.2
MACH NUMBER	0.000	0.151	1.000	2.930

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0997	1.0984	1.0641	0.86049
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	7.1977	7.2078	7.0170	3.1813
CONDUCTIVITY	16.3149	16.3224	15.2579	5.3803
PRANDTL NUMBER	0.4851	0.4850	0.4894	0.5088

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0269	2.0266	2.0189	1.9524
CONDUCTIVITY	3.4588	3.4539	3.3079	2.4809
PRANDTL NUMBER	0.6444	0.6445	0.6494	0.6772

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9789
CSTAR, M/SEC	1776.4	1776.4	1776.4
CF	0.1019	0.6533	1.5934
Ivac, M/SEC	7195.5	2188.7	3117.6
Isp, M/SEC	180.9	1160.6	2830.5

MASS FRACTIONS

*CO	0.38257	0.38236	0.37024	0.30602
*CO2	0.27355	0.27388	0.29294	0.39387
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00151	0.00151	0.00131	0.00031
HCO	0.00002	0.00002	0.00001	0.00000
HO2	0.00011	0.00011	0.00007	0.00000
*H2	0.00721	0.00721	0.00695	0.00641
H2O	0.24513	0.24523	0.25318	0.28597
H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.01042	0.01039	0.00808	0.00032
*OH	0.04905	0.04891	0.04169	0.00579
*O2	0.03039	0.03034	0.02550	0.00131

* 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 FINITE AREA COMBUSTOR

Pin = 587.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012670

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7507	50.000
P, BAR	40.530	39.510	23.150	0.81060
T, K	3593.74	3587.69	3418.04	2468.88
RHO, KG/CU M	3.1631 0	3.0893 0	1.9267 0	9.9748-2
H, KJ/KG	-784.21	-800.72	-1463.39	-4809.94
U, KJ/KG	-2065.53	-2079.66	-2664.96	-5622.59
G, KJ/KG	-41923.8	-41887.2	-40607.0	-33083.7
S, KJ/(KG)(K)	11.4476	11.4521	11.4521	11.4521
M, (1/n)	23.320	23.324	23.652	25.260
MW, MOL WT	23.320	23.324	23.652	25.260
(dLV/dLP)t	-1.04416	-1.04411	-1.03881	-1.00478
(dLV/dLT)p	1.7729	1.7733	1.7163	1.1218
Cp, KJ/(KG)(K)	6.8981	6.9076	6.7137	3.0071
GAMMAS	1.1342	1.1340	1.1305	1.1533
SON VEL,M/SEC	1205.5	1204.3	1165.5	968.1
MACH NUMBER	0.000	0.151	1.000	2.931

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.1094 1.1081 1.0728 0.86156

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.8981	6.9076	6.7137	3.0071
CONDUCTIVITY	15.6168	15.6235	14.5701	5.0038
PRANDTL NUMBER	0.4900	0.4899	0.4943	0.5178

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0295	2.0292	2.0213	1.9528
CONDUCTIVITY	3.4880	3.4830	3.3340	2.4829
PRANDTL NUMBER	0.6455	0.6456	0.6504	0.6776

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9337
CSTAR, M/SEC	1782.3	1782.3	1782.3
CF	0.1020	0.6539	1.5920
Ivac, M/SEC	7219.7	2196.4	3123.9
Isp, M/SEC	181.7	1165.5	2837.5

MASS FRACTIONS

*CO 0.38065 0.38044 0.36836 0.30558

*CO2	0.27655	0.27688	0.29588	0.39457
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00142	0.00142	0.00123	0.00028
HCO	0.00002	0.00002	0.00001	0.00000
HO2	0.00012	0.00012	0.00007	0.00000
*H2	0.00711	0.00711	0.00685	0.00639
H2O	0.24733	0.24743	0.25529	0.28678
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00971	0.00968	0.00748	0.00025
*OH	0.04812	0.04798	0.04072	0.00513
*O2	0.02892	0.02887	0.02407	0.00102

* 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 FINITE AREA COMBUSTOR

Pin = 734.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012681
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7515	50.000
P, BAR	50.663	49.386	28.924	1.0133
T, K	3625.81	3619.65	3445.91	2470.88
RHO, KG/CU M	3.9306 0	3.8388 0	2.3944 0	1.2470-1
H, KJ/KG	-784.21	-800.83	-1467.79	-4824.85
U, KJ/KG	-2073.13	-2087.35	-2675.78	-5637.41
G, KJ/KG	-42002.9	-41965.8	-40656.8	-32925.2
S, KJ/(KG)(K)	11.3681	11.3726	11.3726	11.3726
M, (1/n)	23.389	23.393	23.718	25.283
MW, MOL WT	23.389	23.393	23.718	25.283
(dLV/dLP)t	-1.04287	-1.04282	-1.03751	-1.00424
(dLV/dLT)p	1.7446	1.7449	1.6877	1.1077
Cp, KJ/(KG)(K)	6.6731	6.6822	6.4857	2.8867
GAMMA _s	1.1354	1.1353	1.1318	1.1568
SON VEL,M/SEC	1209.7	1208.5	1169.3	969.5
MACH NUMBER	0.000	0.151	1.000	2.932

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1169	1.1156	1.0795	0.86217
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.6731	6.6822	6.4857	2.8867
CONDUCTIVITY	15.0904	15.0967	14.0520	4.7394
PRANDTL NUMBER	0.4939	0.4938	0.4982	0.5251

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0315	2.0312	2.0232	1.9530
CONDUCTIVITY	3.5107	3.5056	3.3542	2.4838
PRANDTL NUMBER	0.6463	0.6464	0.6511	0.6779

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8979
CSTAR, M/SEC	1786.9	1786.9	1786.9
CF	0.1020	0.6544	1.5909
Ivac, M/SEC	7238.2	2202.4	3128.6
Isp, M/SEC	182.3	1169.3	2842.8

MASS FRACTIONS

*CO	0.37910	0.37889	0.36686	0.30527
*CO2	0.27898	0.27930	0.29823	0.39506
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00135	0.00135	0.00117	0.00025
HCO	0.00003	0.00003	0.00002	0.00000
H02	0.00013	0.00013	0.00008	0.00000
*H2	0.00704	0.00703	0.00678	0.00639
H2O	0.24906	0.24915	0.25693	0.28735
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00917	0.00914	0.00702	0.00020
*OH	0.04735	0.04721	0.03993	0.00465
*O2	0.02776	0.02771	0.02296	0.00084

* 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 FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012689
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7522	50.000

P, BAR	60.795	59.263	34.696	1.2159
T, K	3652.04	3645.80	3468.64	2472.03
RHO, KG/CU M	4.6943 0	4.5845 0	2.8599 0	1.4967-1
H, KJ/KG	-784.21	-800.92	-1471.38	-4836.73
U, KJ/KG	-2079.30	-2093.58	-2684.56	-5649.11
G, KJ/KG	-42064.7	-42027.1	-40694.3	-32790.2
S, KJ/(KG)(K)	11.3034	11.3079	11.3079	11.3079

M, (1/n)	23.446	23.450	23.772	25.301
MW, MOL WT	23.446	23.450	23.772	25.301
(dLV/dLP)t	-1.04181	-1.04175	-1.03645	-1.00383
(dLV/dLT)p	1.7216	1.7220	1.6646	1.0973
Cp, KJ/(KG)(K)	6.4940	6.5028	6.3042	2.7974
GAMMAS	1.1364	1.1363	1.1329	1.1596
SON VEL,M/SEC	1213.2	1211.9	1172.3	970.6
MACH NUMBER	0.000	0.151	1.000	2.933

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1231	1.1217	1.0850	0.86255
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.4940	6.5028	6.3042	2.7974
CONDUCTIVITY	14.6702	14.6760	13.6387	4.5407
PRANDTL NUMBER	0.4972	0.4970	0.5015	0.5314

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0331	2.0328	2.0248	1.9532
CONDUCTIVITY	3.5293	3.5242	3.3708	2.4842
PRANDTL NUMBER	0.6470	0.6470	0.6517	0.6782

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8684
CSTAR, M/SEC	1790.6	1790.6	1790.6
CF	0.1021	0.6547	1.5900
Ivac, M/SEC	7253.2	2207.2	3132.3
Isp, M/SEC	182.8	1172.3	2846.9

MASS FRACTIONS

*CO	0.37779	0.37759	0.36561	0.30503
*CO2	0.28102	0.28133	0.30020	0.39542
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00129	0.00129	0.00112	0.00023
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00014	0.00014	0.00008	0.00000
*H2	0.00697	0.00697	0.00672	0.00638
H2O	0.25048	0.25057	0.25828	0.28777
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00873	0.00871	0.00665	0.00017
*OH	0.04668	0.04654	0.03925	0.00428
*O2	0.02681	0.02677	0.02205	0.00071

* 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 FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012696

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7528	50.000
P, BAR	70.927	69.139	40.465	1.4185
T, K	3674.23	3667.91	3487.81	2472.70
RHO, KG/CU M	5.4548 0	5.3273 0	3.3235 0	1.7466-1
H, KJ/KG	-784.21	-801.00	-1474.40	-4846.55
U, KJ/KG	-2084.48	-2098.83	-2691.93	-5658.71
G, KJ/KG	-42114.8	-42076.9	-40723.6	-32672.5
S, KJ/(KG)(K)	11.2488	11.2533	11.2533	11.2533
M, (1/n)	23.494	23.498	23.818	25.314
MW, MOL WT	23.494	23.498	23.818	25.314
(dLV/dLP)t	-1.04090	-1.04085	-1.03555	-1.00351
(dLV/dLT)p	1.7024	1.7028	1.6452	1.0891
Cp, KJ/(KG)(K)	6.3458	6.3544	6.1539	2.7280
GAMMAS	1.1373	1.1371	1.1338	1.1619
SON VEL,M/SEC	1216.1	1214.8	1174.9	971.4
MACH NUMBER	0.000	0.151	1.000	2.934

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1283	1.1269	1.0896	0.86279
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.3458	6.3544	6.1539	2.7280
CONDUCTIVITY	14.3218	14.3273	13.2962	4.3844
PRANDTL NUMBER	0.4999	0.4998	0.5043	0.5368

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0345	2.0342	2.0260	1.9533
CONDUCTIVITY	3.5451	3.5399	3.3848	2.4843
PRANDTL NUMBER	0.6475	0.6476	0.6522	0.6784

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8433
CSTAR, M/SEC	1793.6	1793.6	1793.6
CF	0.1022	0.6550	1.5892
Ivac, M/SEC	7265.7	2211.2	3135.3
Isp, M/SEC	183.2	1174.9	2850.4

MASS FRACTIONS

*CO	0.37666	0.37647	0.36453	0.30485
*CO2	0.28278	0.28309	0.30189	0.39571
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00125	0.00125	0.00107	0.00021
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00014	0.00014	0.00009	0.00000
*H2	0.00692	0.00691	0.00667	0.00638
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25168	0.25178	0.25942	0.28810
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00837	0.00835	0.00635	0.00015
*OH	0.04609	0.04595	0.03865	0.00398
*O2	0.02601	0.02596	0.02128	0.00061

* 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 FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012703

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7533	50.000
P, BAR	81.060	79.015	46.232	1.6212
T, K	3693.44	3687.06	3504.37	2473.06
RHO, KG/CU M	6.2127 0	6.0674 0	3.7856 0	1.9967-1
H, KJ/KG	-784.21	-801.06	-1477.00	-4854.88
U, KJ/KG	-2088.95	-2103.34	-2698.28	-5666.81
G, KJ/KG	-42156.6	-42118.4	-40747.1	-32568.1
S, KJ/(KG)(K)	11.2016	11.2060	11.2060	11.2060
M, (1/n)	23.537	23.540	23.858	25.325
MW, MOL WT	23.537	23.540	23.858	25.325
(dLV/dLP)t	-1.04012	-1.04007	-1.03477	-1.00325
(dLV/dLT)p	1.6859	1.6862	1.6285	1.0826
Cp, KJ/(KG)(K)	6.2199	6.2282	6.0261	2.6721
GAMMA _s	1.1380	1.1379	1.1346	1.1638
SON VEL,M/SEC	1218.5	1217.3	1177.1	972.1
MACH NUMBER	0.000	0.151	1.000	2.935

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1328	1.1314	1.0936	0.86294
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.2199	6.2282	6.0261	2.6721
CONDUCTIVITY	14.0251	14.0303	13.0047	4.2573
PRANDTL NUMBER	0.5024	0.5023	0.5067	0.5416

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0357	2.0353	2.0272	1.9533
CONDUCTIVITY	3.5588	3.5536	3.3969	2.4842
PRANDTL NUMBER	0.6480	0.6480	0.6526	0.6785

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8214
CSTAR, M/SEC	1796.3	1796.3	1796.3
CF	0.1022	0.6553	1.5885
Ivac, M/SEC	7276.4	2214.6	3137.9
Isp, M/SEC	183.6	1177.1	2853.3

MASS FRACTIONS

*CO	0.37567	0.37547	0.36358	0.30470
*CO2	0.28433	0.28464	0.30338	0.39595
COOH	0.00004	0.00004	0.00003	0.00000
*H	0.00121	0.00121	0.00104	0.00020
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00015	0.00015	0.00009	0.00000
*H2	0.00687	0.00687	0.00662	0.00638
HC00H	0.00001	0.00001	0.00000	0.00000
H2O	0.25273	0.25282	0.26041	0.28837
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.00806	0.00804	0.00609	0.00013
*OH	0.04556	0.04543	0.03812	0.00374
*O2	0.02531	0.02526	0.02061	0.00054

* 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 FINITE AREA COMBUSTOR

$$P_{in} = 1322.6 \text{ PSIA}$$
$$Ac/At = 4.0000 \quad Pinj/Pinf = 1.012708$$

CASE =

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150

OXIDANT O2(L) 1.0000000 -12979.000 90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7538	50.000
P, BAR	91.192	88.891	51.998	1.8238
T, K	3710.38	3703.95	3518.94	2473.22
RHO, KG/CU M	6.9684 0	6.8054 0	4.2463 0	2.2470-1
H, KJ/KG	-784.21	-801.12	-1479.29	-4862.10
U, KJ/KG	-2092.87	-2107.30	-2703.85	-5673.78
G, KJ/KG	-42192.1	-42153.6	-40766.3	-32474.2
S, KJ/(KG)(K)	11.1600	11.1645	11.1645	11.1645
M, (1/n)	23.574	23.577	23.893	25.335
MW, MOL WT	23.574	23.577	23.893	25.335
(dLV/dLP)t	-1.03942	-1.03937	-1.03407	-1.00304
(dLV/dLT)p	1.6714	1.6717	1.6138	1.0772
Cp, KJ/(KG)(K)	6.1106	6.1187	5.9152	2.6260
GAMMAS	1.1387	1.1385	1.1353	1.1655
SON VEL,M/SEC	1220.7	1219.5	1179.1	972.6
MACH NUMBER	0.000	0.151	1.000	2.936

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1368	1.1354	1.0971	0.86302
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.1106	6.1187	5.9152	2.6260
CONDUCTIVITY	13.7674	13.7722	12.7517	4.1514
PRANDTL NUMBER	0.5046	0.5044	0.5089	0.5459

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0367	2.0364	2.0281	1.9533
CONDUCTIVITY	3.5709	3.5656	3.4076	2.4840
PRANDTL NUMBER	0.6484	0.6485	0.6530	0.6787

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.8021
CSTAR, M/SEC	1798.6	1798.6	1798.6
CF	0.1023	0.6555	1.5878
Ivac, M/SEC	7285.8	2217.6	3140.1
Isp, M/SEC	183.9	1179.1	2855.8

MASS FRACTIONS

*CO	0.37478	0.37458	0.36273	0.30457
*CO2	0.28573	0.28603	0.30470	0.39614
COOH	0.00005	0.00005	0.00003	0.00000
*H	0.00117	0.00117	0.00101	0.00019
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00016	0.00015	0.00009	0.00000
*H2	0.00683	0.00682	0.00658	0.00638
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25366	0.25375	0.26128	0.28859
H2O2	0.00003	0.00003	0.00001	0.00000
*O	0.00779	0.00777	0.00587	0.00012
*OH	0.04508	0.04495	0.03764	0.00353
*O2	0.02469	0.02464	0.02003	0.00048

* 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 FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012713

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.60000 %FUEL= 27.777778 R,EQ.RATIO= 1.309872 PHI,EQ.RATIO= 1.309872

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7542	50.000
P, BAR	101.33	98.766	57.762	2.0265
T, K	3725.53	3719.04	3531.93	2473.24
RHO, KG/CU M	7.7221 0	7.5414 0	4.7058 0	2.4974-1
H, KJ/KG	-784.21	-801.17	-1481.34	-4868.44
U, KJ/KG	-2096.35	-2110.83	-2708.80	-5679.88
G, KJ/KG	-42222.7	-42184.1	-40782.3	-32389.0
S, KJ/(KG)(K)	11.1229	11.1273	11.1273	11.1273
M, (1/n)	23.607	23.611	23.924	25.342
MW, MOL WT	23.607	23.611	23.924	25.342
(dLV/dLP)t	-1.03880	-1.03875	-1.03345	-1.00286
(dLV/dLT)p	1.6585	1.6588	1.6008	1.0726
Cp, KJ/(KG)(K)	6.0143	6.0222	5.8175	2.5871
GAMMAS	1.1393	1.1391	1.1359	1.1669
SON VEL,M/SEC	1222.7	1221.4	1180.8	973.1
MACH NUMBER	0.000	0.151	1.000	2.937

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1404	1.1390	1.1002	0.86307
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.0143	6.0222	5.8175	2.5871
CONDUCTIVITY	13.5400	13.5446	12.5285	4.0614
PRANDTL NUMBER	0.5065	0.5064	0.5109	0.5498

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0376	2.0373	2.0290	1.9533
CONDUCTIVITY	3.5817	3.5764	3.4172	2.4837
PRANDTL NUMBER	0.6488	0.6488	0.6533	0.6788

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.7848
CSTAR, M/SEC	1800.6	1800.6	1800.6
CF	0.1023	0.6558	1.5873
Ivac, M/SEC	7294.1	2220.3	3142.0
Isp, M/SEC	184.2	1180.8	2858.1

MASS FRACTIONS

*CO	0.37397	0.37378	0.36197	0.30447
*CO2	0.28699	0.28729	0.30590	0.39631
COOH	0.00005	0.00005	0.00003	0.00000
*H	0.00114	0.00114	0.00098	0.00018
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00016	0.00016	0.00009	0.00000
*H2	0.00679	0.00679	0.00655	0.00637
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25449	0.25458	0.26206	0.28878
H2O2	0.00003	0.00003	0.00002	0.00000
*O	0.00756	0.00754	0.00567	0.00010
*OH	0.04463	0.04451	0.03720	0.00335
*O2	0.02413	0.02409	0.01950	0.00043

* 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 FINITE AREA COMBUSTOR

Pin = 147.0 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012596
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0257	1.7447	50.000
P, BAR	10.133	9.8790	5.8075	0.20265
T, K	3405.25	3399.88	3256.02	2495.41
RHO, KG/CU M	8.3074-1	8.1140-1	5.0557-1	2.4940-2
H, KJ/KG	-773.97	-789.60	-1417.87	-4671.73
U, KJ/KG	-1993.66	-2007.11	-2566.56	-5484.28
G, KJ/KG	-41109.4	-41076.6	-40000.2	-34241.1
S, KJ/(KG)(K)	11.8450	11.8495	11.8495	11.8495
M, (1/n)	23.213	23.218	23.568	25.535
MW, MOL WT	23.213	23.218	23.568	25.535
(dLV/dLP)t	-1.05542	-1.05538	-1.05064	-1.01531

(dLV/dLT)p	2.0173	2.0181	1.9751	1.3887
Cp, KJ/(KG)(K)	8.7457	8.7599	8.6729	5.2011
GAMMAS	1.1252	1.1250	1.1211	1.1178
SON VEL,M/SEC	1171.5	1170.4	1134.8	953.1
MACH NUMBER	0.000	0.151	1.000	2.930

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0698	1.0687	1.0385	0.87331
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	8.7457	8.7599	8.6729	5.2011
CONDUCTIVITY	19.7228	19.7365	18.8121	9.0847
PRANDTL NUMBER	0.4744	0.4743	0.4788	0.5000

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	1.9991	1.9988	1.9919	1.9398
CONDUCTIVITY	3.3146	3.3101	3.1805	2.4940
PRANDTL NUMBER	0.6453	0.6453	0.6504	0.6792

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.2393
CSTAR, M/SEC	1744.1	1744.1	1744.1
CF	0.1014	0.6507	1.6009
Ivac, M/SEC	7064.3	2147.0	3083.1
Isp, M/SEC	176.8	1134.8	2792.0

MASS FRACTIONS

*CO	0.36672	0.36649	0.35374	0.27763
*CO2	0.27483	0.27520	0.29524	0.41484
COOH	0.00001	0.00001	0.00001	0.00000
*H	0.00180	0.00180	0.00159	0.00056
HCO	0.00001	0.00001	0.00000	0.00000
HO2	0.00009	0.00009	0.00006	0.00000
*H2	0.00675	0.00674	0.00647	0.00533
H2O	0.23395	0.23406	0.24206	0.28026
H2O2	0.00001	0.00001	0.00000	0.00000
*O	0.01515	0.01511	0.01233	0.00149
*OH	0.05526	0.05512	0.04826	0.01267
*O2	0.04541	0.04536	0.04023	0.00721

* 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 FINITE AREA COMBUSTOR

Pin = 293.9 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012625
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0257	1.7470	50.000
P, BAR	20.265	19.757	11.600	0.40530
T, K	3504.73	3499.04	3344.52	2524.17
RHO, KG/CU M	1.6292 0	1.5912 0	9.9187-1	4.9582-2
H, KJ/KG	-773.97	-789.94	-1431.61	-4727.20
U, KJ/KG	-2017.84	-2031.56	-2601.13	-5544.64
G, KJ/KG	-41421.5	-41387.1	-40235.9	-34013.6
S, KJ/(KG)(K)	11.5979	11.6024	11.6024	11.6024
M, (1/n)	23.427	23.431	23.777	25.675
MW, MOL WT	23.427	23.431	23.777	25.675
(dLV/dLP)t	-1.05171	-1.05166	-1.04692	-1.01192
(dLV/dLT)p	1.9258	1.9265	1.8829	1.3001
Cp, KJ/(KG)(K)	7.9399	7.9528	7.8594	4.4314
GAMMAS	1.1288	1.1286	1.1246	1.1256
SON VEL,M/SEC	1184.9	1183.8	1146.9	959.2
MACH NUMBER	0.000	0.151	1.000	2.931

TRANSPORT PROPERTIES (GASES ONLY)
CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.0934	1.0922	1.0600	0.88152
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	7.9399	7.9528	7.8594	4.4314
CONDUCTIVITY	17.8969	17.9088	17.0058	7.6246
PRANDTL NUMBER	0.4851	0.4850	0.4899	0.5123

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0054	2.0051	1.9980	1.9432
CONDUCTIVITY	3.3846	3.3799	3.2442	2.5169
PRANDTL NUMBER	0.6479	0.6479	0.6528	0.6806

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1592
CSTAR, M/SEC	1759.3	1759.3	1759.3
CF	0.1016	0.6519	1.5983
Ivac, M/SEC	7126.0	2166.6	3102.6
Isp, M/SEC	178.7	1146.9	2811.8

MASS FRACTIONS

*CO	0.36222	0.36200	0.34917	0.27473
*CO2	0.28190	0.28224	0.30242	0.41940
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00157	0.00157	0.00138	0.00044
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00012	0.00012	0.00008	0.00000
*H2	0.00651	0.00651	0.00624	0.00521
H2O	0.23888	0.23899	0.24686	0.28344

H2O2	0.00001	0.00001	0.00001	0.00000
*O	0.01322	0.01319	0.01064	0.00102
*OH	0.05380	0.05365	0.04665	0.01070
*O2	0.04174	0.04168	0.03654	0.00506

* 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 FINITE AREA COMBUSTOR

Pin = 440.9 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012642
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7483	50.000
P, BAR	30.398	29.634	17.387	0.60795
T, K	3563.85	3557.97	3396.84	2538.41
RHO, KG/CU M	2.4164 0	2.3601 0	1.4715 0	7.4171-2
H, KJ/KG	-773.97	-790.15	-1439.64	-4758.63
U, KJ/KG	-2031.92	-2045.79	-2621.24	-5578.30
G, KJ/KG	-41595.7	-41560.4	-40363.5	-33845.8
S, KJ/(KG)(K)	11.4544	11.4588	11.4588	11.4588
M, (1/n)	23.555	23.560	23.902	25.749
MW, MOL WT	23.555	23.560	23.902	25.749
(dLV/dLP)t	-1.04951	-1.04947	-1.04471	-1.01009
(dLV/dLT)p	1.8737	1.8744	1.8304	1.2531
Cp, KJ/(KG)(K)	7.5000	7.5121	7.4142	4.0331
GAMMAS	1.1309	1.1307	1.1267	1.1308
SON VEL,M/SEC	1192.7	1191.5	1153.8	962.7
MACH NUMBER	0.000	0.151	1.000	2.932

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1074	1.1062	1.0727	0.88562
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	7.5000	7.5121	7.4142	4.0331
CONDUCTIVITY	16.8877	16.8987	16.0086	6.8660
PRANDTL NUMBER	0.4918	0.4917	0.4968	0.5202

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0091	2.0088	2.0016	1.9449
CONDUCTIVITY	3.4264	3.4216	3.2822	2.5282
PRANDTL NUMBER	0.6494	0.6494	0.6542	0.6813

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.1087
CSTAR, M/SEC	1768.0	1768.0	1768.0
CF	0.1017	0.6526	1.5967
Ivac, M/SEC	7161.5	2177.9	3113.4
Isp, M/SEC	179.8	1153.8	2823.0

MASS FRACTIONS

*CO	0.35930	0.35908	0.34624	0.27318
*CO2	0.28647	0.28681	0.30701	0.42183
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.00144	0.00144	0.00126	0.00038
HCO	0.00002	0.00002	0.00001	0.00000
H02	0.00014	0.00013	0.00009	0.00000
*H2	0.00637	0.00637	0.00610	0.00515
H2O	0.24185	0.24195	0.24973	0.28515
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.01213	0.01210	0.00968	0.00079
*OH	0.05274	0.05260	0.04553	0.00953
*O2	0.03950	0.03945	0.03432	0.00399

* 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 FINITE AREA COMBUSTOR

Pin = 587.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012654
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7493	50.000
P, BAR	40.530	39.511	23.170	0.81060
T, K	3606.14	3600.13	3434.13	2547.19
RHO, KG/CU M	3.1966 0	3.1221 0	1.9469 0	9.8741-2
H, KJ/KG	-773.97	-790.29	-1445.33	-4780.39
U, KJ/KG	-2041.87	-2055.84	-2635.43	-5601.32
G, KJ/KG	-41714.7	-41678.6	-40448.4	-33710.1
S, KJ/(KG)(K)	11.3530	11.3575	11.3575	11.3575

M, (1/n)	23.648	23.652	23.992	25.798
MW, MOL WT	23.648	23.652	23.992	25.798
(dLV/dLP)t	-1.04794	-1.04790	-1.04314	-1.00889
(dLV/dLT)p	1.8374	1.8380	1.7938	1.2224
Cp, KJ/(KG)(K)	7.2015	7.2130	7.1114	3.7755
GAMMAS	1.1324	1.1322	1.1282	1.1347
SON VEL,M/SEC	1198.2	1197.0	1158.8	965.1
MACH NUMBER	0.000	0.151	1.000	2.933

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1175	1.1162	1.0818	0.88817
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	7.2015	7.2130	7.1114	3.7755
CONDUCTIVITY	16.1981	16.2083	15.3275	6.3729
PRANDTL NUMBER	0.4968	0.4967	0.5019	0.5262

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0117	2.0114	2.0041	1.9460
CONDUCTIVITY	3.4564	3.4515	3.3094	2.5351
PRANDTL NUMBER	0.6504	0.6505	0.6551	0.6818

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0712
CSTAR, M/SEC	1774.1	1774.1	1774.1
CF	0.1018	0.6531	1.5955
Ivac, M/SEC	7186.4	2185.8	3120.7
Isp, M/SEC	180.6	1158.8	2830.7

MASS FRACTIONS

*CO	0.35710	0.35689	0.34405	0.27216
*CO2	0.28991	0.29025	0.31044	0.42343
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00136	0.00136	0.00118	0.00034
HCO	0.00002	0.00002	0.00001	0.00000
H02	0.00015	0.00015	0.00010	0.00000
*H2	0.00627	0.00627	0.00600	0.00512
H2O	0.24399	0.24409	0.25179	0.28628
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.01136	0.01134	0.00903	0.00065
*OH	0.05190	0.05176	0.04466	0.00870
*O2	0.03789	0.03784	0.03271	0.00332

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 734.8 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012663

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7500	50.000
P, BAR	50.663	49.388	28.950	1.0132
T, K	3639.10	3632.99	3463.12	2553.22
RHO, KG/CU M	3.9718 0	3.8791 0	2.4192 0	1.2331-1
H, KJ/KG	-773.97	-790.40	-1449.73	-4796.91
U, KJ/KG	-2049.54	-2063.60	-2646.38	-5618.65
G, KJ/KG	-41803.8	-41767.3	-40510.7	-33595.0
S, KJ/(KG)(K)	11.2747	11.2791	11.2791	11.2791

M, (1/n)	23.721	23.725	24.062	25.834
MW, MOL WT	23.721	23.725	24.062	25.834
(dLV/dLP)t	-1.04671	-1.04667	-1.04191	-1.00801
(dLV/dLT)p	1.8096	1.8102	1.7657	1.2002
Cp, KJ/(KG)(K)	6.9773	6.9884	6.8839	3.5907
GAMMAS	1.1335	1.1333	1.1294	1.1378
SON VEL,M/SEC	1202.4	1201.2	1162.5	966.9
MACH NUMBER	0.000	0.151	1.000	2.934

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1253	1.1239	1.0888	0.88993
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.9773	6.9884	6.8839	3.5907
CONDUCTIVITY	15.6782	15.6879	14.8143	6.0168
PRANDTL NUMBER	0.5008	0.5007	0.5059	0.5311

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0138	2.0135	2.0061	1.9467
CONDUCTIVITY	3.4799	3.4749	3.3306	2.5399
PRANDTL NUMBER	0.6512	0.6512	0.6558	0.6821

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	8.0411
CSTAR, M/SEC	1778.8	1778.8	1778.8
CF	0.1019	0.6535	1.5946
Ivac, M/SEC	7205.4	2191.9	3126.2
Isp, M/SEC	181.3	1162.5	2836.5

MASS FRACTIONS

*CO	0.35532	0.35512	0.34229	0.27143
*CO2	0.29270	0.29302	0.31320	0.42458
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.00129	0.00129	0.00112	0.00031

HCO	0.00003	0.00002	0.00001	0.00000
HO2	0.00016	0.00016	0.00010	0.00000
*H2	0.00619	0.00618	0.00592	0.00509
H2O	0.24567	0.24577	0.25340	0.28711
H2O2	0.00002	0.00002	0.00001	0.00000
*O	0.01078	0.01076	0.00853	0.00055
*OH	0.05119	0.05105	0.04393	0.00807
*O2	0.03662	0.03657	0.03146	0.00285

* 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 FINITE AREA COMBUSTOR

Pin = 881.8 PSIA
 Ac/At = 4.0000 Pinj/Pinf = 1.012671
 CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7506	50.000
P, BAR	60.795	59.265	34.728	1.2159
T, K	3666.12	3659.92	3486.82	2557.61
RHO, KG/CU M	4.7429 0	4.6322 0	2.8892 0	1.4787-1
H, KJ/KG	-773.97	-790.49	-1453.31	-4810.16
U, KJ/KG	-2055.77	-2069.91	-2655.28	-5632.44
G, KJ/KG	-41874.5	-41837.5	-40559.1	-33494.5
S, KJ/(KG)(K)	11.2109	11.2153	11.2153	11.2153
M, (1/n)	23.781	23.785	24.120	25.862
MW, MOL WT	23.781	23.785	24.120	25.862
(dLV/dLP)t	-1.04571	-1.04566	-1.04090	-1.00734
(dLV/dLT)p	1.7871	1.7877	1.7429	1.1832
Cp, KJ/(KG)(K)	6.7989	6.8097	6.7026	3.4494
GAMMAS	1.1345	1.1343	1.1304	1.1404
SON VEL,M/SEC	1205.9	1204.7	1165.6	968.4
MACH NUMBER	0.000	0.151	1.000	2.934

TRANSPORT PROPERTIES (GASES ONLY)
 CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.1316 1.1303 1.0946 0.89122

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.7989	6.8097	6.7026	3.4494
CONDUCTIVITY	15.2632	15.2724	14.4047	5.7432

PRANDTL NUMBER 0.5041 0.5040 0.5093 0.5353

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K) 2.0154 2.0151 2.0077 1.9472
CONDUCTIVITY 3.4991 3.4942 3.3480 2.5433
PRANDTL NUMBER 0.6518 0.6519 0.6564 0.6823

PERFORMANCE PARAMETERS

Ae/At 4.0000 1.0000 8.0160
CSTAR, M/SEC 1782.6 1782.6 1782.6
CF 0.1020 0.6539 1.5938
Ivac, M/SEC 7220.9 2196.8 3130.6
Isp, M/SEC 181.8 1165.6 2841.2

MASS FRACTIONS

*CO 0.35383 0.35362 0.34082 0.27086
*CO2 0.29504 0.29536 0.31551 0.42547
COOH 0.00004 0.00004 0.00002 0.00000
*H 0.00124 0.00124 0.00108 0.00029
HCO 0.00003 0.00003 0.00002 0.00000
HO2 0.00017 0.00017 0.00011 0.00000
*H2 0.00612 0.00612 0.00586 0.00507
H2O 0.24705 0.24715 0.25471 0.28775
H2O2 0.00002 0.00002 0.00001 0.00000
*O 0.01032 0.01029 0.00812 0.00048
*OH 0.05058 0.05044 0.04331 0.00757
*O2 0.03556 0.03552 0.03043 0.00250

* 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 FINITE AREA COMBUSTOR

Pin = 1028.7 PSIA
Ac/At = 4.0000 Pinj/Pinf = 1.012678
CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7511	50.000
P, BAR	70.927	69.141	40.504	1.4185
T, K	3689.02	3682.74	3506.87	2560.95
RHO, KG/CU M	5.5109 0	5.3821 0	3.3573 0	1.7244-1

H, KJ/KG	-773.97	-790.57	-1456.33	-4821.19
U, KJ/KG	-2061.02	-2075.21	-2662.77	-5643.83
G, KJ/KG	-41932.5	-41895.3	-40598.1	-33405.0
S, KJ/(KG)(K)	11.1570	11.1614	11.1614	11.1614
M, (1/n)	23.832	23.835	24.169	25.884
MW, MOL WT	23.832	23.835	24.169	25.884
(dLV/dLP)t	-1.04485	-1.04481	-1.04004	-1.00679
(dLV/dLT)p	1.7682	1.7688	1.7238	1.1695
Cp, KJ/(KG)(K)	6.6514	6.6618	6.5525	3.3369
GAMMAS	1.1353	1.1351	1.1312	1.1427
SON VEL,M/SEC	1208.8	1207.6	1168.2	969.5
MACH NUMBER	0.000	0.151	1.000	2.934

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1371	1.1357	1.0994	0.89221
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.6514	6.6618	6.5525	3.3369
CONDUCTIVITY	14.9191	14.9280	14.0652	5.5241
PRANDTL NUMBER	0.5069	0.5068	0.5122	0.5390

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0169	2.0166	2.0090	1.9476
CONDUCTIVITY	3.5155	3.5105	3.3628	2.5459
PRANDTL NUMBER	0.6523	0.6524	0.6568	0.6826

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9943
CSTAR, M/SEC	1785.8	1785.8	1785.8
CF	0.1020	0.6542	1.5932
Ivac, M/SEC	7233.8	2200.9	3134.2
Isp, M/SEC	182.2	1168.2	2845.1

MASS FRACTIONS

*CO	0.35253	0.35233	0.33955	0.27041
*CO2	0.29707	0.29738	0.31750	0.42618
COOH	0.00004	0.00004	0.00002	0.00000
*H	0.00119	0.00119	0.00104	0.00027
HCO	0.00003	0.00003	0.00002	0.00000
H02	0.00018	0.00018	0.00011	0.00000
*H2	0.00606	0.00606	0.00580	0.00505
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.24823	0.24832	0.25583	0.28827
H2O2	0.00003	0.00003	0.00002	0.00000
*O	0.00993	0.00990	0.00779	0.00043
*OH	0.05004	0.04990	0.04276	0.00715
*O2	0.03467	0.03462	0.02955	0.00223

* 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 FINITE AREA COMBUSTOR

Pin = 1175.7 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012683

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0258	1.7516	50.000
P, BAR	81.060	79.018	46.278	1.6212
T, K	3708.88	3702.54	3524.23	2563.56
RHO, KG/CU M	6.2760 0	6.1294 0	3.8237 0	1.9701-1
H, KJ/KG	-773.97	-790.63	-1458.94	-4830.60
U, KJ/KG	-2065.55	-2079.79	-2669.23	-5653.49
G, KJ/KG	-41981.5	-41943.9	-40630.4	-33324.2
S, KJ/(KG)(K)	11.1105	11.1149	11.1149	11.1149
M, (1/n)	23.876	23.880	24.211	25.902
MW, MOL WT	23.876	23.880	24.211	25.902
(dLV/dLP)t	-1.04411	-1.04407	-1.03930	-1.00635
(dLV/dLT)p	1.7520	1.7526	1.7074	1.1583
Cp, KJ/(KG)(K)	6.5259	6.5361	6.4247	3.2446
GAMMAS	1.1360	1.1358	1.1319	1.1447
SON VEL,M/SEC	1211.3	1210.0	1170.4	970.5
MACH NUMBER	0.000	0.151	1.000	2.935

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.1418 1.1404 1.1036 0.89300

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.5259	6.5361	6.4247	3.2446
CONDUCTIVITY	14.6260	14.6346	13.7761	5.3432
PRANDTL NUMBER	0.5094	0.5093	0.5147	0.5423

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0181	2.0178	2.0102	1.9480
CONDUCTIVITY	3.5298	3.5247	3.3757	2.5479
PRANDTL NUMBER	0.6528	0.6528	0.6572	0.6827

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9752
CSTAR, M/SEC	1788.5	1788.5	1788.5
CF	0.1021	0.6544	1.5926
Ivac, M/SEC	7244.9	2204.5	3137.3
Isp, M/SEC	182.5	1170.4	2848.4

MASS FRACTIONS

*CO	0.35138	0.35118	0.33843	0.27004
*CO2	0.29886	0.29917	0.31925	0.42676
COOH	0.00005	0.00004	0.00003	0.00000
*H	0.00116	0.00116	0.00100	0.00026
HCO	0.00003	0.00003	0.00002	0.00000
HO2	0.00019	0.00019	0.00012	0.00000
*H2	0.00601	0.00601	0.00576	0.00504
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.24925	0.24934	0.25680	0.28870
H2O2	0.00003	0.00003	0.00002	0.00000
*O	0.00959	0.00957	0.00751	0.00038
*OH	0.04955	0.04942	0.04227	0.00680
*O2	0.03389	0.03384	0.02879	0.00201

* 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 FINITE AREA COMBUSTOR

Pin = 1322.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012688

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7520	50.000
P, BAR	91.192	88.894	52.051	1.8238
T, K	3726.42	3720.02	3539.53	2565.64
RHO, KG/CU M	7.0389 0	6.8744 0	4.2887 0	2.2159-1
H, KJ/KG	-773.97	-790.69	-1461.23	-4838.78
U, KJ/KG	-2069.53	-2083.81	-2674.90	-5661.85
G, KJ/KG	-42023.6	-41985.8	-40657.7	-33250.5
S, KJ/(KG)(K)	11.0695	11.0739	11.0739	11.0739
M, (1/n)	23.915	23.919	24.248	25.918
MW, MOL WT	23.915	23.919	24.248	25.918
(dLV/dLP)t	-1.04345	-1.04341	-1.03864	-1.00597
(dLV/dLT)p	1.7378	1.7383	1.6930	1.1488
Cp, KJ/(KG)(K)	6.4171	6.4270	6.3138	3.1671
GAMMAS	1.1366	1.1364	1.1325	1.1464
SON VEL,M/SEC	1213.5	1212.2	1172.4	971.4
MACH NUMBER	0.000	0.151	1.000	2.935

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE 1.1459 1.1445 1.1074 0.89363

WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.4171	6.4270	6.3138	3.1671
CONDUCTIVITY	14.3714	14.3797	13.5250	5.1906
PRANDTL NUMBER	0.5117	0.5116	0.5169	0.5453

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0192	2.0189	2.0112	1.9482
CONDUCTIVITY	3.5423	3.5372	3.3870	2.5495
PRANDTL NUMBER	0.6532	0.6532	0.6576	0.6829

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9582
CSTAR, M/SEC	1790.9	1790.9	1790.9
CF	0.1021	0.6546	1.5920
Ivac, M/SEC	7254.7	2207.6	3139.9
Isp, M/SEC	182.9	1172.4	2851.2

MASS FRACTIONS

*CO	0.35035	0.35015	0.33743	0.26973
*CO2	0.30047	0.30078	0.32082	0.42725
COOH	0.00005	0.00005	0.00003	0.00000
*H	0.00113	0.00112	0.00098	0.00024
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00020	0.00019	0.00012	0.00000
*H2	0.00597	0.00597	0.00572	0.00503
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25016	0.25025	0.25766	0.28906
H2O2	0.00003	0.00003	0.00002	0.00000
*O	0.00930	0.00928	0.00726	0.00035
*OH	0.04910	0.04898	0.04182	0.00649
*O2	0.03320	0.03315	0.02812	0.00183

* 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 FINITE AREA COMBUSTOR

Pin = 1469.6 PSIA

Ac/At = 4.0000 Pinj/Pinf = 1.012693

CASE = _____

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	RP-1	1.0000000	-24717.700	298.150
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.70000 %FUEL= 27.027027 R,EQ.RATIO= 1.261358 PHI,EQ.RATIO= 1.261358

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0259	1.7524	50.000
P, BAR	101.33	98.770	57.822	2.0265
T, K	3742.12	3735.66	3553.21	2567.34
RHO, KG/CU M	7.7996 0	7.6173 0	4.7525 0	2.4618-1
H, KJ/KG	-773.97	-790.74	-1463.28	-4846.01
U, KJ/KG	-2073.07	-2087.40	-2679.95	-5669.20
G, KJ/KG	-42060.4	-42022.4	-40681.1	-33182.5
S, KJ/(KG)(K)	11.0329	11.0373	11.0373	11.0373
M, (1/n)	23.950	23.954	24.282	25.931
MW, MOL WT	23.950	23.954	24.282	25.931
(dLV/dLP)t	-1.04286	-1.04282	-1.03805	-1.00565
(dLV/dLT)p	1.7251	1.7257	1.6802	1.1407
Cp, KJ/(KG)(K)	6.3211	6.3309	6.2160	3.1009
GAMMAS	1.1371	1.1369	1.1331	1.1480
SON VEL,M/SEC	1215.4	1214.2	1174.1	972.1
MACH NUMBER	0.000	0.151	1.000	2.936

TRANSPORT PROPERTIES (GASES ONLY)

CONDUCTIVITY IN UNITS OF MILLIWATTS/(CM)(K)

VISC,MILLIPOISE	1.1496	1.1482	1.1107	0.89414
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WITH EQUILIBRIUM REACTIONS

Cp, KJ/(KG)(K)	6.3211	6.3309	6.2160	3.1009
CONDUCTIVITY	14.1467	14.1547	13.3034	5.0596
PRANDTL NUMBER	0.5137	0.5136	0.5190	0.5480

WITH FROZEN REACTIONS

Cp, KJ/(KG)(K)	2.0202	2.0198	2.0121	1.9484
CONDUCTIVITY	3.5536	3.5485	3.3972	2.5508
PRANDTL NUMBER	0.6535	0.6536	0.6579	0.6830

PERFORMANCE PARAMETERS

Ae/At	4.0000	1.0000	7.9428
CSTAR, M/SEC	1793.1	1793.1	1793.1
CF	0.1021	0.6548	1.5916
Ivac, M/SEC	7263.4	2210.4	3142.2
Isp, M/SEC	183.1	1174.1	2853.8

MASS FRACTIONS

*CO	0.34942	0.34922	0.33652	0.26946
*CO2	0.30193	0.30224	0.32224	0.42767
COOH	0.00005	0.00005	0.00003	0.00000
*H	0.00110	0.00110	0.00095	0.00023
HCO	0.00004	0.00004	0.00002	0.00000
HO2	0.00020	0.00020	0.00013	0.00000
*H2	0.00593	0.00593	0.00568	0.00503
HCOOH	0.00001	0.00001	0.00000	0.00000
H2O	0.25097	0.25106	0.25843	0.28938
H2O2	0.00003	0.00003	0.00002	0.00000
*O	0.00904	0.00902	0.00704	0.00032
*OH	0.04870	0.04857	0.04142	0.00622
*O2	0.03258	0.03253	0.02752	0.00168

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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