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

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prob case=11117116 ro equilibrium

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 ! iac problem
o/f 2.9 3 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8 3.9 4 4.1 4.2 4.3 4.4
p,bar  100
supar 30
reac
 fuel  H2(L) wt%=100 t,k=20.27
  oxid  O2(L) wt%=100. t,k=90.17
output    short
output trace=1e-5
end
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THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1450.4 PSIA
CASE = 11117116

REACTANT		WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 2.90000 %FUEL= 25.641026 R,EQ.RATIO= 2.736787 PHI,EQ.RATIO= 2.736787

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.8022	499.19
P, BAR	100.00	55.488	0.20033
T, K	2393.83	2134.17	574.20
RHO, KG/CU M	3.9473 0	2.4579 0	3.2989-2
H, KJ/KG	-1447.89	-2857.78	-10144.3
U, KJ/KG	-3981.27	-5115.31	-10751.5
G, KJ/KG	-59649.8	-54746.4	-24104.9
S, KJ/(KG)(K)	24.3133	24.3133	24.3133
M, (1/n)	7.857	7.860	7.862
(dLV/dLP)t	-1.00034	-1.00011	-1.00000
(dLV/dLT)p	1.0081	1.0029	1.0000
Cp, KJ/(KG)(K)	5.5918	5.3329	4.0394
GAMMAs	1.2376	1.2491	1.3547
SON VEL,M/SEC	1770.7	1679.2	907.0
MACH NUMBER	0.000	1.000	4.598

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2422.9	2422.9
CF	0.6931	1.7213
Ivac, M/SEC	3023.6	4316.1
Isp, M/SEC	1679.2	4170.5

MOLE FRACTIONS

*H	1.232 -3	4.110 -4	1.137-17
*H2	6.3363-1	6.3428-1	6.3461-1
H2O	3.6500-1	3.6528-1	3.6539-1
*OH	1.431 -4	3.339 -5	7.248-23

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

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FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.00000 %FUEL= 25.000000 R,EQ.RATIO= 2.645561 PHI,EQ.RATIO= 2.645561

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7995	490.88
P, BAR	100.00	55.571	0.20372
T, K	2452.75	2191.39	600.89
RHO, KG/CU M	3.9504 0	2.4586 0	3.2879-2
H, KJ/KG	-1421.83	-2828.43	-10160.6
U, KJ/KG	-3953.23	-5088.73	-10780.2
G, KJ/KG	-60217.0	-55358.3	-24564.5
S, KJ/(KG)(K)	23.9711	23.9711	23.9711
M, (1/n)	8.056	8.061	8.064
(dLV/dLP)t	-1.00045	-1.00016	-1.00000
(dLV/dLT)p	1.0105	1.0040	1.0000
Cp, KJ/(KG)(K)	5.5621	5.2856	3.9648
GAMMAs	1.2331	1.2446	1.3515
SON VEL,M/SEC	1766.7	1677.3	915.1
MACH NUMBER	0.000	1.000	4.569

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2425.0	2425.0
CF	0.6916	1.7239
Ivac, M/SEC	3024.9	4328.8

Isp, M/SEC	1677.3	4180.6

MOLE FRACTIONS

*H	1.606 -3	5.682 -4	8.622-17
*H2	6.2075-1	6.2156-1	6.2201-1
H2O	3.7744-1	3.7782-1	3.7799-1
*OH	2.112 -4	5.313 -5	1.033-21

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	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.10000 %FUEL= 24.390244 R,EQ.RATIO= 2.560220 PHI,EQ.RATIO= 2.560220

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7968	482.74
P, BAR	100.00	55.654	0.20715
T, K	2510.18	2247.52	628.03
RHO, KG/CU M	3.9554 0	2.4605 0	3.2788-2
H, KJ/KG	-1397.05	-2799.67	-10173.3
U, KJ/KG	-3925.21	-5061.59	-10805.1
G, KJ/KG	-60742.2	-55935.1	-25021.2
S, KJ/(KG)(K)	23.6418	23.6418	23.6418
M, (1/n)	8.255	8.262	8.265
(dLV/dLP)t	-1.00059	-1.00021	-1.00000
(dLV/dLT)p	1.0133	1.0053	1.0000
Cp, KJ/(KG)(K)	5.5417	5.2456	3.8957
GAMMAs	1.2286	1.2402	1.3481
SON VEL,M/SEC	1762.4	1674.9	922.9
MACH NUMBER	0.000	1.000	4.540

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2426.6	2426.6
CF	0.6902	1.7265
Ivac, M/SEC	3025.4	4340.4
Isp, M/SEC	1674.9	4189.6

MOLE FRACTIONS

*H	2.053 -3	7.677 -4	5.676-16
*H2	6.0782-1	6.0881-1	6.0941-1

H2O	3.8983-1	3.9034-1	3.9059-1
*OH	3.039 -4	8.206 -5	1.228-20

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CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.20000 %FUEL= 23.809524 R,EQ.RATIO= 2.480213 PHI,EQ.RATIO= 2.480213

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7942	474.79
P, BAR	100.00	55.736	0.21062
T, K	2566.08	2302.55	655.63
RHO, KG/CU M	3.9623 0	2.4635 0	3.2713-2
H, KJ/KG	-1373.44	-2771.46	-10182.7
U, KJ/KG	-3897.20	-5033.91	-10826.5
G, KJ/KG	-61226.9	-56478.0	-25475.0
S, KJ/(KG)(K)	23.3248	23.3248	23.3248
M, (1/n)	8.454	8.462	8.467
(dLV/dLP)t	-1.00075	-1.00028	-1.00000
(dLV/dLT)p	1.0167	1.0070	1.0000
Cp, KJ/(KG)(K)	5.5306	5.2130	3.8315
GAMMAs	1.2241	1.2359	1.3446
SON VEL,M/SEC	1757.6	1672.1	930.4
MACH NUMBER	0.000	1.000	4.511

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2427.6	2427.6
CF	0.6888	1.7291
Ivac, M/SEC	3025.2	4350.8
Isp, M/SEC	1672.1	4197.4

MOLE FRACTIONS

*H	2.578 -3	1.016 -3	3.284-15
*H2	5.9484-1	5.9602-1	5.9681-1
H2O	4.0216-1	4.0284-1	4.0319-1
*OH	4.272 -4	1.233 -4	1.235-19

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Pin = 1450.4 PSIA
CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.30000 %FUEL= 23.255814 R,EQ.RATIO= 2.405055 PHI,EQ.RATIO= 2.405055

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7915	467.02
P, BAR	100.00	55.818	0.21413
T, K	2620.46	2356.46	683.64
RHO, KG/CU M	3.9710 0	2.4676 0	3.2654-2
H, KJ/KG	-1350.93	-2743.76	-10188.9
U, KJ/KG	-3869.20	-5005.74	-10844.6
G, KJ/KG	-61672.5	-56988.1	-25926.0
S, KJ/(KG)(K)	23.0195	23.0195	23.0195
M, (1/n)	8.652	8.662	8.668
(dLV/dLP)t	-1.00095	-1.00038	-1.00000
(dLV/dLT)p	1.0206	1.0090	1.0000
Cp, KJ/(KG)(K)	5.5288	5.1882	3.7720
GAMMAs	1.2197	1.2315	1.3410
SON VEL,M/SEC	1752.6	1669.0	937.7
MACH NUMBER	0.000	1.000	4.483

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2428.0	2428.0
CF	0.6874	1.7316
Ivac, M/SEC	3024.3	4360.2
Isp, M/SEC	1669.0	4204.3

MOLE FRACTIONS

*H	3.185 -3	1.319 -3	1.688-14
*H2	5.8181-1	5.8320-1	5.8421-1
H2O	4.1441-1	4.1530-1	4.1579-1
*OH	5.879 -4	1.808 -4	1.068-18

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Pin = 1450.4 PSIA

CASE = 11117116

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FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.40000 %FUEL= 22.727273 R,EQ.RATIO= 2.334318 PHI,EQ.RATIO= 2.334318

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7889	459.43
P, BAR	100.00	55.900	0.21766
T, K	2673.28	2409.22	712.08
RHO, KG/CU M	3.9812 0	2.4728 0	3.2609-2
H, KJ/KG	-1329.45	-2716.53	-10192.2
U, KJ/KG	-3841.22	-4977.10	-10859.7
G, KJ/KG	-62080.0	-57466.3	-26374.2
S, KJ/(KG)(K)	22.7251	22.7251	22.7251
M, (1/n)	8.849	8.861	8.870
(dLV/dLP)t	-1.00117	-1.00049	-1.00000
(dLV/dLT)p	1.0252	1.0114	1.0000
Cp, KJ/(KG)(K)	5.5361	5.1713	3.7169
GAMMAs	1.2154	1.2272	1.3372
SON VEL,M/SEC	1747.2	1665.6	944.8
MACH NUMBER	0.000	1.000	4.456

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2428.0	2428.0
CF	0.6860	1.7340
Ivac, M/SEC	3022.8	4368.7
Isp, M/SEC	1665.6	4210.2

MOLE FRACTIONS

*H	3.876 -3	1.682 -3	7.793-14
*H2	5.6874-1	5.7034-1	5.7161-1
H2O	4.2659-1	4.2771-1	4.2839-1
*OH	7.933 -4	2.592 -4	8.035-18

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Pin = 1450.4 PSIA
CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.50000 %FUEL= 22.222222 R,EQ.RATIO= 2.267624 PHI,EQ.RATIO= 2.267624

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7863	452.05
P, BAR	100.00	55.981	0.22122
T, K	2724.54	2460.82	740.89
RHO, KG/CU M	3.9930 0	2.4789 0	3.2576-2
H, KJ/KG	-1308.92	-2689.75	-10192.7
U, KJ/KG	-3813.27	-4948.02	-10871.7
G, KJ/KG	-62450.9	-57913.4	-26819.1
S, KJ/(KG)(K)	22.4412	22.4412	22.4412
M, (1/n)	9.046	9.060	9.071
(dLV/dLP)t	-1.00143	-1.00062	-1.00000
(dLV/dLT)p	1.0303	1.0143	1.0000
Cp, KJ/(KG)(K)	5.5524	5.1625	3.6658
GAMMAs	1.2111	1.2229	1.3334
SON VEL,M/SEC	1741.6	1661.8	951.6
MACH NUMBER	0.000	1.000	4.430

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2427.4	2427.4
CF	0.6846	1.7365
Ivac, M/SEC	3020.7	4376.3
Isp, M/SEC	1661.8	4215.2

MOLE FRACTIONS

*H	4.651 -3	2.110 -3	3.257-13
*H2	5.5562-1	5.5745-1	5.5901-1
H2O	4.3867-1	4.4008-1	4.4099-1
*OH	1.051 -3	3.637 -4	5.319-17

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FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.60000 %FUEL= 21.739130 R,EQ.RATIO= 2.204634 PHI,EQ.RATIO= 2.204634

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7837	444.83
P, BAR	100.00	56.063	0.22481

T, K	2774.23	2511.21	770.09
RHO, KG/CU M	4.0063 0	2.4860 0	3.2558-2
H, KJ/KG	-1289.28	-2663.39	-10190.5
U, KJ/KG	-3785.36	-4918.53	-10881.0
G, KJ/KG	-62786.1	-58329.8	-27261.3
S, KJ/(KG)(K)	22.1672	22.1672	22.1672
M, (1/n)	9.241	9.259	9.273
(dLV/dLP)t	-1.00173	-1.00078	-1.00000
(dLV/dLT)p	1.0361	1.0177	1.0000
Cp, KJ/(KG)(K)	5.5774	5.1620	3.6184
GAMMAs	1.2069	1.2186	1.3294
SON VEL,M/SEC	1735.7	1657.8	958.1
MACH NUMBER	0.000	1.000	4.404

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2426.5	2426.5
CF	0.6832	1.7389
Ivac, M/SEC	3018.1	4383.0
Isp, M/SEC	1657.8	4219.3

MOLE FRACTIONS

*H	5.509 -3	2.607 -3	1.243-12
*H2	5.4247-1	5.4451-1	5.4641-1
H2O	4.5064-1	4.5238-1	4.5359-1
*OH	1.370 -3	5.004 -4	3.134-16

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FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.70000 %FUEL= 21.276596 R,EQ.RATIO= 2.145049 PHI,EQ.RATIO= 2.145049

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7811	437.79
P, BAR	100.00	56.144	0.22842
T, K	2822.35	2560.38	799.65
RHO, KG/CU M	4.0209 0	2.4939 0	3.2551-2
H, KJ/KG	-1270.48	-2637.44	-10185.9
U, KJ/KG	-3757.49	-4888.66	-10887.7
G, KJ/KG	-63087.1	-58716.3	-27700.2
S, KJ/(KG)(K)	21.9025	21.9025	21.9025

M, (1/n)	9.436	9.456	9.475
(dLV/dLP)t	-1.00207	-1.00097	-1.00000
(dLV/dLT)p	1.0426	1.0217	1.0000
Cp, KJ/(KG)(K)	5.6111	5.1698	3.5746
GAMMAs	1.2028	1.2144	1.3254
SON VEL,M/SEC	1729.6	1653.5	964.4
MACH NUMBER	0.000	1.000	4.379

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2425.1	2425.1
CF	0.6818	1.7413
Ivac, M/SEC	3015.0	4388.9
Isp, M/SEC	1653.5	4222.7

MOLE FRACTIONS

*H	6.446 -3	3.176 -3	4.366-12
*H2	5.2929-1	5.3153-1	5.3381-1
H2O	4.6249-1	4.6461-1	4.6619-1
*O	1.226 -5	2.382 -6	1.528-26
*OH	1.759 -3	6.763 -4	1.658-15

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FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.80000 %FUEL= 20.833333 R,EQ.RATIO= 2.088601 PHI,EQ.RATIO= 2.088601

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7786	430.93
P, BAR	100.00	56.225	0.23205
T, K	2868.89	2608.30	829.54
RHO, KG/CU M	4.0368 0	2.5027 0	3.2555-2
H, KJ/KG	-1252.46	-2611.89	-10179.0
U, KJ/KG	-3729.67	-4858.45	-10891.8
G, KJ/KG	-63354.8	-59073.4	-28136.0
S, KJ/(KG)(K)	21.6469	21.6469	21.6469

M, (1/n)	9.629	9.653	9.676
(dLV/dLP)t	-1.00245	-1.00118	-1.00000
(dLV/dLT)p	1.0497	1.0262	1.0000
Cp, KJ/(KG)(K)	5.6529	5.1860	3.5342

GAMMAs	1.1989	1.2102	1.3212
SON VEL,M/SEC	1723.3	1648.9	970.5
MACH NUMBER	0.000	1.000	4.354

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2423.2	2423.2
CF	0.6805	1.7437
Ivac, M/SEC	3011.4	4394.0
Isp, M/SEC	1648.9	4225.3

MOLE FRACTIONS

*H	7.459 -3	3.819 -3	1.419-11
*H2	5.1609-1	5.1853-1	5.2121-1
H2O	4.7420-1	4.7675-1	4.7879-1
*O	1.832 -5	3.880 -6	2.359-25
*OH	2.225 -3	8.987 -4	7.946-15

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1450.4 PSIA
CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 3.90000 %FUEL= 20.408163 R,EQ.RATIO= 2.035047 PHI,EQ.RATIO= 2.035047

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7760	424.26
P, BAR	100.00	56.305	0.23571
T, K	2913.85	2654.94	859.75
RHO, KG/CU M	4.0539 0	2.5123 0	3.2570-2
H, KJ/KG	-1235.18	-2586.73	-10169.9
U, KJ/KG	-3701.93	-4827.91	-10893.6
G, KJ/KG	-63590.7	-59401.6	-28568.3
S, KJ/(KG)(K)	21.3997	21.3997	21.3997
M, (1/n)	9.822	9.850	9.878
(dLV/dLP)t	-1.00287	-1.00144	-1.00000
(dLV/dLT)p	1.0576	1.0313	1.0000
Cp, KJ/(KG)(K)	5.7029	5.2105	3.4968
GAMMAs	1.1950	1.2061	1.3170
SON VEL,M/SEC	1716.9	1644.1	976.3
MACH NUMBER	0.000	1.000	4.330

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2421.0	2421.0
CF	0.6791	1.7460
Ivac, M/SEC	3007.3	4398.4
Isp, M/SEC	1644.1	4227.2

MOLE FRACTIONS

*H	8.542 -3	4.536 -3	4.297-11
*H2	5.0288-1	5.0549-1	5.0861-1
H2O	4.8576-1	4.8879-1	4.9139-1
*O	2.677 -5	6.149 -6	3.103-24
*OH	2.778 -3	1.176 -3	3.474-14
*O2	1.028 -5	2.408 -6	1.836-24

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1450.4 PSIA
CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 4.00000 %FUEL= 20.000000 R,EQ.RATIO= 1.984171 PHI,EQ.RATIO= 1.984171

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7735	417.76
P, BAR	100.00	56.384	0.23937
T, K	2957.26	2700.29	890.26
RHO, KG/CU M	4.0722 0	2.5226 0	3.2595-2
H, KJ/KG	-1218.59	-2561.95	-10158.7
U, KJ/KG	-3674.27	-4797.10	-10893.1
G, KJ/KG	-63795.8	-59701.5	-28997.1
S, KJ/(KG)(K)	21.1605	21.1605	21.1605
M, (1/n)	10.013	10.045	10.079
(dLV/dLP)t	-1.00333	-1.00172	-1.00000
(dLV/dLT)p	1.0663	1.0371	1.0000
Cp, KJ/(KG)(K)	5.7605	5.2433	3.4624
GAMMAs	1.1913	1.2020	1.3128
SON VEL,M/SEC	1710.4	1639.1	981.9
MACH NUMBER	0.000	1.000	4.307

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2418.4	2418.4
CF	0.6778	1.7484

Ivac, M/SEC	3002.7	4402.2
Isp, M/SEC	1639.1	4228.5

MOLE FRACTIONS

*H	9.687 -3	5.325 -3	1.218-10
*H2	4.8967-1	4.9242-1	4.9601-1
H2O	4.9716-1	5.0073-1	5.0399-1
*O	3.828 -5	9.505 -6	3.518-23
*OH	3.426 -3	1.516 -3	1.395-13
*O2	1.541 -5	3.901 -6	2.136-23

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1450.4 PSIA
CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 4.10000 %FUEL= 19.607843 R,EQ.RATIO= 1.935776 PHI,EQ.RATIO= 1.935776

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7711	411.43
P, BAR	100.00	56.463	0.24305
T, K	2999.11	2744.31	921.05
RHO, KG/CU M	4.0916 0	2.5337 0	3.2630-2
H, KJ/KG	-1202.65	-2537.56	-10145.5
U, KJ/KG	-3646.70	-4766.04	-10890.4
G, KJ/KG	-63971.3	-59973.5	-29422.2
S, KJ/(KG)(K)	20.9291	20.9291	20.9291
M, (1/n)	10.203	10.239	10.281
(dLV/dLP)t	-1.00384	-1.00205	-1.00000
(dLV/dLT)p	1.0756	1.0436	1.0000
Cp, KJ/(KG)(K)	5.8258	5.2844	3.4309
GAMMAs	1.1876	1.1980	1.3084
SON VEL,M/SEC	1703.7	1634.0	987.2
MACH NUMBER	0.000	1.000	4.284

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2415.5	2415.5
CF	0.6764	1.7508
Ivac, M/SEC	2997.8	4405.3
Isp, M/SEC	1634.0	4229.1

MOLE FRACTIONS

*H	1.089 -2	6.184 -3	3.247-10
*H2	4.7648-1	4.7934-1	4.8341-1
H2O	5.0838-1	5.1253-1	5.1659-1
*O	5.370 -5	1.435 -5	3.478-22
*OH	4.176 -3	1.928 -3	5.181-13
*O2	2.266 -5	6.174 -6	2.170-22

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1450.4 PSIA
CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 4.20000 %FUEL= 19.230769 R,EQ.RATIO= 1.889686 PHI,EQ.RATIO= 1.889686

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7687	405.28
P, BAR	100.00	56.539	0.24675
T, K	3039.41	2786.99	952.09
RHO, KG/CU M	4.1120 0	2.5454 0	3.2674-2
H, KJ/KG	-1187.32	-2513.54	-10130.4
U, KJ/KG	-3619.24	-4734.76	-10885.6
G, KJ/KG	-64118.5	-60218.2	-29843.5
S, KJ/(KG)(K)	20.7050	20.7050	20.7050
M, (1/n)	10.391	10.432	10.483
(dLV/dLP)t	-1.00440	-1.00241	-1.00000
(dLV/dLT)p	1.0858	1.0508	1.0000
Cp, KJ/(KG)(K)	5.8983	5.3336	3.4020
GAMMAs	1.1842	1.1941	1.3040
SON VEL,M/SEC	1697.0	1628.6	992.4
MACH NUMBER	0.000	1.000	4.262

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2412.2	2412.2
CF	0.6752	1.7532
Ivac, M/SEC	2992.5	4407.8
Isp, M/SEC	1628.6	4229.2

MOLE FRACTIONS

*H	1.213 -2	7.108 -3	8.180-10
*H2	4.6331-1	4.6625-1	4.7081-1
H2O	5.1941-1	5.2419-1	5.2919-1

*O	7.395 -5	2.120 -5	3.028-21
*OH	5.037 -3	2.420 -3	1.789-12
*O2	3.270 -5	9.559 -6	1.945-21

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1450.4 PSIA
CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 4.30000 %FUEL= 18.867925 R,EQ.RATIO= 1.845740 PHI,EQ.RATIO= 1.845740

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7663	399.29
P, BAR	100.00	56.615	0.25045
T, K	3078.20	2828.32	983.37
RHO, KG/CU M	4.1334 0	2.5578 0	3.2727-2
H, KJ/KG	-1172.57	-2489.90	-10113.6
U, KJ/KG	-3591.91	-4703.31	-10878.9
G, KJ/KG	-64238.4	-60436.3	-30260.9
S, KJ/(KG)(K)	20.4879	20.4879	20.4879
M, (1/n)	10.579	10.624	10.684
(dLV/dLP)t	-1.00500	-1.00282	-1.00000
(dLV/dLT)p	1.0967	1.0587	1.0000
Cp, KJ/(KG)(K)	5.9780	5.3909	3.3756
GAMMAs	1.1808	1.1903	1.2996
SON VEL,M/SEC	1690.2	1623.2	997.3
MACH NUMBER	0.000	1.000	4.240

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2408.6	2408.6
CF	0.6739	1.7557
Ivac, M/SEC	2986.8	4409.7
Isp, M/SEC	1623.2	4228.7

MOLE FRACTIONS

*H	1.3411-2	8.0927-3	1.9551-9
*H2	4.5019-1	4.5316-1	4.5821-1
H2O	5.3024-1	5.3570-1	5.4179-1
*O	1.001 -4	3.067 -5	2.342-20
*OH	6.014 -3	3.002 -3	5.775-12
*O2	4.641 -5	1.450 -5	1.552-20

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

Pin = 1450.4 PSIA
CASE = 11117116

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
FUEL	H2(L)	1.0000000	-9012.000	20.270
OXIDANT	O2(L)	1.0000000	-12979.000	90.170

O/F= 4.40000 %FUEL= 18.518519 R,EQ.RATIO= 1.803792 PHI,EQ.RATIO= 1.803792

	CHAMBER	THROAT	EXIT
Pinf/P	1.0000	1.7640	393.46
P, BAR	100.00	56.689	0.25416
T, K	3115.48	2868.30	1014.87
RHO, KG/CU M	4.1557 0	2.5708 0	3.2788-2
H, KJ/KG	-1158.37	-2466.64	-10095.1
U, KJ/KG	-3564.70	-4671.71	-10870.3
G, KJ/KG	-64332.4	-60628.4	-30674.2
S, KJ/(KG)(K)	20.2775	20.2775	20.2775
M, (1/n)	10.765	10.815	10.886
(dLV/dLP)t	-1.00565	-1.00327	-1.00000
(dLV/dLT)p	1.1084	1.0674	1.0000
Cp, KJ/(KG)(K)	6.0645	5.4562	3.3510
GAMMAs	1.1776	1.1866	1.2952
SON VEL,M/SEC	1683.4	1617.6	1002.0
MACH NUMBER	0.000	1.000	4.219

PERFORMANCE PARAMETERS

Ae/At	1.0000	30.000
CSTAR, M/SEC	2404.7	2404.7
CF	0.6727	1.7581
Ivac, M/SEC	2980.8	4411.1
Isp, M/SEC	1617.6	4227.7

MOLE FRACTIONS

*H	1.4715-2	9.1308-3	4.4497-9
*H2	4.3712-1	4.4009-1	4.4561-1
H2O	5.4085-1	5.4703-1	5.5439-1
*O	1.334 -4	4.353 -5	1.624-19
*OH	7.114 -3	3.683 -3	1.751-11
*O2	6.482 -5	2.158 -5	1.111-19

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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