FileEditor:junk.out

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        NASA-GLENN CHEMICAL EQUILIBRIUM PROGRAM CEA2, MAY 21, 2004
                  BY  BONNIE MCBRIDE AND SANFORD GORDON
     REFS: NASA RP-1311, PART I, 1994 AND NASA RP-1311, PART II, 1996

 ******************************************************************************



 problem
     rocket  fac   ac/at=3.0  tcest,k=3800
   p,bar=4,
   sup,ae/at=10,
 react
   name=Air wt=0.935  t,k=298.15
   name=JP-4 wt=0.065  t,k=298.15
 end

 OPTIONS: TP=F  HP=F  SP=F  TV=F  UV=F  SV=F  DETN=F  SHOCK=F  REFL=F  INCD=F
 RKT=T  FROZ=F  EQL=T  IONS=F  SIUNIT=T  DEBUGF=F  SHKDBG=F  DETDBG=F  TRNSPT=F

 TRACE= 0.00E+00  S/R= 0.000000E+00  H/R= 0.000000E+00  U/R= 0.000000E+00

 Pc,BAR =     4.000000

 Pc/P =

 SUBSONIC AREA RATIOS =

 SUPERSONIC AREA RATIOS =    10.0000

 NFZ=  1  Mdot/Ac= 0.000000E+00  Ac/At= 3.000000E+00

    REACTANT          WT.FRAC   (ENERGY/R),K   TEMP,K  DENSITY
        EXPLODED FORMULA
 N: Air              0.935000  -0.150977E+02   298.15  0.0000
          N  1.56168  O  0.41959  AR 0.00937  C  0.00032
 N: JP-4             0.065000  -0.273293E+04   298.15  0.0000
          C  1.00000  H  1.94000

  SPECIES BEING CONSIDERED IN THIS SYSTEM
 (CONDENSED PHASE MAY HAVE NAME LISTED SEVERAL TIMES)
  LAST thermo.inp UPDATE:    9/09/04

  g 3/98  *Ar              g 7/97  *C               tpis79  *CH
  g 4/02  CH2              g 4/02  CH3              g11/00  CH2OH
  g 7/00  CH3O             g 8/99  CH4              g 7/00  CH3OH
  srd 01  CH3OOH           g 8/99  *CN              g12/99  CNN
  tpis79  *CO              g 9/99  *CO2             tpis91  COOH
  tpis91  *C2              g 6/01  C2H              g 1/91  C2H2,acetylene
  g 5/01  C2H2,vinylidene  g 4/02  CH2CO,ketene     g 3/02  O(CH)2O
  srd 01  HO(CO)2OH        g 7/01  C2H3,vinyl       g 9/00  CH3CN
  g 6/96  CH3CO,acetyl     g 1/00  C2H4             g 8/88  C2H4O,ethylen-o
  g 8/88  CH3CHO,ethanal   g 6/00  CH3COOH          srd 01  OHCH2COOH
  g 7/00  C2H5             g 7/00  C2H6             g 8/88  CH3N2CH3
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g 8/88	C2H5OH	g 7/00	CH3OCH3	srd 01	CH3O2CH3
g 7/00	CCN	tpis91	CNC	srd 01	OCCN
tpis79	C2N2	g 8/00	C2O	tpis79	*C3
n 4/98	C3H3,1-propynl	n 4/98	C3H3,2-propynl	g 2/00	C3H4,allene
g 1/00	C3H4,propyne	g 5/90	C3H4,cyclo-	g 3/01	C3H5,allyl
g 2/00	C3H6,propylene	g 1/00	C3H6,cyclo-	g 6/01	C3H6O,propylox
g 6/97	C3H6O,acetone	g 1/02	C3H6O,propanal	g 7/01	C3H7,n-propyl
g 9/85	C3H7,i-propyl	g 2/00	C3H8	g 2/00	C3H8O,1propanol
g 2/00	C3H8O,2propanol	srd 01	CNCOCN	g 7/88	C3O2
g tpis	*C4	g 7/01	C4H2,butadiyne	g 8/00	C4H4,1,3-cyclo-
n10/92	C4H6,butadiene	n10/93	C4H6,1butyne	n10/93	C4H6,2butyne
g 8/00	C4H6,cyclo-	n 4/88	C4H8,1-butene	n 4/88	C4H8,cis2-buten
n 4/88	C4H8,tr2-butene	n 4/88	C4H8,isobutene	g 8/00	C4H8,cyclo-
g10/00	(CH3COOH)2	n10/84	C4H9,n-butyl	n10/84	C4H9,i-butyl
g 1/93	C4H9,s-butyl	g 1/93	C4H9,t-butyl	g12/00	C4H10,n-butane
g 8/00	C4H10,isobutane	g 6/01	C4N2	g 8/00	*C5
g 5/90	C5H6,1,3cyclo-	g 1/93	C5H8,cyclo-	n 4/87	C5H10,1-pentene
g 2/01	C5H10,cyclo-	n10/84	C5H11,pentyl	g 1/93	C5H11,t-pentyl
n10/85	C5H12,n-pentane	n10/85	C5H12,i-pentane	n10/85	CH3C(CH3)2CH3
g 2/93	C6H2	g11/00	C6H5,phenyl	g 8/00	C6H5O,phenoxy
g 8/00	C6H6	g 8/00	C6H5OH,phenol	g 1/93	C6H10,cyclo-
n 4/87	C6H12,1-hexene	g 6/90	C6H12,cyclo-	n10/83	C6H13,n-hexyl
g 6/01	C6H14,n-hexane	g 7/01	C7H7,benzyl	g 1/93	C7H8
g12/00	C7H8O,cresol-mx	n 4/87	C7H14,1-heptene	n10/83	C7H15,n-heptyl
n10/85	C7H16,n-heptane	n10/85	C7H16,2-methylh	n 4/89	C8H8,styrene
n10/86	C8H10,ethylbenz	n 4/87	C8H16,1-octene	n10/83	C8H17,n-octyl
n 4/85	C8H18,n-octane	n 4/85	C8H18,isooctane	n10/83	C9H19,n-nonyl
g 3/01	C10H8,naphthale	n10/83	C10H21,n-decyl	g 8/00	C12H9,o-bipheny
g 8/00	C12H10,biphenyl	g 6/97	*H	g 6/01	HCN
g 1/01	HCO	tpis89	HCCN	g 6/01	HCCO
g 6/01	HNC	g 7/00	HNCO	g10/01	HNO
tpis89	HNO2	g 5/99	HNO3	g 4/02	HO2
tpis78	*H2	g 5/01	HCHO,formaldehy	g 6/01	HCOOH
g 8/89	H2O	g 6/99	H2O2	g 6/01	(HCOOH)2
g 5/97	*N	g 6/01	NCO	g 4/99	*NH
g 3/01	NH2	tpis89	NH3	tpis89	NH2OH
tpis89	*NO	g 4/99	NO2	j12/64	NO3
tpis78	*N2	g 6/01	NCN	g 5/99	N2H2
tpis89	NH2NO2	g 4/99	N2H4	g 4/99	N2O
g 4/99	N2O3	tpis89	N2O4	g 4/99	N2O5
tpis89	N3	g 4/99	N3H	g 5/97	*O
g 4/02	*OH	tpis89	*O2	g 8/01	O3
n 4/83	C(gr)	n 4/83	C(gr)	n 4/83	C(gr)
g11/99	H2O(cr)	g 8/01	H2O(L)	g 8/01	H2O(L)

O/F = 0.000000

	EFFECTIVE FUEL	EFFECTIVE OXIDANT	MIXTURE
ENTHALPY	h(2)/R	h(1)/R	h0/R
(KG-MOL)(K)/KG	-0.13206770E+02	0.00000000E+00	-0.13206770E+02

KG-FORM.WT./KG	bi(2)	bi(1)	b0i
*N	0.50411357E-01	0.00000000E+00	0.50411357E-01
*O	0.13544453E-01	0.00000000E+00	0.13544453E-01
*Ar	0.30230416E-03	0.00000000E+00	0.30230416E-03
*C	0.46644230E-02	0.00000000E+00	0.46644230E-02
*H	0.90290036E-02	0.00000000E+00	0.90290036E-02

POINT	ITN	T	N	O	AR	C	H
1	26	2318.329	-13.195	-16.890	-24.934	-19.907	-12.242
2	2	2317.292	-13.217	-16.903	-24.979	-19.933	-12.260

Pinf/Pt = 1.765465

3	4	2114.359	-13.340	-17.629	-25.346	-20.444	-12.566

Pinf/Pt = 1.782295

3	2	2110.902	-13.342	-17.645	-25.352	-20.449	-12.570

Pinf/Pt = 1.782642

3	1	2110.831	-13.342	-17.645	-25.352	-20.449	-12.570
4	2	2309.885	-13.222	-16.924	-24.993	-19.957	-12.272
4	2	2308.794	-13.223	-16.928	-24.995	-19.960	-12.274
4	1	2308.706	-13.223	-16.928	-24.995	-19.960	-12.274
2	2	2317.802	-13.206	-16.897	-24.957	-19.920	-12.251

Pinf/Pt = 1.765606

3	4	2114.548	-13.329	-17.625	-25.324	-20.428	-12.556

Pinf/Pt = 1.782460

3	2	2111.082	-13.331	-17.641	-25.330	-20.433	-12.560

Pinf/Pt = 1.782807

3	1	2111.011	-13.331	-17.641	-25.330	-20.433	-12.561
4	2	2310.383	-13.211	-16.918	-24.971	-19.944	-12.263
4	2	2309.290	-13.212	-16.921	-24.973	-19.947	-12.265
4	1	2309.202	-13.212	-16.921	-24.973	-19.947	-12.265

END OF CHAMBER ITERATIONS

4	6	937.361	-14.046	-35.236	-27.601	-13.242	-12.808
4	3	907.586	-14.077	-36.287	-27.687	-12.813	-12.815
4	1	907.627	-14.077	-36.285	-27.687	-12.813	-12.815

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 58.0 PSIA
Ac/At = 3.0000 Pinj/Pinf = 1.023643

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CASE =

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
NAME	Air	0.9350000	-125.530	298.150
NAME	JP-4	0.0650000	-22723.000	298.150

O/F= 0.00000 %FUEL= 0.000000 R,EQ.RATIO= 1.022068 PHI,EQ.RATIO= 0.000000

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0490	1.8250	99.767
P, BAR	4.0000	3.8133	2.1918	0.04009
T, K	2318.33	2309.20	2111.01	907.63
RHO, KG/CU M	5.9513-1	5.6968-1	3.5942-1	1.5317-2
H, KJ/KG	-109.81	-126.20	-480.40	-2150.40
U, KJ/KG	-781.93	-795.57	-1090.23	-2412.16
G, KJ/KG	-21297.0	-21245.6	-19787.2	-10451.3
S, KJ/(KG)(K)	9.1390	9.1458	9.1458	9.1458
M, (1/n)	28.679	28.684	28.782	28.829
(dLV/dLP)t	-1.00232	-1.00226	-1.00093	-1.00000
(dLV/dLT)p	1.0682	1.0669	1.0303	1.0000
Cp, KJ/(KG)(K)	2.0379	2.0280	1.7214	1.2529
GAMMAs	1.1905	1.1911	1.2154	1.2990
SON VEL,M/SEC	894.5	892.9	860.9	583.1
MACH NUMBER	0.000	0.203	1.000	3.464

PERFORMANCE PARAMETERS

Ae/At	3.0001	1.0000	10.000
CSTAR, M/SEC	1262.9	1262.9	1262.9
CF	0.1434	0.6817	1.5997
Ivac, M/SEC	3878.3	1569.3	2149.8
Isp, M/SEC	181.0	860.9	2020.2

MOLE FRACTIONS

*Ar	0.00867	0.00867	0.00870	0.00872
*CO	0.01455	0.01432	0.00936	0.00279
*CO2	0.11922	0.11947	0.12489	0.13168
*H	0.00028	0.00027	0.00010	0.00000
*H2	0.00271	0.00267	0.00192	0.00582
H2O	0.12545	0.12554	0.12752	0.12433
*NO	0.00181	0.00175	0.00061	0.00000
*N2	0.72197	0.72211	0.72516	0.72666
*O	0.00015	0.00014	0.00003	0.00000
*OH	0.00236	0.00229	0.00089	0.00000
*O2	0.00284	0.00276	0.00082	0.00000

* THERMODYNAMIC PROPERTIES FITTED TO 20000.K

PRODUCTS WHICH WERE CONSIDERED BUT WHOSE MOLE FRACTIONS
WERE LESS THAN 5.000000E-06 FOR ALL ASSIGNED CONDITIONS

*C	*CH	CH2	CH3	CH2OH
CH3O	CH4	CH3OH	CH3OOH	*CN

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CNN	COOH	*C2	C2H	C2H2,acetylene
C2H2,vinylidene	CH2CO,ketene	O(CH)2O	HO(CO)2OH	C2H3,vinyl
CH3CN	CH3CO,acetyl	C2H4	C2H4O,ethylen-o	CH3CHO,ethanal
CH3COOH	OHCH2COOH	C2H5	C2H6	CH3N2CH3
C2H5OH	CH3OCH3	CH3O2CH3	CCN	CNC
OCCN	C2N2	C2O	*C3	C3H3,1-propynl
C3H3,2-propynl	C3H4,allene	C3H4,propyne	C3H4,cyclo-	C3H5,allyl
C3H6,propylene	C3H6,cyclo-	C3H6O,propylox	C3H6O,acetone	C3H6O,propanal
C3H7,n-propyl	C3H7,i-propyl	C3H8	C3H8O,1propanol	C3H8O,2propanol
CNCOCN	C3O2	*C4	C4H2,butadiyne	C4H4,1,3-cyclo-
C4H6,butadiene	C4H6,1butyne	C4H6,2butyne	C4H6,cyclo-	C4H8,1-butene
C4H8,cis2-buten	C4H8,tr2-butene	C4H8,isobutene	C4H8,cyclo-	(CH3COOH)2
C4H9,n-butyl	C4H9,i-butyl	C4H9,s-butyl	C4H9,t-butyl	C4H10,n-butane
C4H10,isobutane	C4N2	*C5	C5H6,1,3cyclo-	C5H8,cyclo-
C5H10,1-pentene	C5H10,cyclo-	C5H11,pentyl	C5H11,t-pentyl	C5H12,n-pentane
C5H12,i-pentane	CH3C(CH3)2CH3	C6H2	C6H5,phenyl	C6H5O,phenoxy
C6H6	C6H5OH,phenol	C6H10,cyclo-	C6H12,1-hexene	C6H12,cyclo-
C6H13,n-hexyl	C6H14,n-hexane	C7H7,benzyl	C7H8	C7H8O,cresol-mx
C7H14,1-heptene	C7H15,n-heptyl	C7H16,n-heptane	C7H16,2-methylh	C8H8,styrene
C8H10,ethylbenz	C8H16,1-octene	C8H17,n-octyl	C8H18,n-octane	C8H18,isooctane
C9H19,n-nonyl	C10H8,naphthale	C10H21,n-decyl	C12H9,o-bipheny	C12H10,biphenyl
HCN	HCO	HCCN	HCCO	HNC
HNCO	HNO	HNO2	HNO3	HO2
HCHO,formaldehy	HCOOH	H2O2	(HCOOH)2	*N
NCO	*NH	NH2	NH3	NH2OH
NO2	NO3	NCN	N2H2	NH2NO2
N2H4	N2O	N2O3	N2O4	N2O5
N3	N3H	O3	C(gr)	H2O(cr)
H2O(L)				

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