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=100,
   sup,ae/at=100000,
 react
   name=JP-5 moles=1.0  t,k=298.15
   name=O2 moles=1.5  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 =   100.000000

 Pc/P =

 SUBSONIC AREA RATIOS =

 SUPERSONIC AREA RATIOS =100000.0000

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

    REACTANT           MOLES    (ENERGY/R),K   TEMP,K  DENSITY
        EXPLODED FORMULA
 N: JP-5             1.000000  -0.266799E+04   298.15  0.0000
          C  1.00000  H  1.92000
 N: O2               1.500000  -0.154035E-05   298.15  0.0000
          O  2.00000

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

  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
  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 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  C2H5OH          g 7/00  CH3OCH3
  srd 01  CH3O2CH3         g 8/00  C2O             tpis79  *C3
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 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  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 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 1/01  HCO              g 6/01  HCCO             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  *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       -0.43070842E+02     0.00000000E+00     -0.43070842E+02

 KG-FORM.WT./KG             bi(2)              bi(1)              b0i
  *C                   0.16143576E-01     0.00000000E+00     0.16143576E-01
  *H                   0.30995666E-01     0.00000000E+00     0.30995666E-01
  *O                   0.48430728E-01     0.00000000E+00     0.48430728E-01

 POINT ITN      T            C           H           O
   1   23    3789.903     -16.035     -10.212     -14.481
   2    2    3782.438     -16.060     -10.229     -14.499
 Pinf/Pt = 1.730025
   3    3    3605.448     -16.458     -10.444     -14.688
 Pinf/Pt = 1.726677
   3    2    3606.047     -16.457     -10.443     -14.688
   4    2    3775.735     -16.075     -10.237     -14.506
   4    2    3774.679     -16.077     -10.238     -14.507
   4    2    3774.587     -16.077     -10.238     -14.507
   2    2    3786.271     -16.047     -10.220     -14.490
 Pinf/Pt = 1.730087
   3    3    3608.881     -16.445     -10.435     -14.679
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 Pinf/Pt = 1.726738
   3    2    3609.482     -16.444     -10.434     -14.678
   4    2    3779.552     -16.062     -10.228     -14.497
   4    2    3778.493     -16.064     -10.229     -14.498
   4    2    3778.402     -16.064     -10.229     -14.498
 END OF CHAMBER ITERATIONS
   4    9     462.463     -99.562     -39.107     -21.115
   4    3     699.456     -65.167     -28.167     -20.447
   4    2     696.274     -65.472     -28.265     -20.454
```

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

```
 Pin =  1450.4 PSIA
 Ac/At =  3.0000      Pinj/Pinf =  1.022589
 CASE =

             REACTANT                        MOLES         ENERGY      TEMP
                                                          KJ/KG-MOL       K
 NAME        JP-5                         1.0000000    -22183.000    298.150
 NAME        O2                           1.5000000         0.000    298.150

 O/F=    0.00000  %FUEL=  0.000000  R,EQ.RATIO= 0.986667  PHI,EQ.RATIO= 0.000000

                INJECTOR  COMB END  THROAT     EXIT
 Pinj/P           1.0000   1.0467   1.7657 4142800.
 P, BAR           100.00   95.536   56.633  0.00002
 T, K            3789.90  3778.40  3609.48   696.27
 RHO, KG/CU M   8.1609 0 7.8226 0 4.9239 0 1.3044-5
 H, KJ/KG         -358.11  -386.65 -1006.38 -9594.99
 U, KJ/KG        -1583.47 -1607.93 -2156.55 -9780.04
 G, KJ/KG        -40231.1 -40165.9 -39007.2 -16925.4
 S, KJ/(KG)(K)    10.5208  10.5281  10.5281  10.5281

 M, (1/n)          25.716   25.724   26.093   31.285
 (dLV/dLP)t      -1.05513 -1.05510 -1.05206 -1.00000
 (dLV/dLT)p        1.9249   1.9272   1.9201   1.0000
 Cp, KJ/(KG)(K)    6.9666   6.9925   7.1222   1.3900
 GAMMAs            1.1323   1.1320   1.1273   1.2364
 SON VEL,M/SEC     1177.9   1175.8   1138.7    478.3
 MACH NUMBER        0.000    0.203    1.000    8.986

 PERFORMANCE PARAMETERS

 Ae/At                      3.0001   1.0000 100000.0
 CSTAR, M/SEC               1744.2   1744.2   1744.2
 CF                         0.1370   0.6528   2.4642
 Ivac, M/SEC                5351.0   2148.8   4341.2
 Isp, M/SEC                  238.9   1138.7   4298.1


 MOLE FRACTIONS
```

*CO	0.21023	0.20997	0.19965	0.00000
*CO2	0.20487	0.20525	0.22155	0.50505
COOH	0.00003	0.00003	0.00002	0.00000
*H	0.02055	0.02056	0.01838	0.00000
HCO	0.00002	0.00002	0.00001	0.00000
HO2	0.00042	0.00041	0.00029	0.00000
*H2	0.03585	0.03583	0.03380	0.00000
H2O	0.30285	0.30316	0.31635	0.48485
H2O2	0.00004	0.00004	0.00003	0.00000
*O	0.03009	0.03003	0.02624	0.00000
*OH	0.09858	0.09825	0.08972	0.00000
*O2	0.09647	0.09646	0.09397	0.01010

 * 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	*C2
C2H	C2H2,acetylene	C2H2,vinylidene	CH2CO,ketene	O(CH)2O
HO(CO)2OH	C2H3,vinyl	CH3CO,acetyl	C2H4	C2H4O,ethylen-o
CH3CHO,ethanal	CH3COOH	OHCH2COOH	C2H5	C2H6
C2H5OH	CH3OCH3	CH3O2CH3	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	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	*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	HCCO
HCHO,formaldehy	HCOOH	(HCOOH)2	O3	C(gr)
H2O(cr)	H2O(L)			