FileEditor:CH4_O2_Comb.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=CH4 moles=1.0  t,k=298.15
   name=O2 moles=2.0  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: CH4              1.000000  -0.897227E+04   298.15  0.0000
          C  1.00000  H  4.00000
 N: O2               2.000000  -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       -0.11209720E+03     0.00000000E+00     -0.11209720E+03

 KG-FORM.WT./KG             bi(2)              bi(1)              b0i
  *C                  0.12493744E-01     0.00000000E+00     0.12493744E-01
  *H                  0.49974975E-01     0.00000000E+00     0.49974975E-01
  *O                  0.49974975E-01     0.00000000E+00     0.49974975E-01

 POINT ITN      T            C           H           O
   1   22    3680.166     -16.311      -9.973     -14.606
   2    2    3673.417     -16.336      -9.991     -14.623
 Pinf/Pt = 1.728726
   3    3    3500.561     -16.742     -10.212     -14.819
 Pinf/Pt = 1.725874
   3    2    3501.062     -16.741     -10.212     -14.818
   4    2    3666.888     -16.351      -9.999     -14.630
   4    2    3665.860     -16.353     -10.000     -14.631
   4    2    3665.772     -16.354     -10.000     -14.632
   2    2    3676.886     -16.323      -9.982     -14.614
 Pinf/Pt = 1.728786
   3    3    3503.649     -16.729     -10.203     -14.809
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 Pinf/Pt = 1.725934
   3    2    3504.152     -16.728     -10.203     -14.809
   4    2    3670.342     -16.338      -9.990     -14.621
   4    2    3669.313     -16.340      -9.991     -14.622
   4    2    3669.224     -16.340      -9.991     -14.622
 END OF CHAMBER ITERATIONS
   4    9     328.874    -126.796     -47.965     -28.304
   4    7     396.610    -106.299     -41.259     -25.934
   4    3     491.252     -80.394     -33.284     -27.077

 SINGULAR MATRIX, ITERATION  2  VARIABLE  3(EQLBRM)
   4   24     490.705     -31.162     -20.983     -51.749
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THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

Pin = 1450.4 PSIA
Ac/At = 3.0000 Pinj/Pinf = 1.022564
CASE =

REACTANT		MOLES	ENERGY KJ/KG-MOL	TEMP K
NAME	CH4	1.0000000	-74600.000	298.150
NAME	O2	2.0000000	0.000	298.150

O/F= 0.00000 %FUEL= 0.000000 R,EQ.RATIO= 1.000000 PHI,EQ.RATIO= 0.000000

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0467	1.7649	5392448.
P, BAR	100.00	95.540	56.661	0.00002
T, K	3680.17	3669.22	3504.15	490.71
RHO, KG/CU M	7.4634 0	7.1538 0	4.5014 0	1.2127-5
H, KJ/KG	-932.03	-963.20	-1640.61	-10695.6
U, KJ/KG	-2271.91	-2298.73	-2899.34	-10848.5
G, KJ/KG	-43821.1	-43754.6	-42506.9	-16418.3
S, KJ/(KG)(K)	11.6541	11.6622	11.6622	11.6623
M, (1/n)	22.837	22.843	23.147	26.680
(dLV/dLP)t	-1.04656	-1.04651	-1.04311	-1.00000
(dLV/dLT)p	1.8037	1.8053	1.7840	1.0000
Cp, KJ/(KG)(K)	7.3240	7.3472	7.3799	1.4318
GAMMAs	1.1302	1.1299	1.1259	1.2782
SON VEL,M/SEC	1230.6	1228.4	1190.4	442.1
MACH NUMBER	0.000	0.203	1.000	9.995

PERFORMANCE PARAMETERS

Ae/At	3.0001	1.0000	100000.0
CSTAR, M/SEC	1824.9	1824.9	1824.9
CF	0.1368	0.6523	2.4214
Ivac, M/SEC	5598.6	2247.8	4453.5
Isp, M/SEC	249.7	1190.4	4418.9

MOLE FRACTIONS

*CO	0.13951	0.13930	0.13135	0.00000
*CO2	0.14578	0.14606	0.15782	0.33333
COOH	0.00002	0.00002	0.00001	0.00000
*H	0.01983	0.01983	0.01739	0.00000
HCO	0.00001	0.00001	0.00001	0.00000
HO2	0.00034	0.00033	0.00023	0.00000
*H2	0.05172	0.05168	0.04808	0.00000
H2O	0.46104	0.46143	0.47867	0.66667
H2O2	0.00005	0.00005	0.00003	0.00000
*O	0.01961	0.01956	0.01675	0.00000
*OH	0.09544	0.09509	0.08554	0.00000
*O2	0.06664	0.06664	0.06412	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	*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)			