```
        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 Wed 20-Nov-2024 23:09:11

    # Problem Type: "Rocket" (Infinite Area Combustor)

    prob case=_____3088 ro equilibrium

    # Pressure (1 value):
    p,psia= 850
    # Chamber/Exit Pressure Ratio (1 value):
    pi/p= 2092.699
    # Supersonic Area Ratio (1 value):
    supar= 102.788

    # You selected the following fuels and oxidizers:
    reac
    fuel H2(L)              wt%=100.0000
    oxid O2(L)              wt%=100.0000

    # You selected these options for output:
    # long version of output
    # Proportions of any products will be expressed as Mass Fractions.
    output massf
    # Heat will be expressed as siunits
    output siunits

    # Input prepared by this script:/var/www/sites/cearun.grc.nasa.gov/cgi-bin/CEARU
    N/prepareInputFile.cgi

    ### IMPORTANT:  The following line is the end of your CEA input file!
    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 =    58.605209

    Pc/P =  2092.6990

    SUBSONIC AREA RATIOS =

    SUPERSONIC AREA RATIOS =   102.7880

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

       REACTANT           WT.FRAC   (ENERGY/R),K   TEMP,K  DENSITY
            EXPLODED FORMULA
    F: H2(L)              1.000000  -0.108389E+04   20.27  0.0000
            H  2.00000
    O: O2(L)              1.000000  -0.156101E+04   90.17  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 6/97  *H           g 4/02  HO2            tpis78  *H2
 g 8/89  H2O          g 6/99  H2O2           g 5/97  *O
 g 4/02  *OH          tpis89  *O2            g 8/01  O3
 g11/99  H2O(cr)      g 8/01  H2O(L)         g 8/01  H2O(L)


 O/F =   1.000000


                      EFFECTIVE FUEL    EFFECTIVE OXIDANT      MIXTURE
 ENTHALPY                 h(2)/R             h(1)/R             h0/R
 (KG-MOL)(K)/KG       -0.53767500E+03    -0.48783267E+02    -0.29322914E+03


 KG-FORM.WT./KG           bi(2)              bi(1)              b0i
  *H                  0.99212255E+00     0.00000000E+00     0.49606127E+00
  *O                  0.00000000E+00     0.62502344E-01     0.31251172E-01


 POINT ITN      T            H            O
 Pinf/Pt = 1.868006
 Pinf/Pt = 1.874529
 ADD  H2O(cr)
```

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM INFINITE AREA COMBUSTOR

```
 Pin =   850.0 PSIA
 CASE = _____


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


 O/F=    1.00000  %FUEL= 50.000000  R,EQ.RATIO= 7.936683  PHI,EQ.RATIO= 7.936683


                CHAMBER   THROAT     EXIT      EXIT
 Pinf/P          1.0000   1.8745   2092.70   1730.50
 P, BAR          58.605   31.264   0.02800   0.03387
 T, K            977.49   826.58    245.01    249.41
 RHO, KG/CU M   2.9072 0 1.8341 0 6.2371-3 7.3737-3
 H, KJ/KG       -2438.06 -3604.54 -9354.83 -9268.52
 U, KJ/KG       -4453.89 -5309.16 -9803.83 -9727.80
 G, KJ/KG       -37152.1 -32959.3 -18055.9 -18125.9
 S, KJ/(KG)(K)   35.5134  35.5134  35.5134  35.5134


 M, (1/n)         4.032    4.032    4.537    4.515
 MW, MOL WT       4.032    4.032    4.032    4.032
 (dLV/dLP)t     -1.00000 -1.00000 -1.01675 -1.02167
 (dLV/dLT)p      1.0000   1.0000   1.4204   1.5344
 Cp, KJ/(KG)(K)  7.8107   7.6564  26.5399  31.4909
 GAMMAs          1.3587   1.3686   1.1397   1.1312
 SON VEL,M/SEC   1655.0   1527.4    715.3    720.8
 MACH NUMBER     0.000    1.000    5.199    5.128


 PERFORMANCE PARAMETERS


 Ae/At           1.0000   120.76   102.79
 CSTAR, M/SEC    2092.0   2092.0   2092.0
 CF              0.7301   1.7779   1.7667
 Ivac, M/SEC     2643.4   3840.1   3820.3
 Isp, M/SEC      1527.4   3719.3   3696.1


 MASS FRACTIONS
```

```
*H2                0.43700  0.43700  0.43700  0.43700
H2O                0.56300  0.56300  0.06541  0.08464
H2O(cr)            0.00000  0.00000  0.49759  0.47836
```

 * THERMODYNAMIC PROPERTIES FITTED TO 20000.K

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

```
*H              HO2           H2O2          *O            *OH
*O2             O3            H2O(L)
```

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