FileEditor:paraffinN2O.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=N2O wt=9.45  t,k=298.15
   name=paraffin  wt=1.0  t,k=298.15
     h,kj/mol=-698.52  C 32 H 66
 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          WT.FRAC   (ENERGY/R),K   TEMP,K  DENSITY
        EXPLODED FORMULA
 N: N2O              0.904306   0.981417E+04   298.15  0.0000
          N  2.00000  O  1.00000
 N: paraffin         0.095694  -0.840122E+05   298.15  0.0000
          C 32.00000  H 66.00000

  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
  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
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g 7/00	C2H6	g 8/88	CH3N2CH3	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	0.18381510E+03	0.00000000E+00	0.18381510E+03

KG-FORM.WT./KG	bi(2)	bi(1)	b0i
*N	0.41092874E-01	0.00000000E+00	0.41092874E-01
*O	0.20546437E-01	0.00000000E+00	0.20546437E-01
*C	0.67918139E-02	0.00000000E+00	0.67918139E-02
*H	0.14008116E-01	0.00000000E+00	0.14008116E-01

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POINT	ITN	T	N	O	C	H
1	22	3437.156	-12.445	-14.914	-16.521	-10.453
2	2	3432.539	-12.466	-14.931	-16.546	-10.471

Pinf/Pt = 1.741713

3	3	3230.019	-12.620	-15.133	-17.057	-10.725

Pinf/Pt = 1.739603

3	2	3230.446	-12.620	-15.133	-17.055	-10.725
4	2	3424.904	-12.471	-14.938	-16.564	-10.480
4	2	3423.706	-12.472	-14.939	-16.567	-10.481
4	2	3423.603	-12.472	-14.939	-16.567	-10.481
2	2	3434.882	-12.455	-14.922	-16.533	-10.462

Pinf/Pt = 1.741791

3	3	3231.971	-12.609	-15.124	-17.044	-10.717

Pinf/Pt = 1.739685

3	2	3232.398	-12.609	-15.124	-17.043	-10.716
4	2	3427.232	-12.461	-14.929	-16.551	-10.471
4	2	3426.032	-12.462	-14.930	-16.554	-10.472
4	2	3425.929	-12.462	-14.930	-16.555	-10.473

END OF CHAMBER ITERATIONS

4	18	95.882	-19.833	-271.328	5.089	-36.445

ADD H2O(cr)

4	4	191.482	-18.279	-144.160	0.733	-22.798

ADD C(gr)

4	3	191.512	-18.279	-143.381	-0.788	-23.173

THE TEMPERATURE= 0.1915E+03 IS OUT OF RANGE FOR POINT   4(EQLBRM)

4	4	199.529	-17.701	-137.839	-0.771	-22.206

THE TEMPERATURE= 0.1995E+03 IS OUT OF RANGE FOR POINT   4(EQLBRM)

4	2	199.538	-17.700	-137.833	-0.771	-22.205

THE TEMPERATURE= 0.1995E+03 IS OUT OF RANGE FOR POINT   4(EQLBRM)

THEORETICAL ROCKET PERFORMANCE ASSUMING EQUILIBRIUM

COMPOSITION DURING EXPANSION FROM FINITE AREA COMBUSTOR

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Pin = 1450.4 PSIA
Ac/At = 3.0000 Pinj/Pinf = 1.022878
CASE =

	REACTANT	WT FRACTION (SEE NOTE)	ENERGY KJ/KG-MOL	TEMP K
NAME	N2O	0.9043062	81600.000	298.150
NAME	paraffin	0.0956938	-698520.000	298.150

O/F= 0.00000 %FUEL= 0.000000 R,EQ.RATIO= 1.002008 PHI,EQ.RATIO= 0.000000

	INJECTOR	COMB END	THROAT	EXIT
Pinj/P	1.0000	1.0473	1.779510591770.	
P, BAR	100.00	95.480	56.196	0.00001
T, K	3437.16	3425.93	3232.40	199.54
RHO, KG/CU M	9.5351 0	9.1367 0	5.7614 0	1.7481-5
H, KJ/KG	1528.33	1503.59	968.39	-4553.83
U, KJ/KG	479.57	458.58	-6.9951	-4607.84
G, KJ/KG	-30763.6	-30706.5	-29422.2	-6429.86
S, KJ/(KG)(K)	9.3950	9.4019	9.4019	9.4019
M, (1/n)	27.250	27.258	27.554	30.719
MW, MOL WT	27.250	27.258	27.554	29.121
(dLV/dLP)t	-1.01881	-1.01875	-1.01613	-1.19176
(dLV/dLT)p	1.3592	1.3593	1.3295	6.8997
Cp, KJ/(KG)(K)	3.7502	3.7561	3.6738	50.1709
GAMMAs	1.1514	1.1511	1.1482	1.0696
SON VEL,M/SEC	1098.9	1096.8	1058.3	240.3
MACH NUMBER	0.000	0.203	1.000	14.511

PERFORMANCE PARAMETERS

Ae/At	3.0001	1.0000	100000.0
CSTAR, M/SEC	1603.5	1603.5	1603.5
CF	0.1387	0.6600	2.1751
Ivac, M/SEC	4920.6	1979.9	3503.2
Isp, M/SEC	222.4	1058.2	3487.7

MOLE FRACTIONS

CH4	0.00000	0.00000	0.00000	0.00003
*CO	0.08237	0.08205	0.07120	0.00000
*CO2	0.10269	0.10308	0.11594	0.19721
*H	0.00634	0.00631	0.00466	0.00000
HNO	0.00001	0.00001	0.00001	0.00000
HO2	0.00007	0.00007	0.00005	0.00000
*H2	0.01537	0.01531	0.01293	0.00000
H2O	0.15683	0.15707	0.16515	0.15240
H2O2	0.00001	0.00001	0.00000	0.00000
*N	0.00001	0.00001	0.00001	0.00000
*NO	0.02278	0.02254	0.01794	0.00000
NO2	0.00004	0.00004	0.00002	0.00000
*N2	0.54845	0.54874	0.55714	0.59832
N2O	0.00001	0.00001	0.00001	0.00000
*O	0.00692	0.00687	0.00499	0.00000

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*OH	0.03084	0.03065	0.02510	0.00000
*O2	0.02723	0.02722	0.02485	0.00000
C(gr)	0.00000	0.00000	0.00000	0.00053
H2O(cr)	0.00000	0.00000	0.00000	0.05150

* 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	CH3OH	CH3OOH	*CN	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
HNO2	HNO3	HCHO,formaldehy	HCOOH	(HCOOH)2
NCO	*NH	NH2	NH3	NH2OH
NO3	NCN	N2H2	NH2NO2	N2H4
N2O3	N2O4	N2O5	N3	N3H
O3	H2O(L)			

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