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RESEARCH LABORATORY

TECHNICAL REPORT

CHEMICAL CORROSION OF ROCKET LINER
MATERIALS AND PROPELLANT
PERFORMANCE STUDIES (U)
DETAILED THEORETICAL PERFORMANCE OF
SOME LIQUID PROPELLANT SYSTEMS

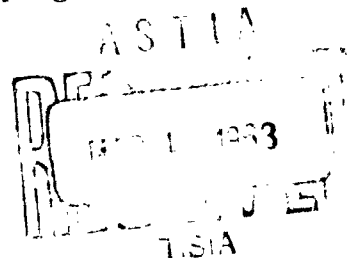
Second Quarterly Technical Summary Report
Volume Two of Three

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Prepared by: R. C. Oliver D. Piper
S. E. Stephanou R. W. Sprague
R. J. Getz

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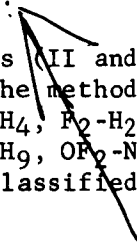
SECTION 1

SUMMARY.



The theoretical performance of certain binary liquid propellant systems under a wide variety of expansion conditions and mixture ratios has been computed and results are presented in graphical and tabular form. The graphs show vacuum specific impulse for area ratios of 8, 20, and 50, sea level optimum specific impulse, characteristic velocity, molecular weight and chamber temperature as a function of mixture ratio, for both frozen and equilibrium (shifting) expansion conditions, at chamber pressures of 300 and 1000 psi. The tabular data are in the form of computer output sheets, and give detailed performance and other data for all integral area ratios from 1 to 50; values are also given at two larger area ratios, the values depending on the system. Altitude effects are discussed, and techniques described for computing ideal performance for any of these mixtures at any altitude; results are given for sea level, 10,000 feet and 50,000 feet and vacuum as a function of area ratio for each mixture for zero divergence angle. The methods used in carrying out the computations are described briefly, with reference to more detailed descriptions. The latest thermodynamic data are used, and a large number of minor species are considered for maximum precision.

This portion of the work is reported in two volumes (II and III) of this Second Quarterly Report. Volume II describes the methods used and gives results for eleven propellant systems ($\text{ClF}_3\text{-N}_2\text{H}_4$, $\text{F}_2\text{-H}_2$, $\text{H}_2\text{O}_2\text{-B}_5\text{H}_9$, $\text{N}_2\text{F}_4\text{-B}_5\text{H}_9$, $\text{N}_2\text{H}_4\text{-B}_5\text{H}_9$, $\text{N}_2\text{O}_4\text{-N}_2\text{H}_4$, $\text{OF}_2\text{-B}_2\text{H}_6$, $\text{OF}_2\text{-B}_5\text{H}_9$, $\text{OF}_2\text{-N}_2\text{H}_4$, $\text{O}_2\text{-H}_2$, and $\text{O}_2\text{-RP-1}$); Volume III gives results for certain classified systems.

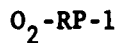
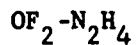
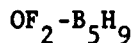
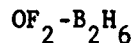
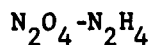
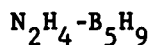
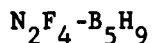
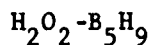
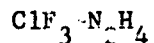


SECTION 2

INTRODUCTION

Theoretical performance calculations, even though idealized, are useful in making preliminary comparisons of different propellant systems. Quite obviously, such comparisons should be made under the conditions of a specific application rather than at some arbitrary standard condition such as optimum expansion at sea level. It is our purpose here to provide the theoretical data needed for these more detailed comparisons for certain specified liquid propellant systems of interest, using the latest available thermodynamic data.

This volume contains results for the following systems:



SECTION 3

CALCULATION METHODS

3.1 COMPUTATION OF PERFORMANCE

a. Performance at Specific Pressures - the Pressure Profile

The performance calculation method is based on an extension of the free energy minimization procedure originally suggested by White, Johnson, and Dantzig¹ and has been described in a number of publications^{2,3,4}. The standard assumptions are made, which include adiabatic combustion of the reactants, isentropic expansion, perfect gas behavior, zero nozzle divergence angle, and zero linear velocity in the chamber. Performance is computed both for frozen expansion, in which no change in chemical composition is permitted for propellants leaving the chamber--although liquid-solid transformations are permitted, and for the case where complete chemical and phase equilibrium is required at every point in the system. Results are generally reported here for chamber pressures of 300 and 1000 psia. For other pressures, or for predicting the variation in performance to be expected by changes in the data used in the calculations, the discussions by Wilkins and Weiher⁵ and by Gordon and Zeleznik⁶ should be consulted.

The program as used is set up to compute necessary parameters at 10 exponentially spaced pressures (plus the throat and at 14.696 psia) between the chamber pressure and an exhaust pressure which is set to be sufficiently low that two of the points are at a nozzle area ratio greater than the final value desired; this permits interpolation with a four-point logarithmic routine to give values at all integral area ratios between 1 and 50 as desired. Complete composition, temperature, and performance data are computed and reported at each of the profile points. The pressure profile

points are spaced according to the relation

$$P_n = \frac{P_c}{\left(\frac{P_c}{P_e}\right)^{n/N}} \quad (1)$$

where P_n = exhaust stream static pressure at nth pressure profile point,

P_c = chamber pressure

P_e = final exhaust pressure

n = profile number

N = total number of profiles specified

Impulse values are calculated at each profile point for both optimum expansion (assuming the surroundings are at the static pressure of the point in question) and at vacuum conditions. The equations used are

$$I_{OPT} = 29.49534 \sqrt{H_c - H_e} \quad (2)$$

$$I_{VAC} = I_{OPT} + 0.86452 \frac{\bar{X}_e T_e}{I_{OPT}} \quad (3)$$

where

I_{OPT} = optimum expansion specific impulse

I_{VAC} = vacuum specific impulse

H_c = chamber enthalpy, kcal/100 grams

H_e = exhaust enthalpy, kcal/100 grams

$\bar{X}_e$ = moles gas/100 grams at exhaust plane

T_e = exhaust temperature, °K

In order to find the throat and to compute the area ratio, the mass flow rate is first determined at each profile point, according to

$$\rho_u = 2397.9 \frac{P_c}{X_e T_e} \sqrt{H_c - H_e} \quad (4)$$

where ρ_u is in gm/cm²-sec, and P_c is in psia. (This value is not printed out on the output sheet but the necessary data are given at each profile point.) The throat is found by locating the pressure in the system at which ρ_u is a maximum; the nozzle area ratio at any point is then

$$\epsilon = \frac{(\rho_u)_t}{(\rho_u)_e} \quad (5)$$

where

$(\rho_u)_t$ = flow rate in the throat

$(\rho_u)_e$ = flow rate at profile point in question

The characteristic velocity is calculated from

$$C^* = \frac{2262.03}{(\rho_u)_t} P_c \quad (6)$$

where

C^* = characteristic velocity, ft/sec

P_c = chamber pressure, psia.

Note that once $(\rho_u)_t$ is known, ρ_u at any area ratio can be found directly from equation (6), rather than from equation (5). The thrust coefficient C_F (dimensionless) is simply

$$C_F = 32.174 \frac{I_{sp}}{C^*} \quad (7)$$

where I_{sp} represents the specific impulse, vacuum, altitude, or sea level, where the thrust coefficient is desired.

Densities of the various liquids at the feed temperature are included in the input description. The bulk density is defined as

$$\rho_{\text{Bulk}} = \frac{100}{\frac{X_A}{\rho_A} + \frac{X_B}{\rho_B}} \quad (8)$$

where X_A and X_B represent the weight percentages of components A and B. This value can be used in burnout velocity comparisons or in comparisons involving the product of density and specific impulse.

The specific heat at constant pressure (C_p) requires extra comment, as completely adequate means for finding its value as a function of area ratio appear too expensive to be merited. The approach has been to compute C_p for both shifting and frozen conditions by the formula

$$C_p = \left(\frac{\partial H}{\partial T} \right)_p \approx \left(\frac{H_{T+\Delta T} - H_{T-\Delta T}}{2\Delta T} \right)_p \quad (9)$$

Where C_p is in cal/gm-°K, H is in kcal/100 grams, and ΔT is set at 5°, the equation reduces to

$$C_p \approx \frac{H_{(T+\Delta T)} - H_{(T-\Delta T)}}{2\Delta T} \quad (9a)$$

The ΔT of 5° was set after trials with several larger and smaller increments; this value appeared to give the best general accuracy. The problem with this approach is where phase changes occur within the interval, either by appearance or disappearance of a condensed phase (in shifting expansion) or by freezing, which in our program can occur either with frozen or shifting expansion. (C_p , in fact, becomes infinite at a freezing point.) Further difficulties are then encountered if interpolation is attempted using a four-point interpolation routine, as very high values at one profile point followed by a reasonable value at the next often are interpolated to give negative values in between. A variety of techniques have been suggested to handle the problems, generally involving rather complicated rests or considerable machine time. The approach which has been taken is, however, the very simple one of requiring that all four points in the interpolation region decrease in specific heat with increasing area ratio; if not, condensation, freezing, or other unusual effects are assumed to be involved, and no value is printed out. It is, of course, possible that specific heat values are normal at each point in the interval, but that a freezing point is involved in the middle of one of the intervals. Errors of this nature will not be rejected by the test procedure.

No γ values have been reported, due to the somewhat ambiguous nature of this term, especially in the case of equilibrium expansion. The tabulated data can, however, be used to give a value based on the particular definition assigned. If γ is defined as follows

$$\gamma = \left(\frac{\partial \ln P}{\partial \ln \rho_s} \right) \quad (10)$$

a value can be derived from a plot of $\ln P$ vs. $\ln \rho$ either over an interval, or by slope measurement, at a point. The value of ρ in gm/cm³ can be obtained at any point from

$$\rho = \frac{2.3066 P_c}{C^* \epsilon I_{OPT}} \quad (11)$$

where the symbols have their previous meanings. Alternatively for frozen expansion, γ can be obtained from the C_p value and the molecular weight

$$\gamma_{fr} = \frac{C_{pfr}}{C_{pfr} - \frac{R}{M}} \quad (12)$$

where R is the universal gas constant 1.986 cal/mole-°K, and M is $\frac{100}{\bar{X}}$, where $\bar{X}$ is the number of moles of gas per 100 grams.

It should be noted that in equilibrium expansion a value of γ relating pressure and density over an interval (which for a differential interval is defined by equation 10), will be different numerically from γ relating pressure and temperature, according to

$$\gamma = \frac{1}{1 - \left(\frac{\partial \ln T}{\partial \ln P} \right)_s} \quad (13)$$

as for these two values of γ to be equal (equations 10 and 13), the molecular weight must be constant*

b. Performance at Specified Area Ratios and Altitudes

The data computed at each profile point are used to compute data at the 50 integral area ratios desired by four-point logarithmic interpolation. The resulting data are given for both frozen and shifting expansion.

*A number of mean γ values can also be computed, based on the calculated specific impulse or other performance parameters.

On the interpolation output sheets, the difference between I_{VAC} and I_{OPT} is termed DELVAC, representing the increment between the vacuum and optimum expansion value; it, along with DELVAC divided by the exhaust pressure (DELVAC/P), is used in computing impulse at specified altitude as follows

$$I_{ALT} = \lambda I_{OPT} + DELVAC \left(1 - \frac{P_o}{P_e} \right) \quad (14a)$$

$$\text{or } I_{ALT} = I_{VAC} - \left(\frac{DELVAC}{P} \right) P_o - I_{OPT} (1 - \lambda) \quad (14b)$$

where λ represents the divergence angle correction and where P_o represents the ambient pressure, in psia. This equation is normally used in cases where P_o is less than or equal to P ; where P_o exceeds P (over expansion) a decrease in performance below the optimum expansion value is indicated, but the magnitude of this decrease can be greatly overestimated by this equation, especially at high area ratios, inasmuch as such nozzles do not always in fact, run "full". The overexpanded case has thus been excluded from consideration here.

The value of λ depends on the particular nozzle; for an ideal nozzle with zero divergence angle, it is equal to unity so that the final term in equation (14b) drops out. The assumption of zero divergence was used here to calculate performance at sea level, 10,000 and 50,000 feet, as well as at vacuum for each case. Altitude effects are amplified in Section 3.3 below.

3.2 THERMODYNAMIC DATA*

Thermodynamic data employed in these calculations are the latest values reported in the JANAF tables. One species, C_2H , has been added, based on the work of Hildenbrand⁷; this species is not important in these runs. The data as used begin at 298°K so that the very few points reported on the computer output sheets at extreme expansion ratios which are calculated to have temperatures lower than 298°K must be considered suspect. In general, a large number of normally relatively unimportant species have been included in these computations in order to obtain the maximum precision at all stoichiometries. The summary sheets show compositions (moles/100 grams) to four decimal places. The computer program, however, does not reject a species as being zero until its mole number is less than 10^{-6} .

*Propellant heats of formation are discussed in Vol. III of this report.

The heat of formation used for BOF(g) was -143.00 kcal/mole. This value is in close agreement with the value of -144.00 recently reported by Hildenbrand⁸. Note that the heat of formation value used for each species is given in the printout; this usually is the most important single thermodynamic datum, and yet is often the most unreliable. Values used for propellant heats of formation are also shown on the printout. The printing out of these values will aid in interpretation of these results in the future, should new heat of formation data become available.

3.3 ALTITUDE EFFECTS

The conventional comparison of propellants on an impulse basis at sea level optimum expansion is convenient, but, as noted earlier, not necessarily definitive. A somewhat better approach might involve a "trajectory-averaged impulse" at a given area ratio, but the computation of such a value would be expensive to obtain and limited in significance to a particular mission. An easier approach, which we have selected, is to compute performance at specified area ratios at three arbitrary altitudes and vacuum, which correspond roughly to the conditions encountered by a first-stage booster where 0, 25, 50, and 100 percent of the fuel is burned.

In order to select the altitudes for specific impulse calculations, an equation was derived for the altitude of a first-stage booster as a function of fraction of fuel consumed, assuming no drag, neglecting impulse variations with altitude, and assuming a straight line trajectory and a flat earth. The equation is as follows:

$$h = \frac{I_{sp}^2 g_c \cos \theta}{T} \left\{ \left(1 - \frac{T_{t_{bo}} P_F}{I_{sp}} \right) \left[\ln \left(1 - \frac{T_{t_{bo}} P_F}{I_{sp}} \right) - 1 \right] + 1 \right\} - g_{t_{bo}}^2 \frac{P_F^2}{2}$$

where h = altitude, feet

I_{sp} = specific impulse, sec

g_c = conversion constant, 32.174 lb.mass-ft/lb.force-sec²

θ = firing angle from vertical

T = initial thrust/gross weight ratio

t_{bo} = total burning time, sec

P_F = percentage fuel consumed

g = local acceleration of gravity, assumed constant at 32.174 ft/sec²

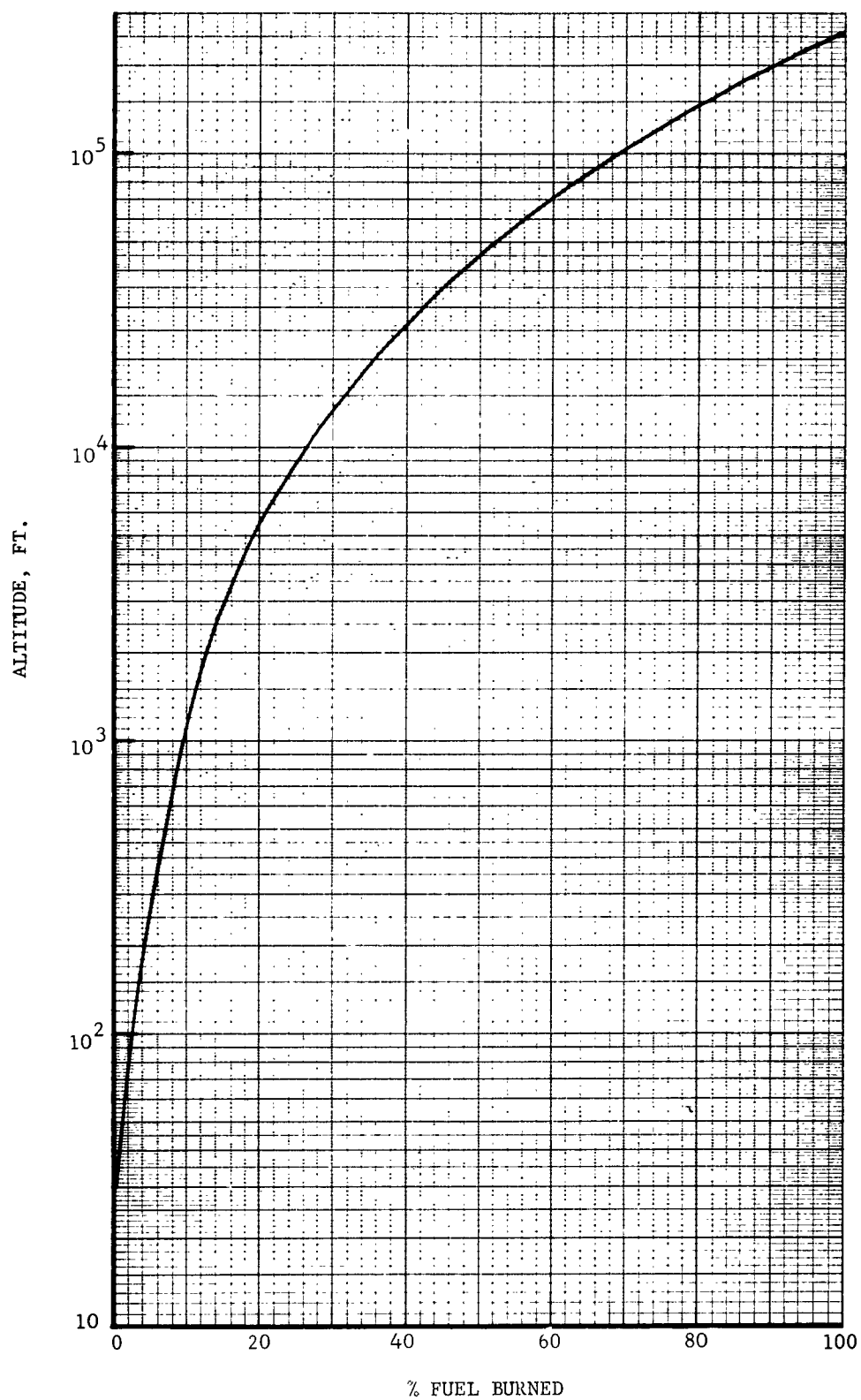
This equation gives the following results for a case where $t_{bo} = 150$ sec, $T = 1.5$, $I_{sp} = 300$ sec, ($m_{bo}/M_{Initial} = 0.25$), for vertical and 30° off-vertical firings:

$\theta = 0^\circ$			$\theta = 30^\circ$		
P_F	h_{ft}	h/h_{bo}	P_F	h_{ft}	h/h_{bo}
0.25	1.4×10^4	.03	0.25	9.1×10^3	.03
0.50	6.7×10^4	.16	0.50	4.6×10^4	.15
0.75	2.0×10^5	.51	0.75	1.5×10^5	.48
1.0	4.1×10^5	1.00	1.0	3.1×10^5	1.00

Note that 25 percent of the fuel is burned in achieving 3 percent of burnout altitude, and 50 percent of the fuel is consumed in reaching 15-16 percent of burnout altitude. Note also, that about 25 percent of the fuel is burned by the time 10,000 feet is reached, and about 50 percent by the time 50,000 feet is reached.

In order to check the validity of these results, an accurate computation, obtained by numerical integration on a computer for a typical first-stage trajectory, and including all the factors neglected in the simplified analysis was obtained for comparison, with results plotted in Figure 1. In this real case, 25 percent of the fuel is consumed at the 10,000 ft. mark and 52 percent at the 50,000 ft. mark.

Based on these considerations, computations of theoretical impulse were made at the 10,000 and 50,000 foot levels, as well as at sea level and at vacuum conditions. Pressures at these levels were taken by interpolation of the data provided by COSPAR⁹, as being 10.2695 psia at 10,000 feet and 1.7058 psia at 50,000 feet. A plot of the pressure as a function of altitude to 105,000 feet, using COSPAR data is shown in Figure 2.



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FIGURE 1. PERCENTAGE FUEL CONSUMED VS ALTITUDE REACHED -
TYPICAL FIRST STAGE TRAJECTORY

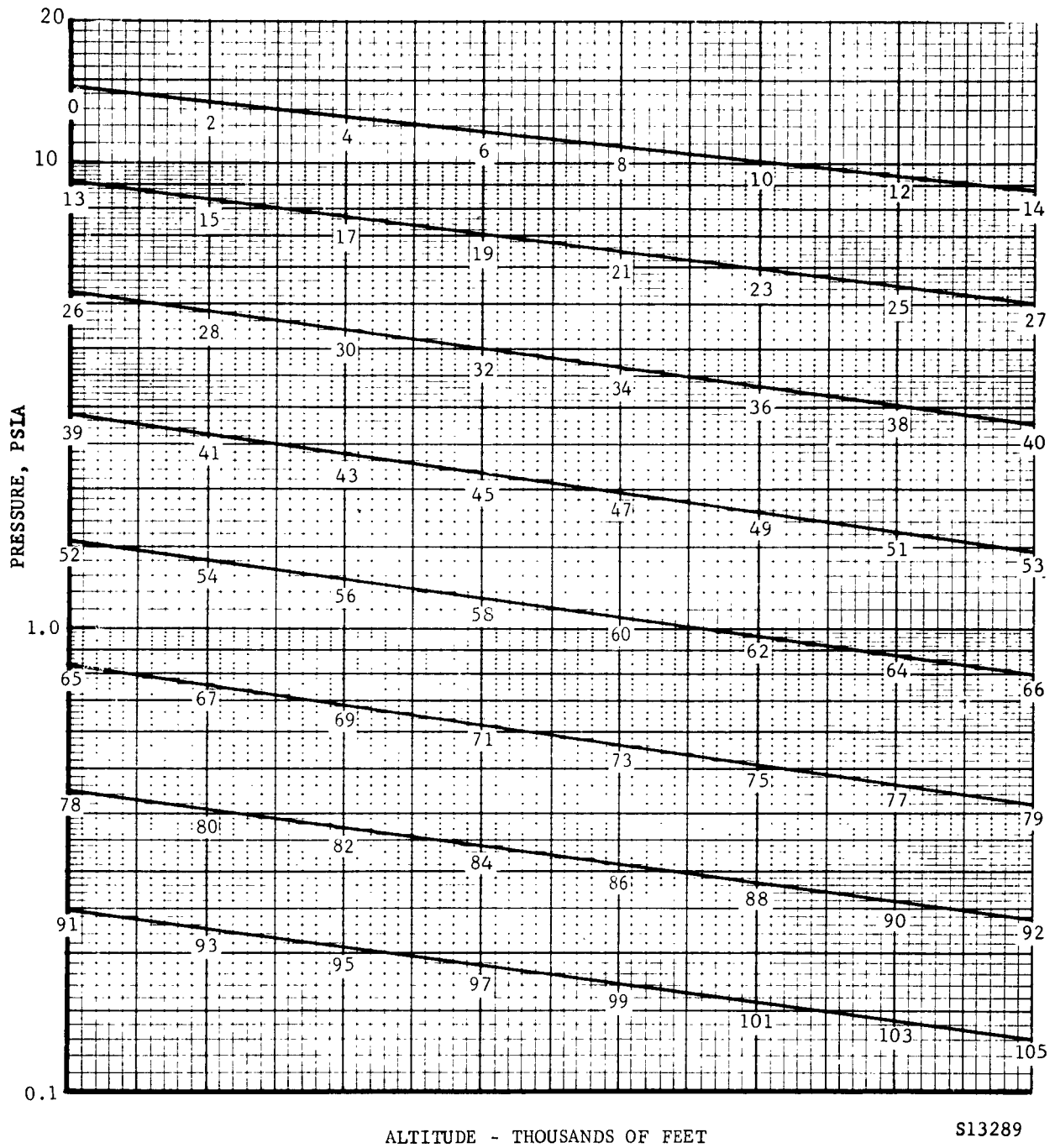


FIGURE 2. COSPAR INTERNATIONAL REFERENCE ATMOSPHERE 1961

SECTION 4

RESULTS AND DISCUSSION

Results are presented in the form of summary graphs (Figures 3-13), which are included in this Section, and computer output sheets, which are given in Section 5. In addition, a tabulation of maximum impulse values and other data for the various systems at various conditions is given as Table I immediately following. The systems can thus be studied in increasing detail by considering first Table I, then the appropriate graphs, and finally the computer output sheets. Altitude performance data must be obtained from the computer output sheets themselves. The systems studied are arbitrarily arranged alphabetically by oxidizer. N_2H_4 is arbitrarily considered the oxidizer in the N_2H_4 - B_5H_9 system.

Our primary purpose here is to present the data for the various systems, and not to attempt comparisons, as such comparisons are valid only for specific applications. However, a few comments appear to be worth mentioning, as follows:

(1) Some deviation is to be expected from previously published results due to use of up-to-date thermodynamic data. This is evident for example, in the H_2O_2 - B_5H_9 system, in that results herein differ in some regions by three or four seconds from results published previously by this laboratory¹⁰. (Maximum sea level optimum shifting impulse appears to be a few seconds lower using the more modern data; in certain non-optimum composition regions the old values were in some cases higher.)

(2) As would be expected, the hotter systems show greater losses in impulse if freezing of chemical reactions takes place than do cooler systems. Thus, the ClF_3 - N_2H_4 system shows nearly identical impulse values to the N_2O_4 - N_2H_4 system with equilibrium expansion, but with frozen expansion the latter system is superior on an impulse basis.

Similarly, the F_2-H_2 system loses most of its apparent advantage over the O_2-H_2 system, if freezing takes place and performance at high expansion ratios is considered. Freezing of reactions leads to severe performance loss in the $OF_2-B_5H_9$ and $N_2F_4-B_5H_9$ systems.

(3) Certain systems are not very sensitive to mixture ratio in terms of specific impulse. This is especially true of $ClF_3-N_2H_4$ with frozen expansion. (See Figure 3b)

(4) Freezing can have a considerable effect on the optimum mixture ratio. Note that in the $N_2O_4-N_2H_4$ system, at $C = 50$ in a vacuum, the peak shifts from 90 percent to 83 percent N_2O_4 , for a change in oxidizer fuel ratio of 10 to 1, to 6/1.

(5) The density data given on the computer output sheets permit study of density effects. Note, for example, that the greater density at peak of the $ClF_3-N_2H_4$ system relative to the $N_2O_4-N_2H_4$ system would offer considerable advantage.

(6) Oxidizer/fuel ratios at peak performance generally, but not always, shift slightly toward higher values at higher values of area ratio, for both frozen and equilibrium expansion. In general this is also true as chamber pressure is increased. (See summary plots.)

TABLE I

PROPELLANT PERFORMANCE DATA⁽¹⁾

System	Oxid. (2) Density	Fuel (2) Density	(3) T _c , °K	Exp. Cond.	SL I _{OPT} , at % Oxid.	$\epsilon = 8$ I _{VAC} at % Oxid.	$\epsilon = 50$ I _{VAC} at % Oxid.
ClF ₃ -N ₂ H ₄	1.81	1.005	3900 3700	Shift. Froz.	292.5 at 73 279 at 69	314 at 72 300 at 68	342 at 74 322 at 69
F ₂ -H ₂	1.51	0.071	3800 2900	Shift. Froz.	410 at 88 397.5 at 82	440.5 at 88 428 at 81	479 at 90 457 at 83
H ₂ O ₂ -B ₅ H ₉	1.448	0.620	3000 3300	Shift. Froz.	309 at 70 299 at 76	329 at 70 319 at 76	377 at 68 355 at 76
N ₂ F ₄ -B ₅ H ₉	1.500	0.620	4850 4700	Shift. Froz.	333 at 87 308 at 85	357 at 87 331 at 85	402 at 88 357 at 85
N ₂ H ₄ -B ₅ H ₉	1.005	0.620	2800 2800	Shift. Froz.	328 at 56 324 at 58	352 at 56 347 at 58	395 at 56 389 at 57
N ₂ O ₄ -N ₂ H ₄	1.43	1.005	3230 3150	Shift. Froz.	291.5 at 55 283 at 51	312.5 at 55 304.5 at 52	345 at 55 332 at 53
OF ₂ -B ₂ H ₆	1.53	0.445	4600 4400	Shift. Froz.	372 at 78 344 at 75	397 at 78 370 at 74	448 at 78 402 at 75
OF ₂ -B ₅ H ₉	1.53	0.620	4950 4800	Shift. Froz.	359 at 79 331 at 76	384 at 79 356 at 76	436 at 80 387 at 76
OF ₂ -N ₂ H ₄	1.53	1.005	4050 3800	Shift. Froz.	345 at 60 321.5 at 52	370 at 60 346 at 53	413 at 62 373 at 53
O ₂ -H ₂	1.14	0.071	3100 2900	Shift. Froz.	391.5 at 80 388 at 77	421 at 81 416 at 77	461 at 83 454 at 78
O ₂ -RP-1	1.14	0.80	3700 3500	Shift. Froz.	299 at 73 284 at 69	319 at 72 305 at 69	361 at 74 335 at 70

(1) Maxima from Graphs - 1000 psi chamber

(2) In gm/cc.

(3) Approximate value in region of peak performance.

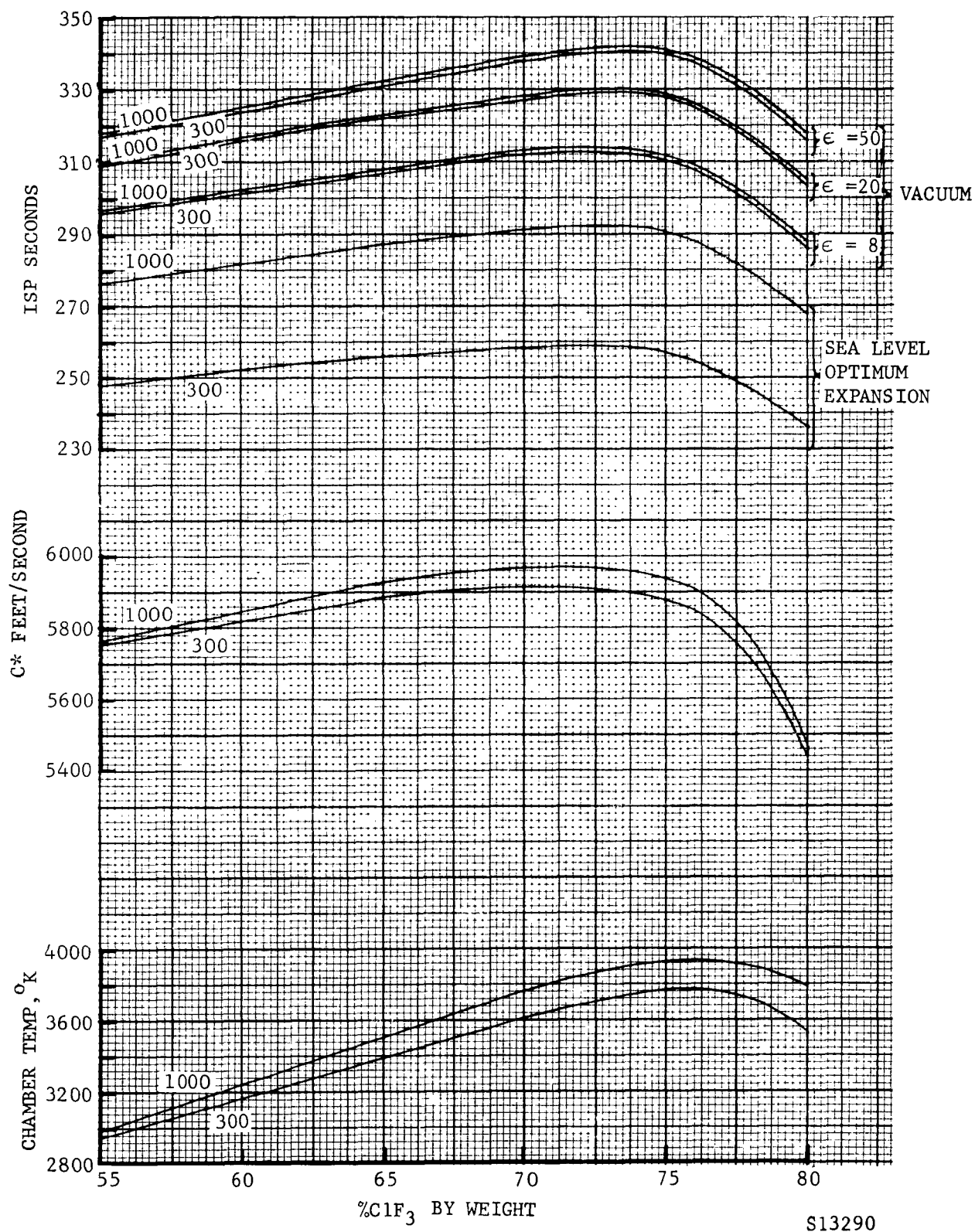


FIGURE 3a. $\text{C}_1\text{F}_3\text{-N}_2\text{H}_4$ SYSTEM - FROZEN EXPANSION

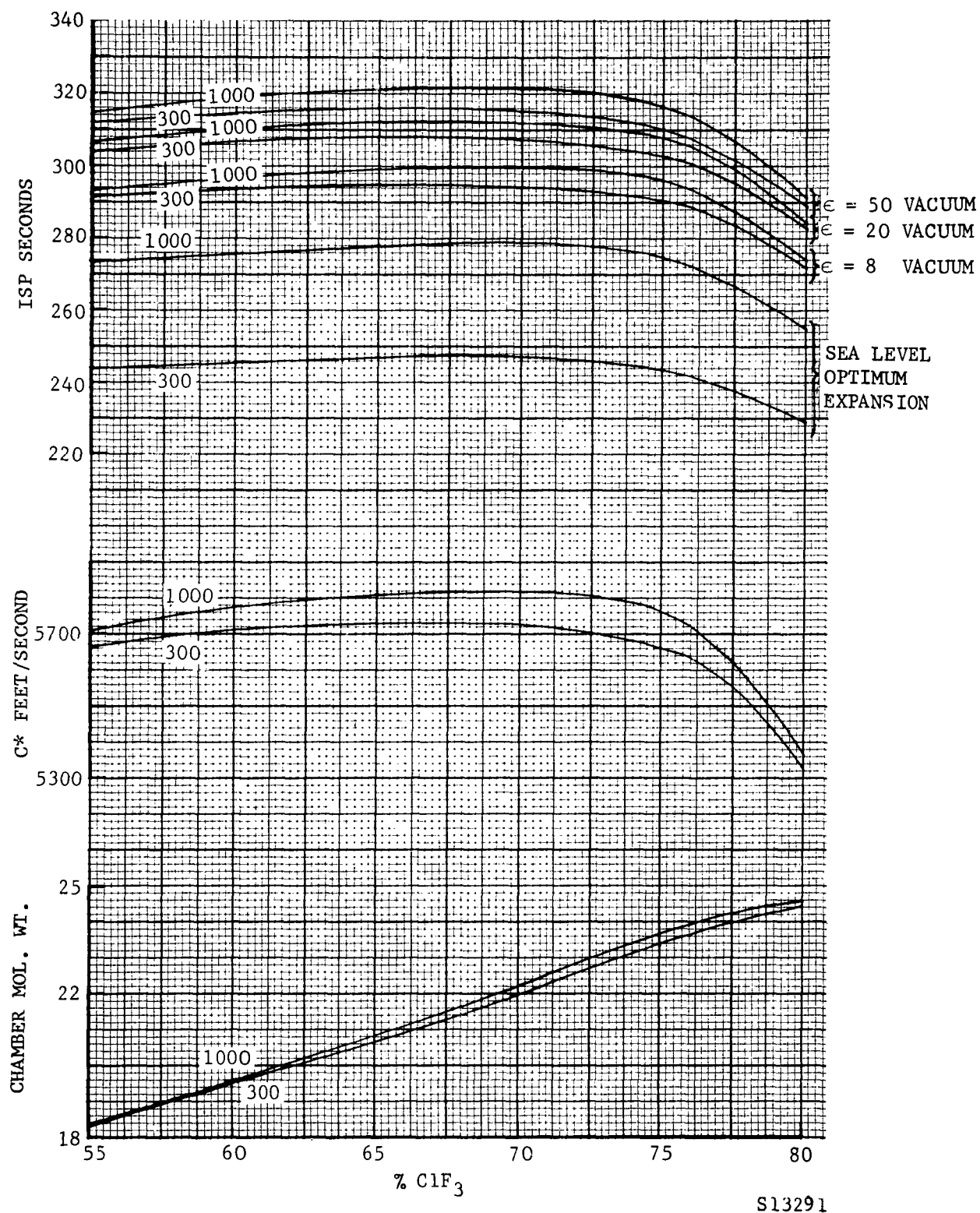


FIGURE 3b. $\text{ClF}_3\text{-N}_2\text{H}_4$ SYSTEM - SHIFTING EXPANSION

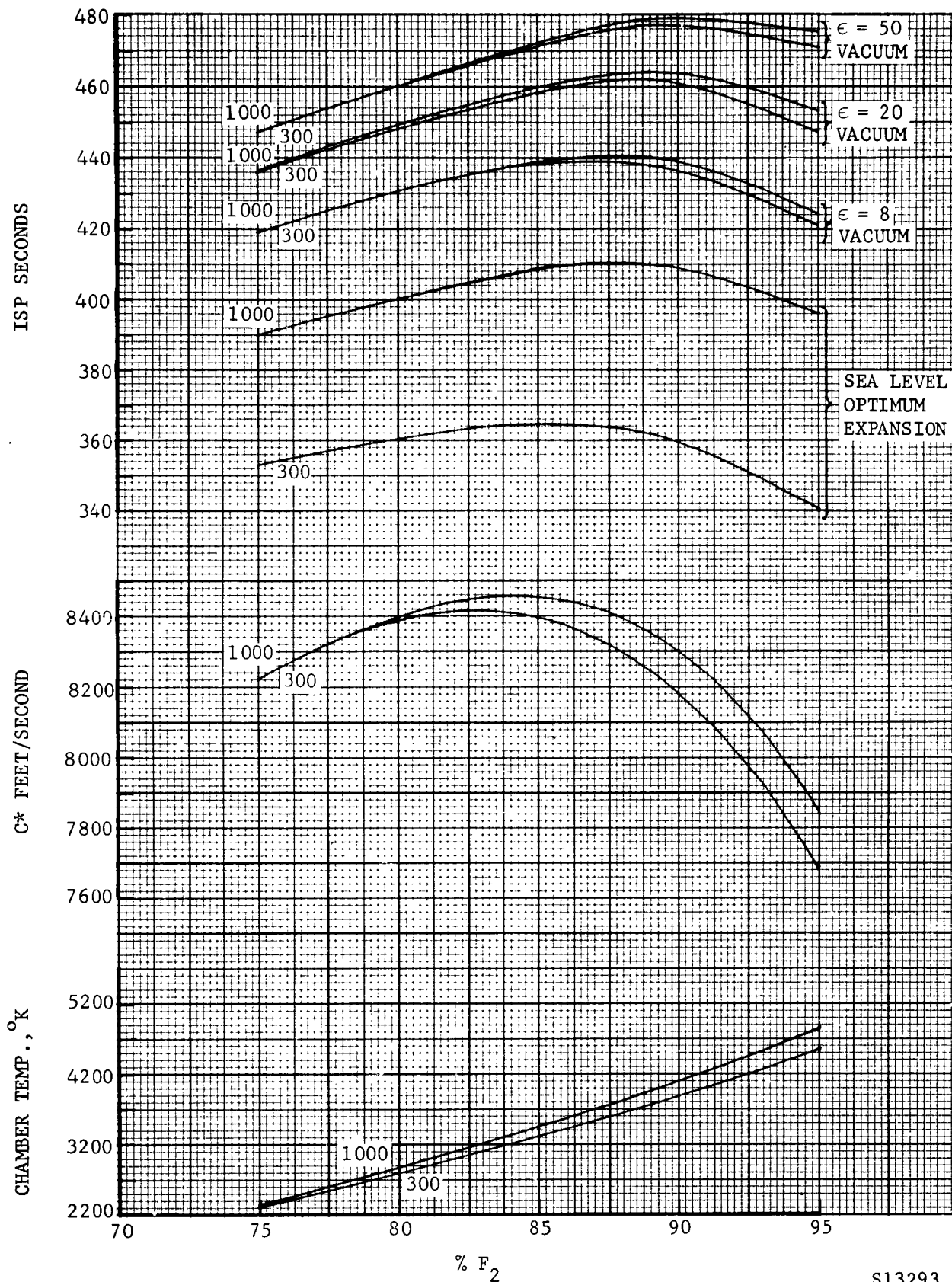


FIGURE 4b. F_2 - H_2 SYSTEM - SHIFTING EXPANSION

S13293

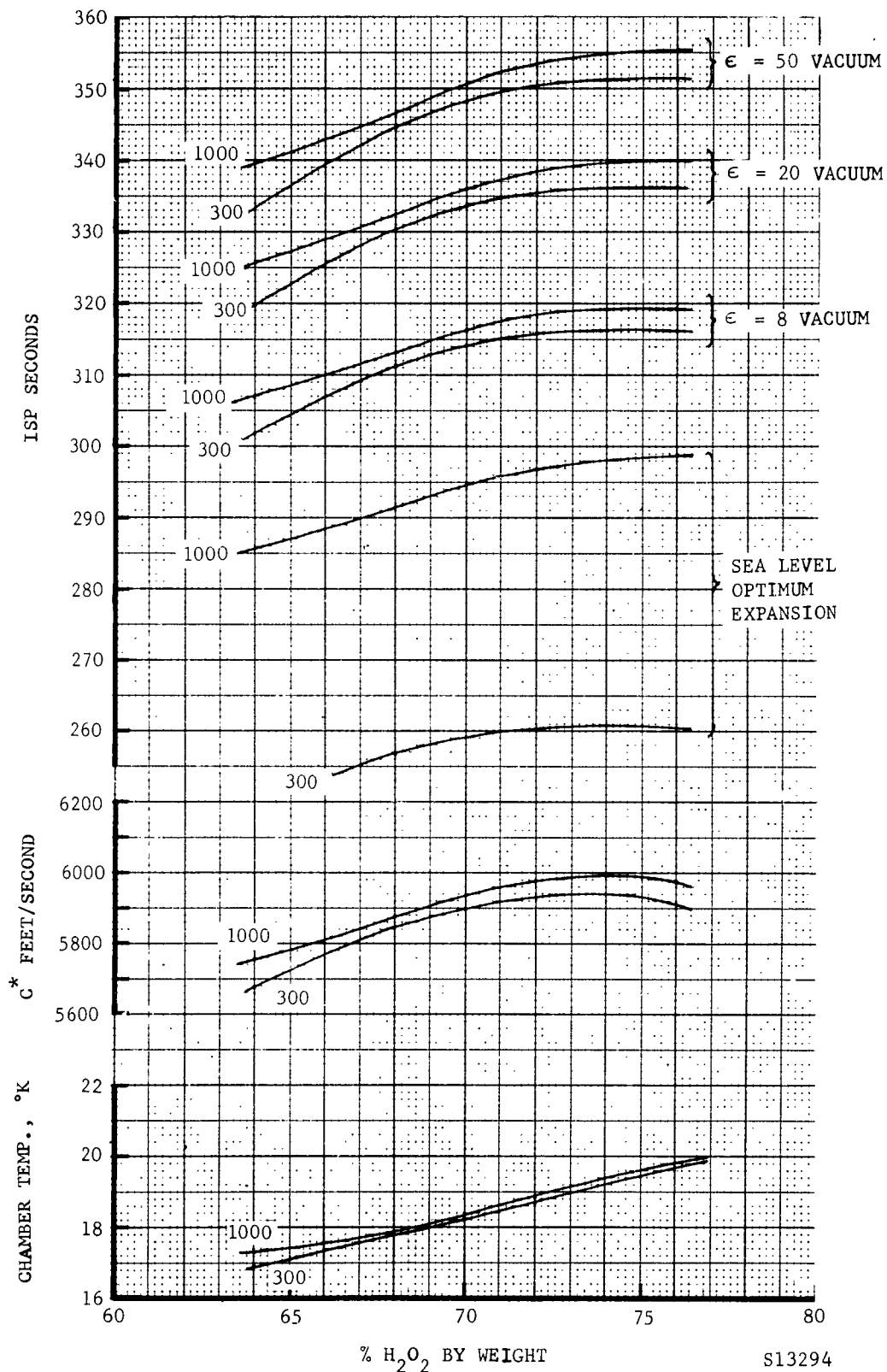
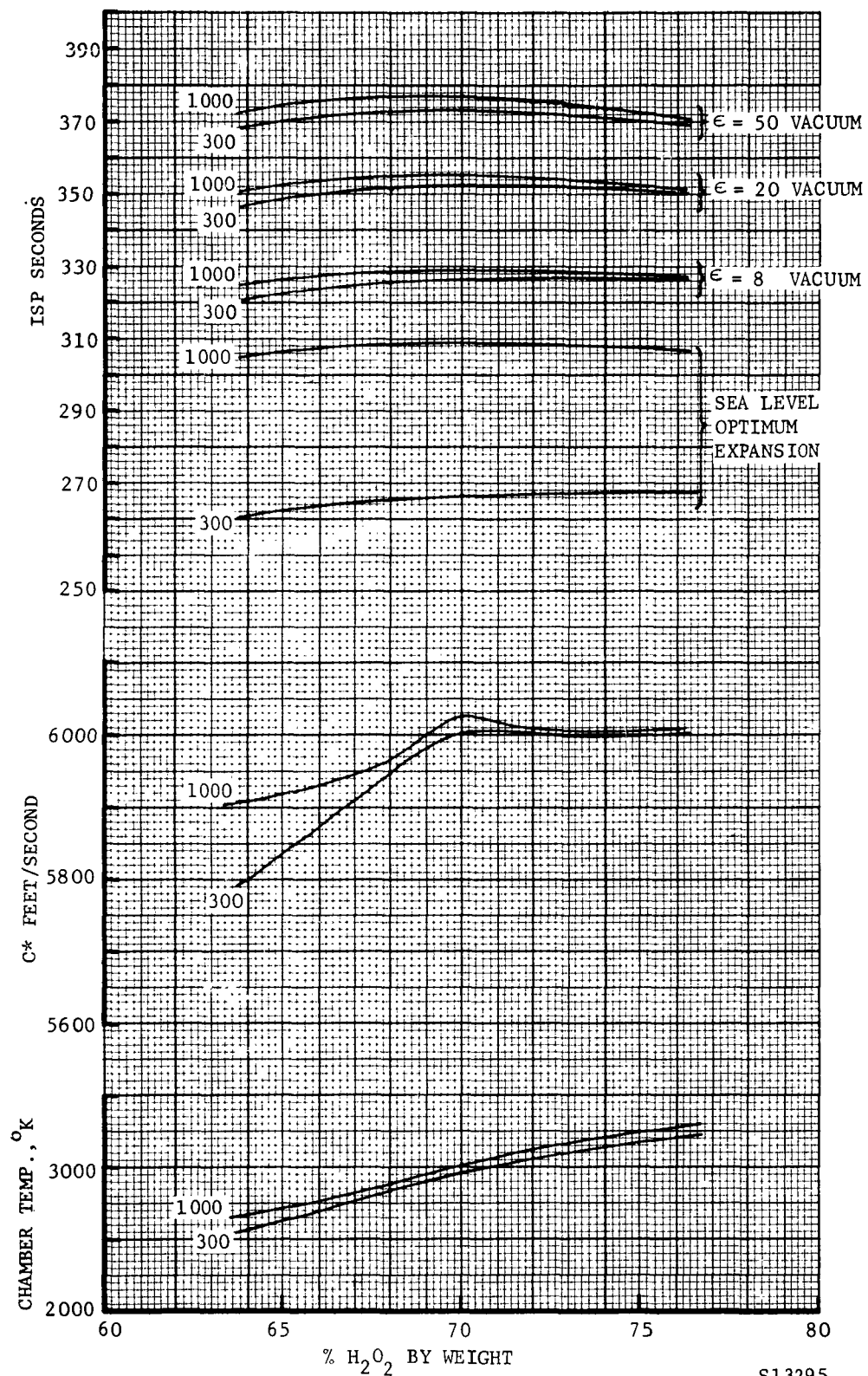


FIGURE 5a. H_2O_2 - B_5H_9 SYSTEM - FROZEN EXPANSION

S13294



S13295

FIGURE 5b. H_2O_2 - B_5H_9 - SHIFTING EXPANSION

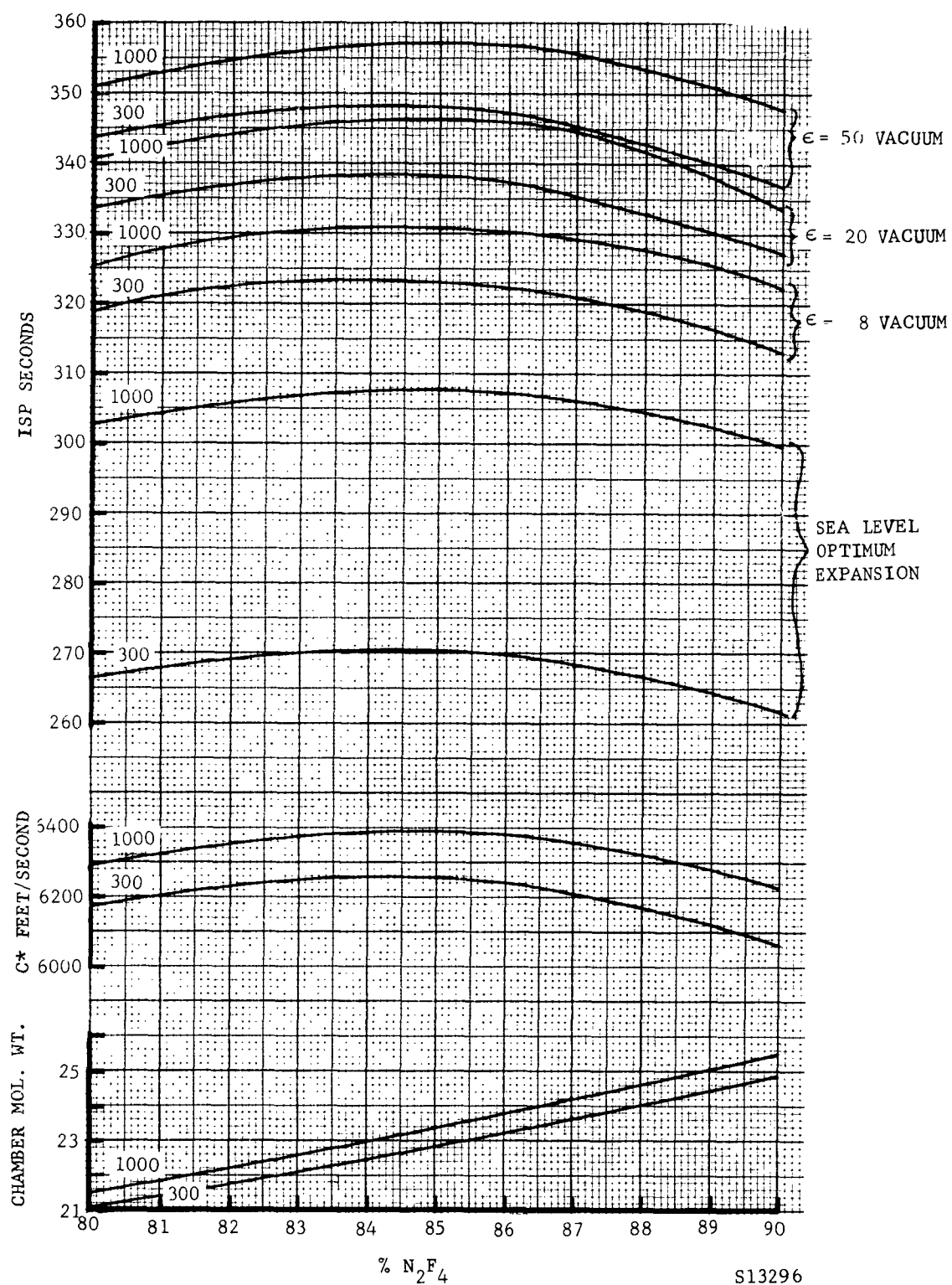
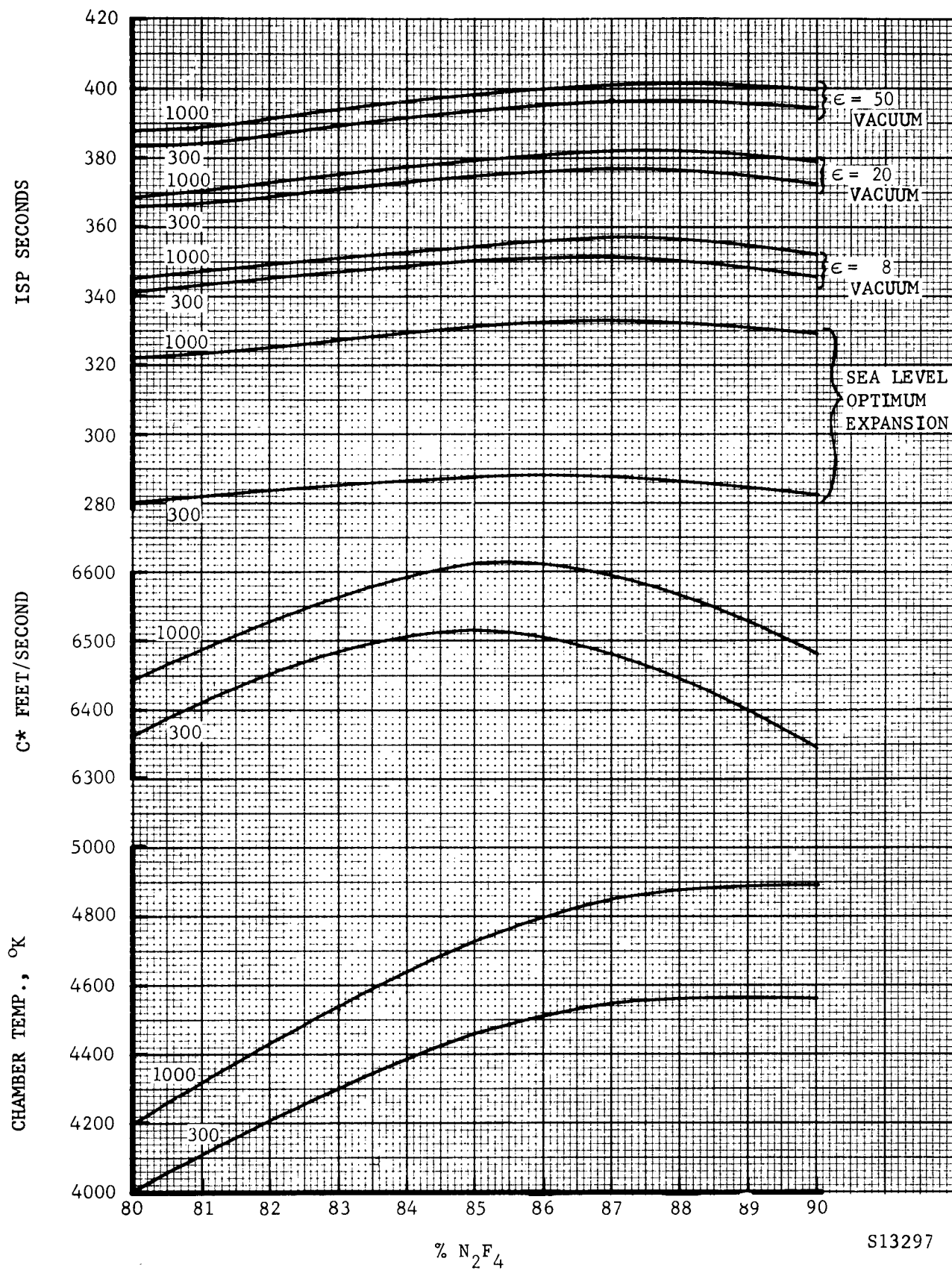


FIGURE 6a. N_2F_4 - B_5H_9 SYSTEM - FROZEN EXPANSION



S13297

FIGURE 6b. N_2F_4 - B_5H_9 SYSTEM - SHIFTING EXPANSION

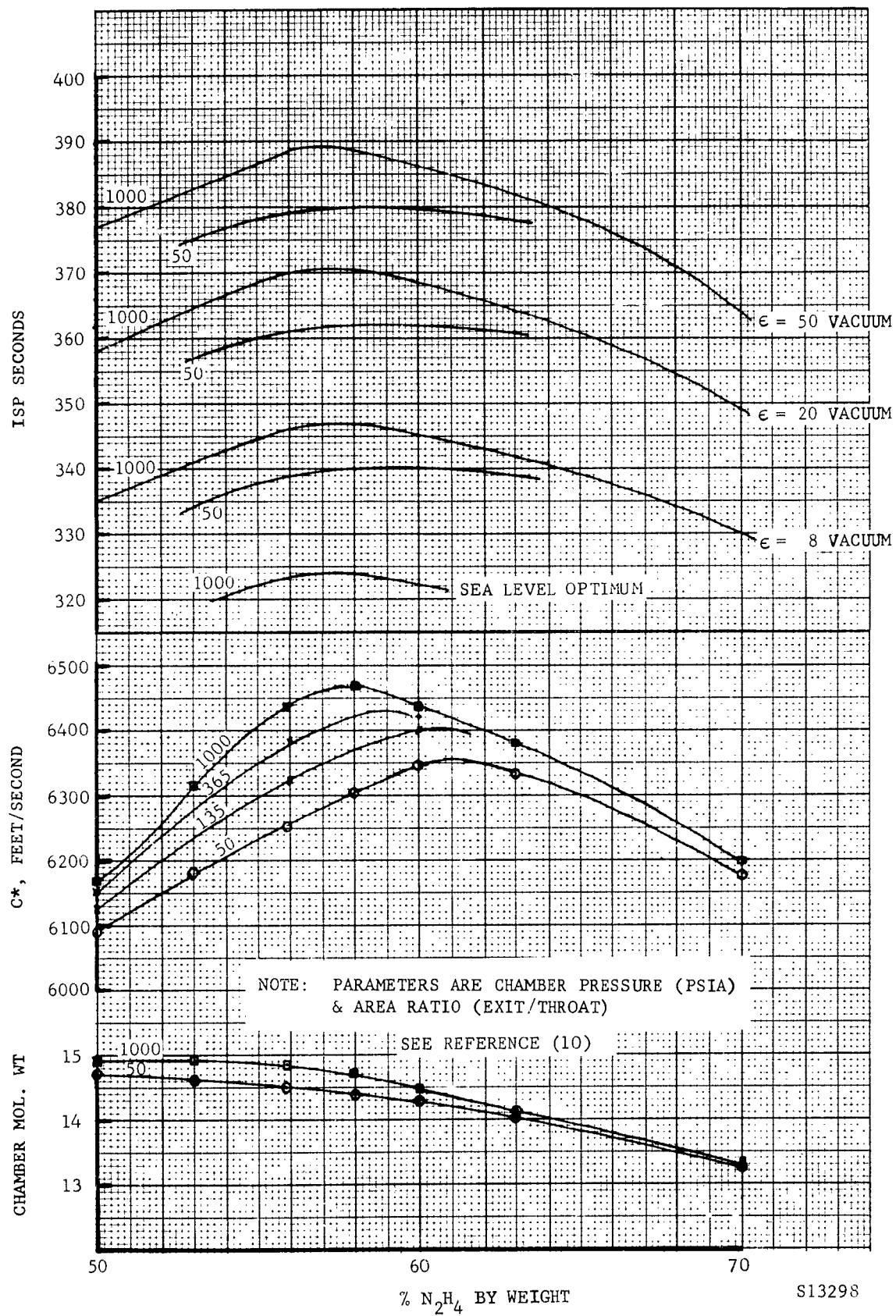


FIGURE 7a. N₂H₄ - B₅H₉ SYSTEM - FROZEN EXPANSION

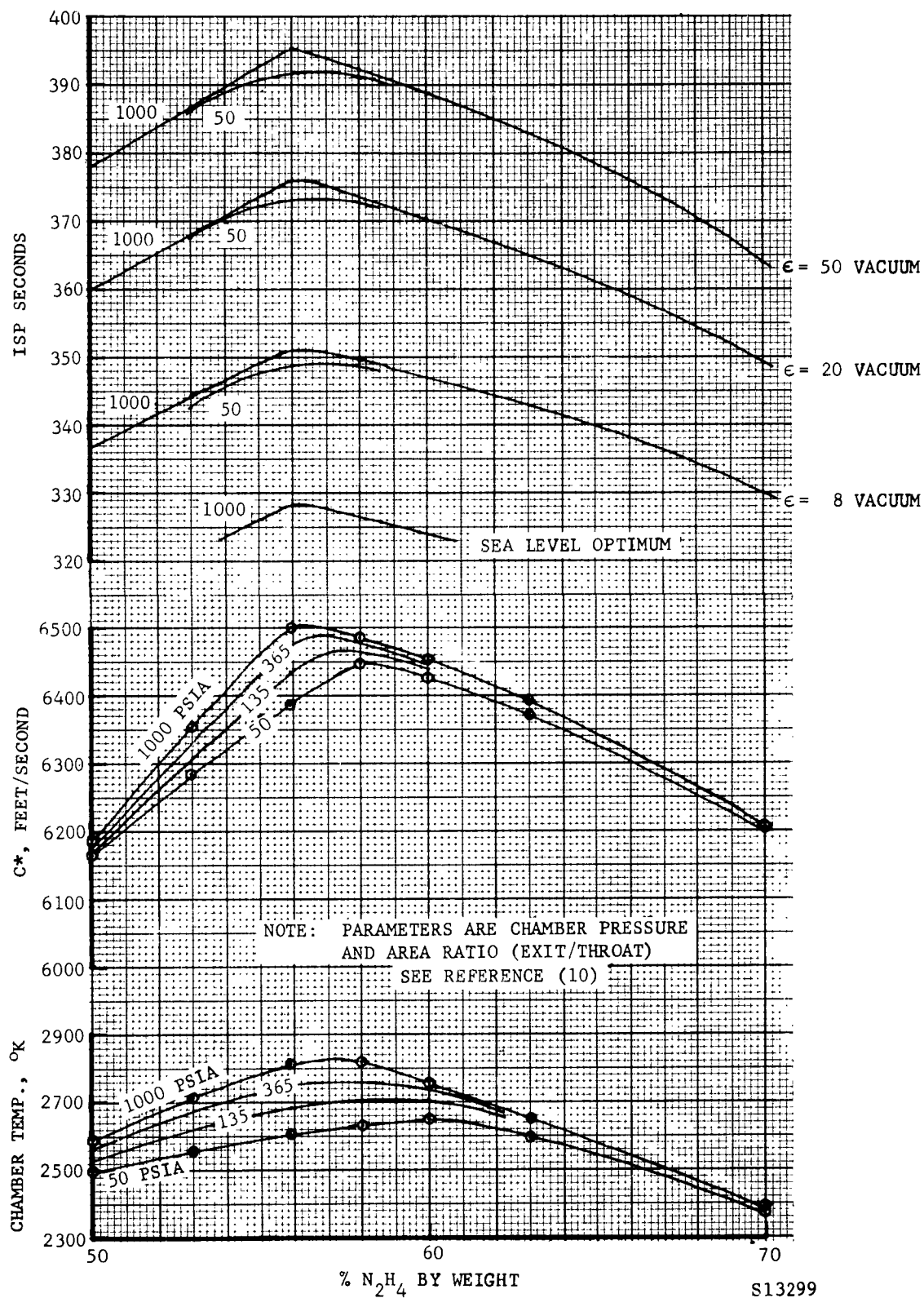


FIGURE 7b. N_2H_4 - B_5H_9 SYSTEM - SHIFTING EXPANSION

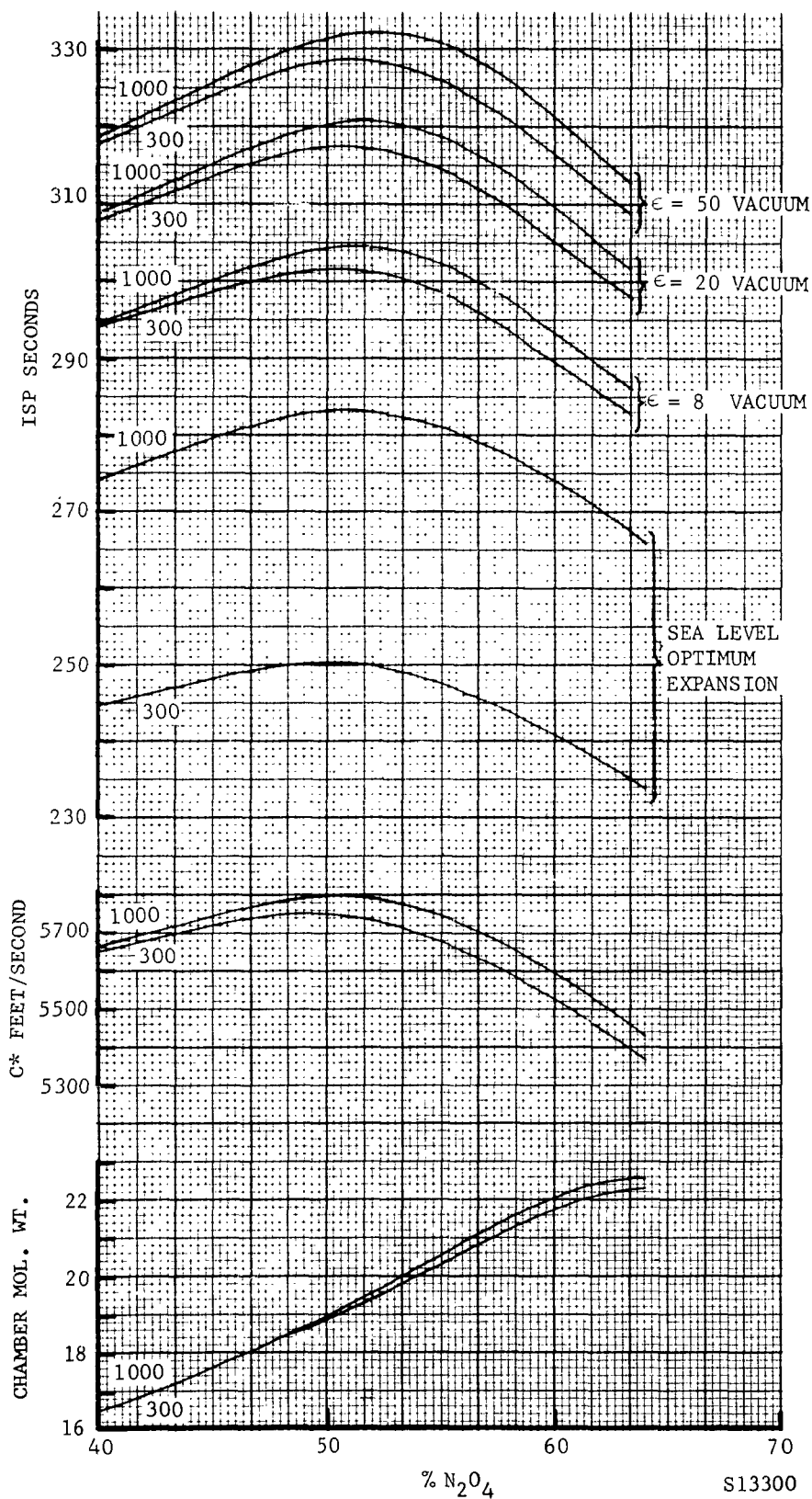
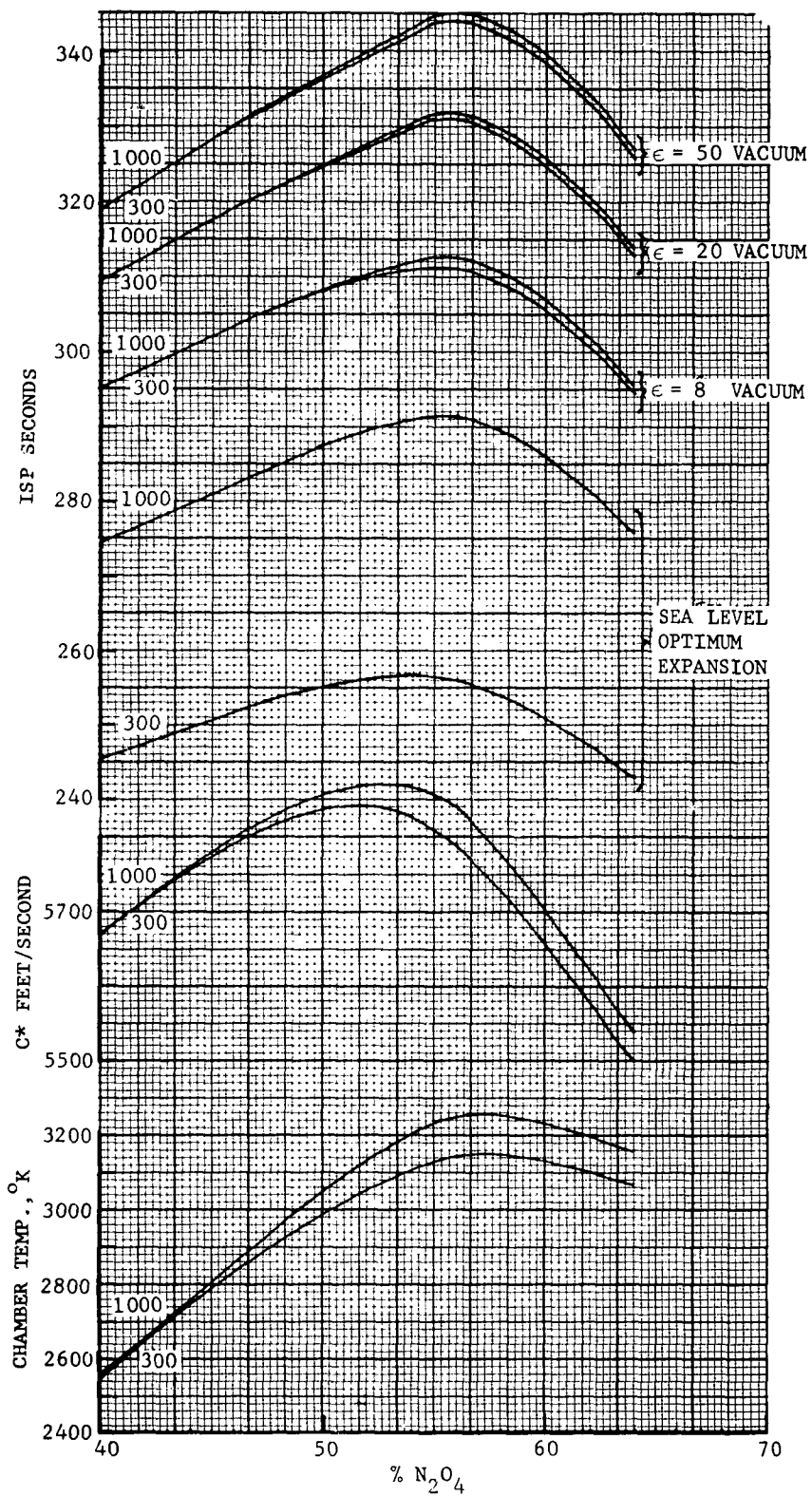


FIGURE 8a. $N_2O_4 - N_2H_4$ SYSTEM - FROZEN EXPANSION



S13301

FIGURE 8b. $N_2O_4 - N_2H_4$ SYSTEM - SHIFTING EXPANSION

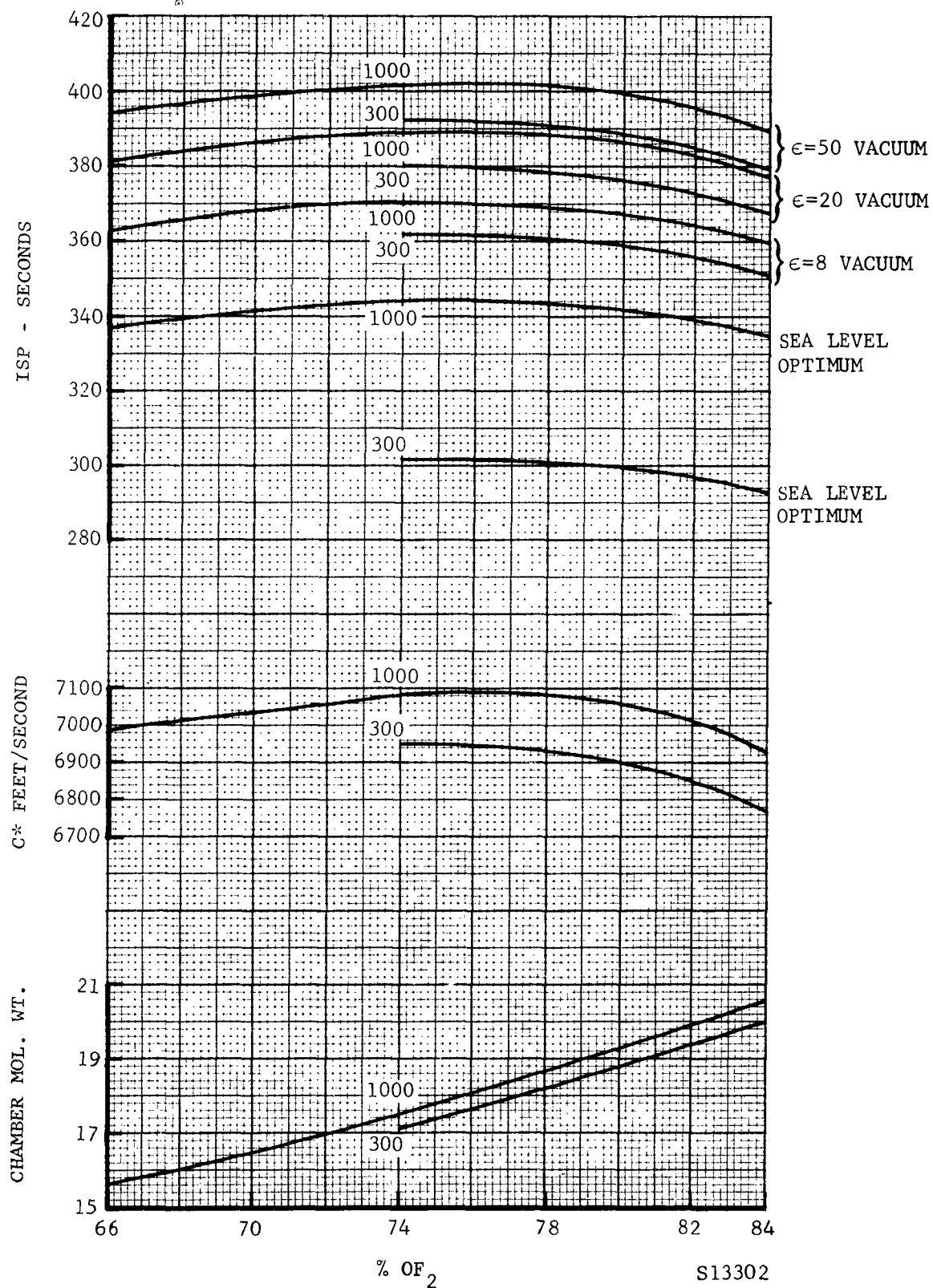


FIGURE 9a. $\text{OF}_2 - \text{B}_2\text{H}_6$ SYSTEM - FROZEN EXPANSION

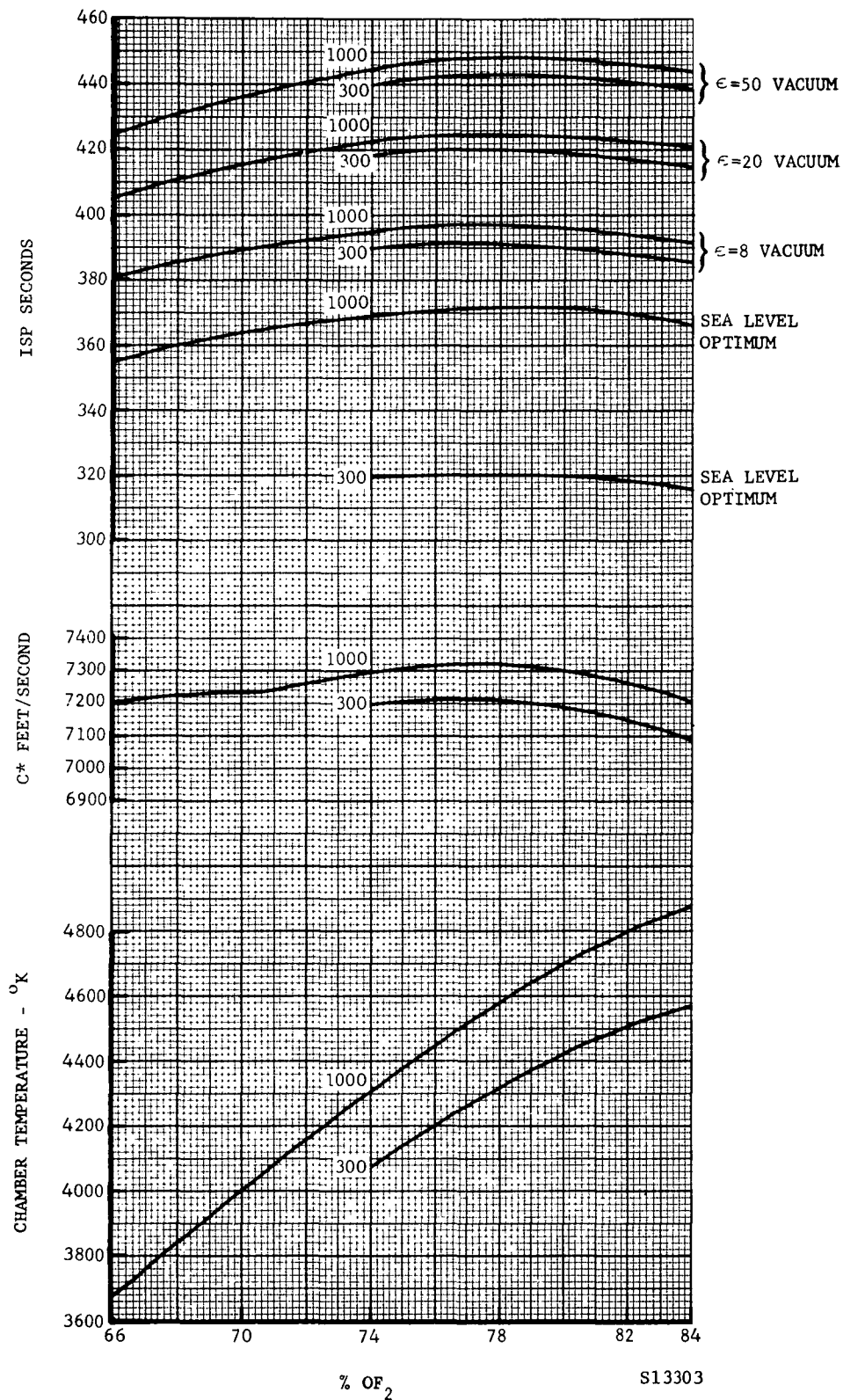


FIGURE 9b. OF_2 - B_2H_6 - SHIFTING EXPANSION

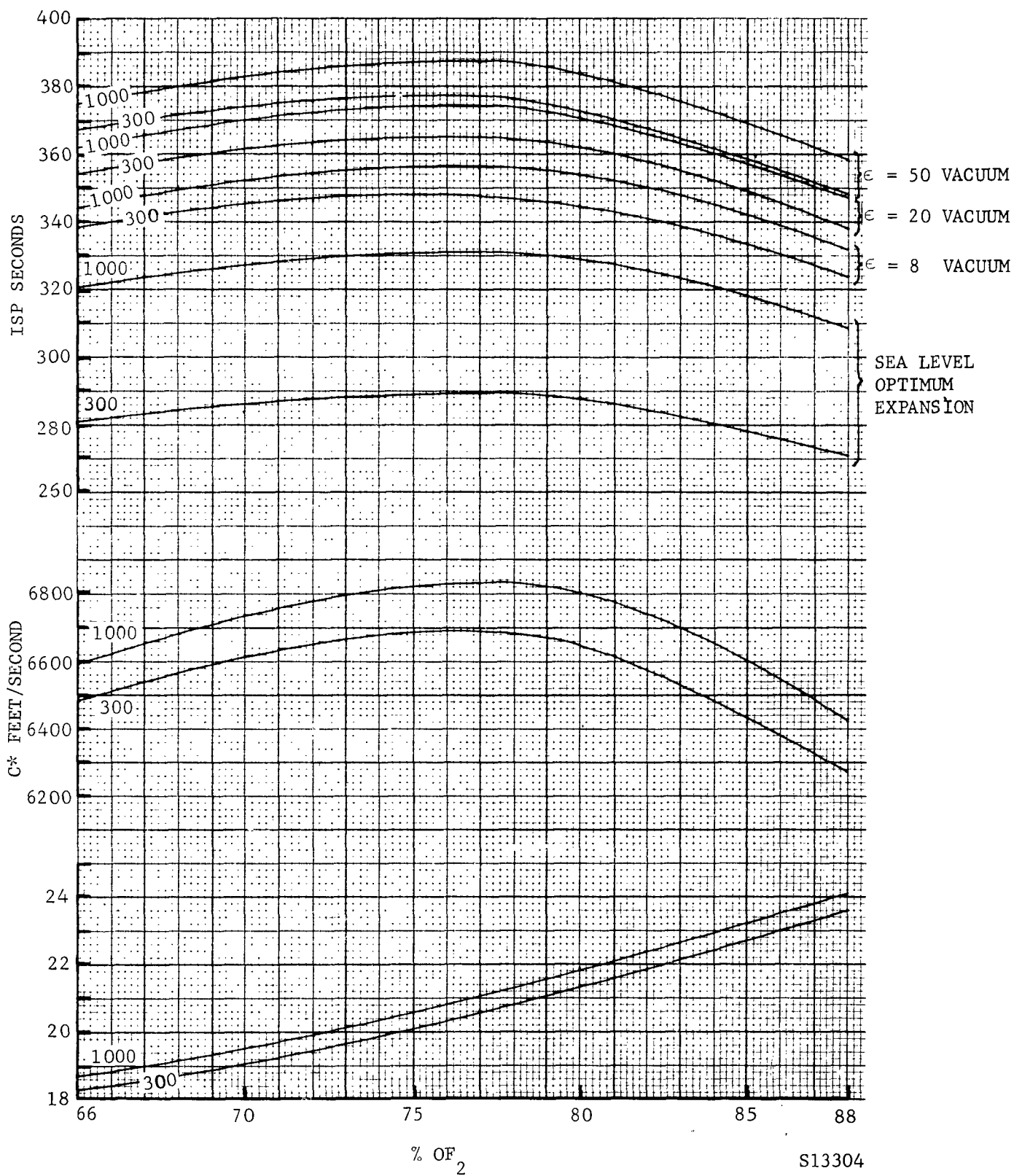


FIGURE 10a. OF_2 - B_5H_9 SYSTEM - FROZEN EXPANSION

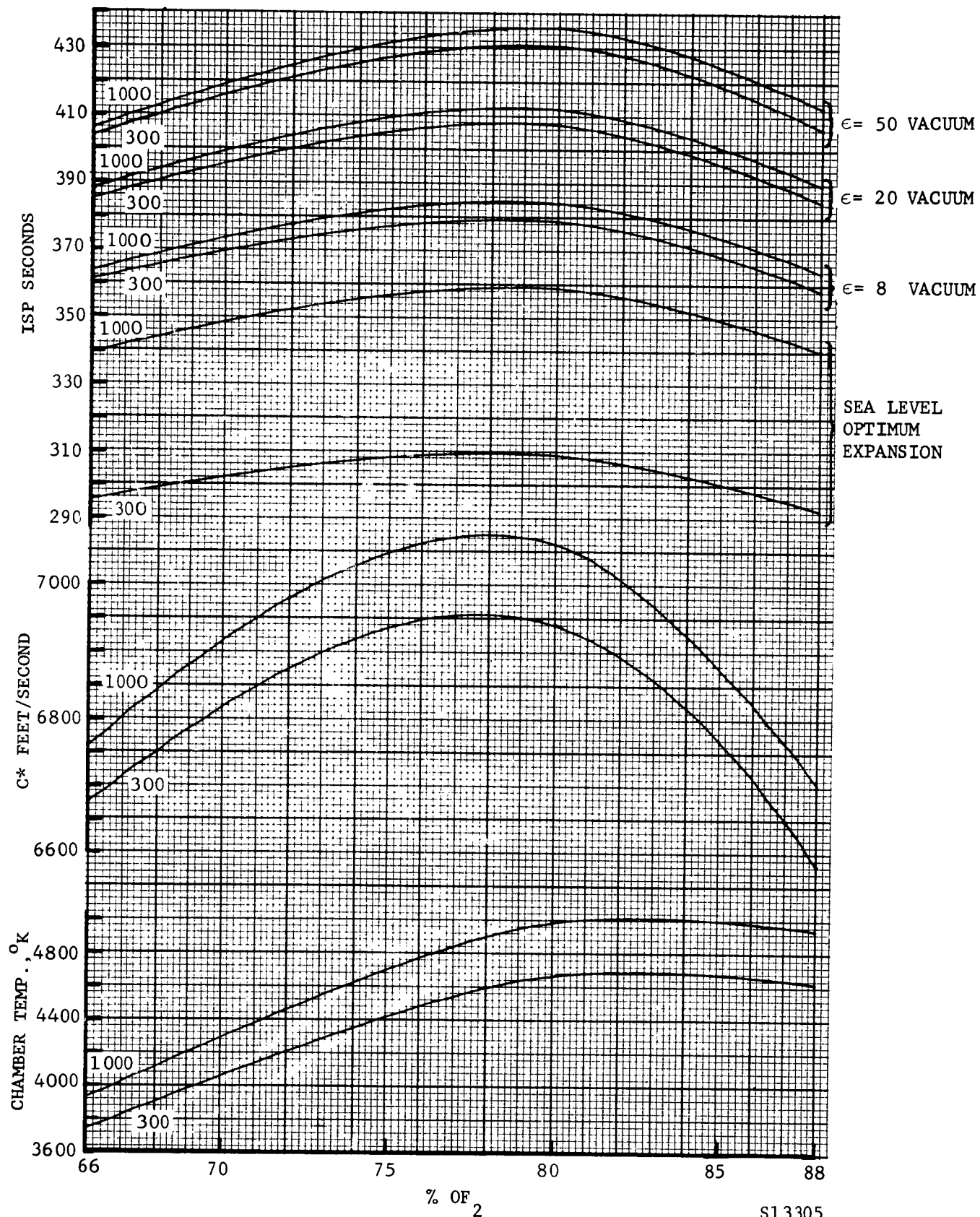
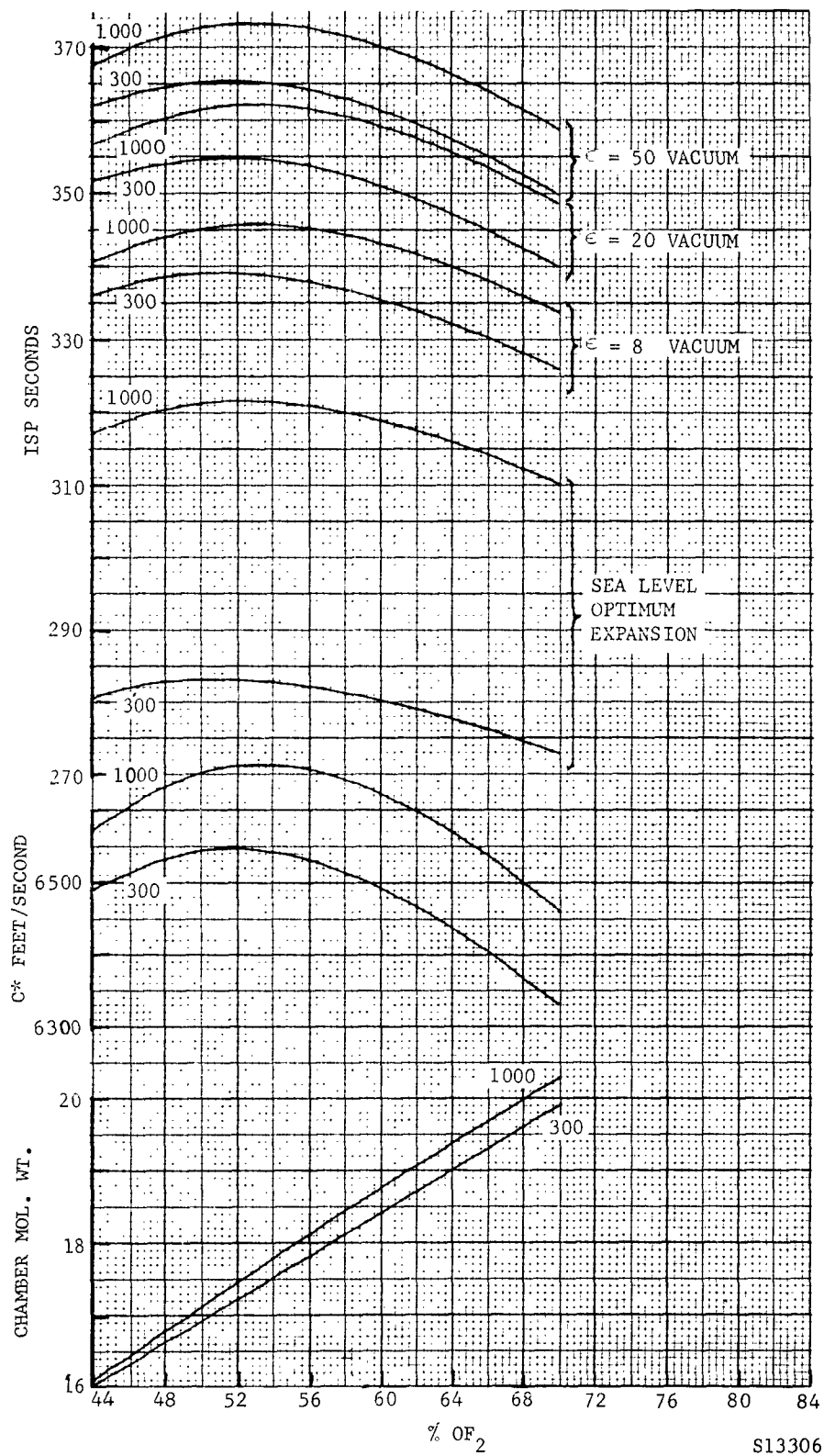


FIGURE 10b. $\text{OF}_2 - \text{B}_5\text{H}_9$ SYSTEM - SHIFTING EXPANSION

S13305



S13306

FIGURE 11a. $\text{OF}_2 - \text{N}_2\text{H}_4$ SYSTEM - FROZEN EXPANSION

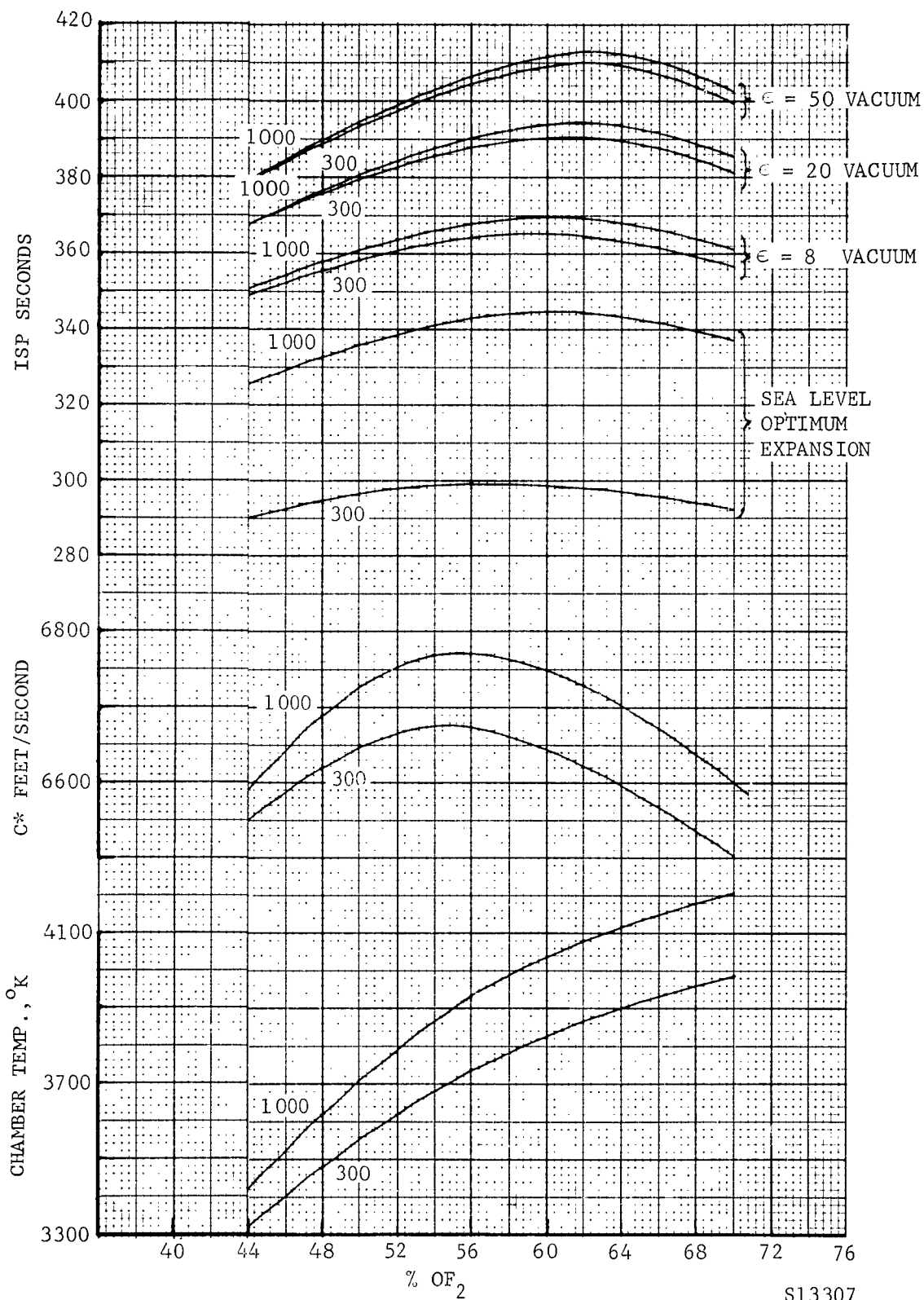


FIGURE 11b. $\text{OF}_2 - \text{N}_2\text{H}_4$ SYSTEM - SHIFTING EXPANSION

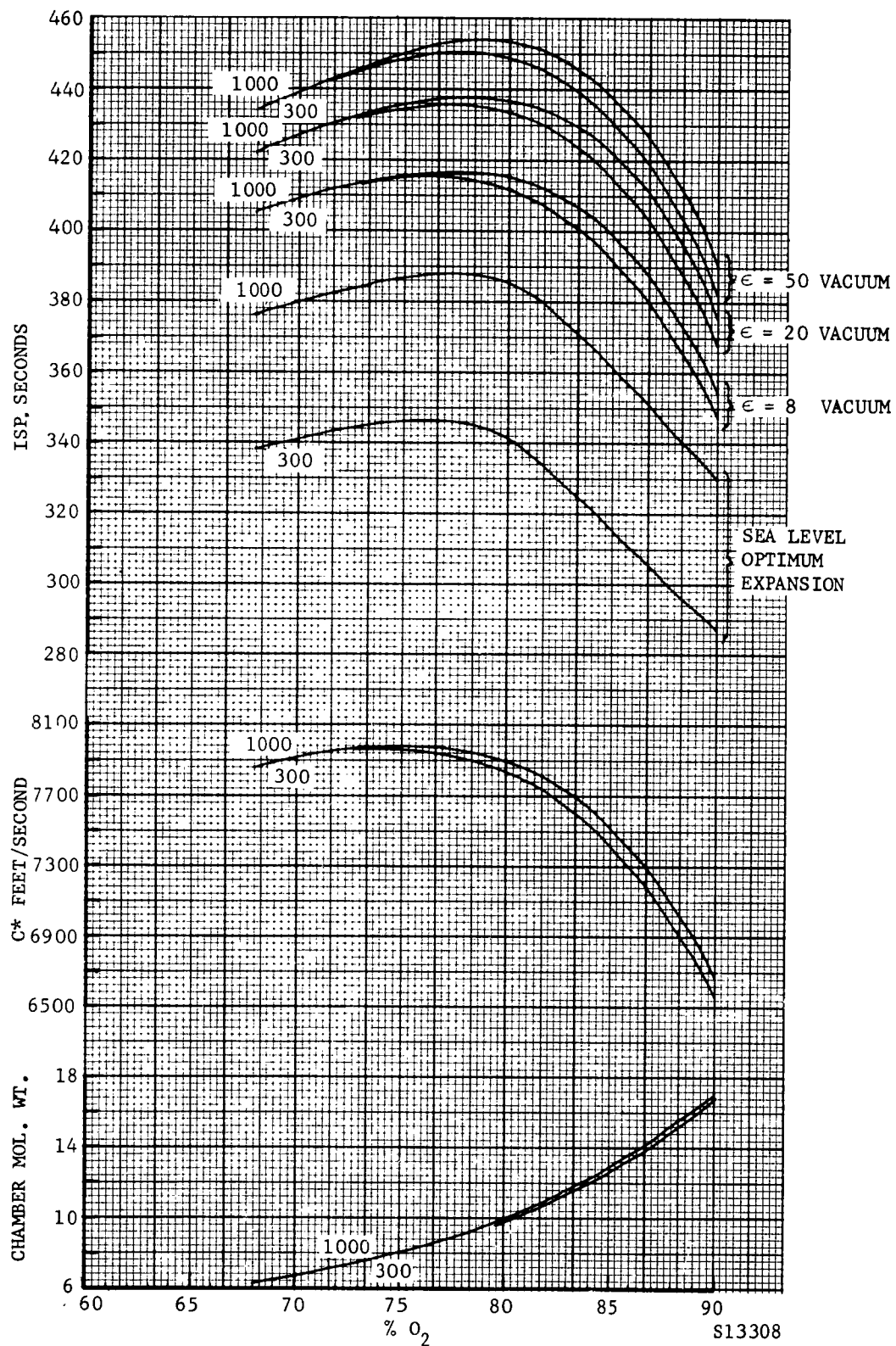


FIGURE 12a. $O_2 - H_2$ SYSTEM - FROZEN EXPANSION

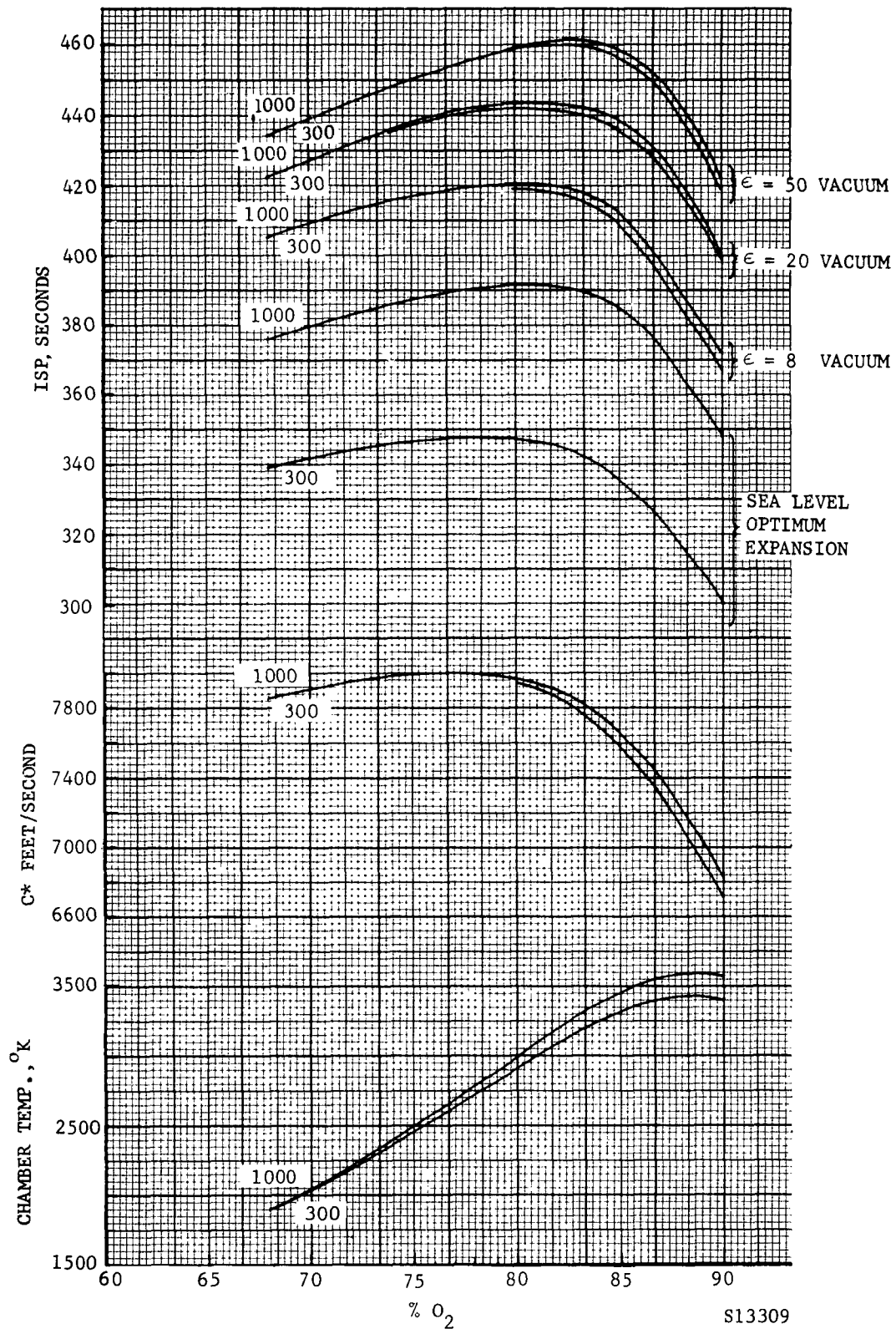
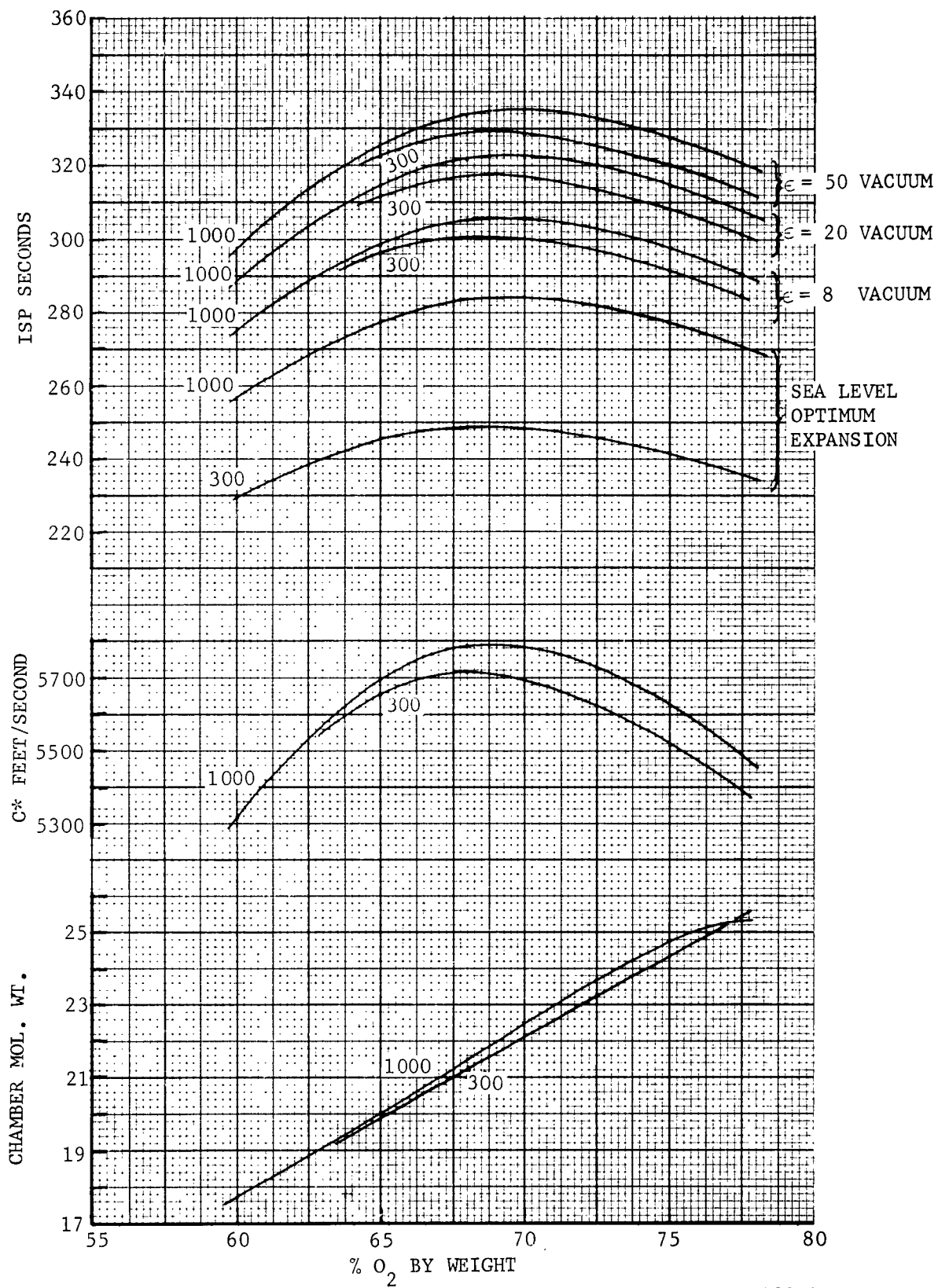
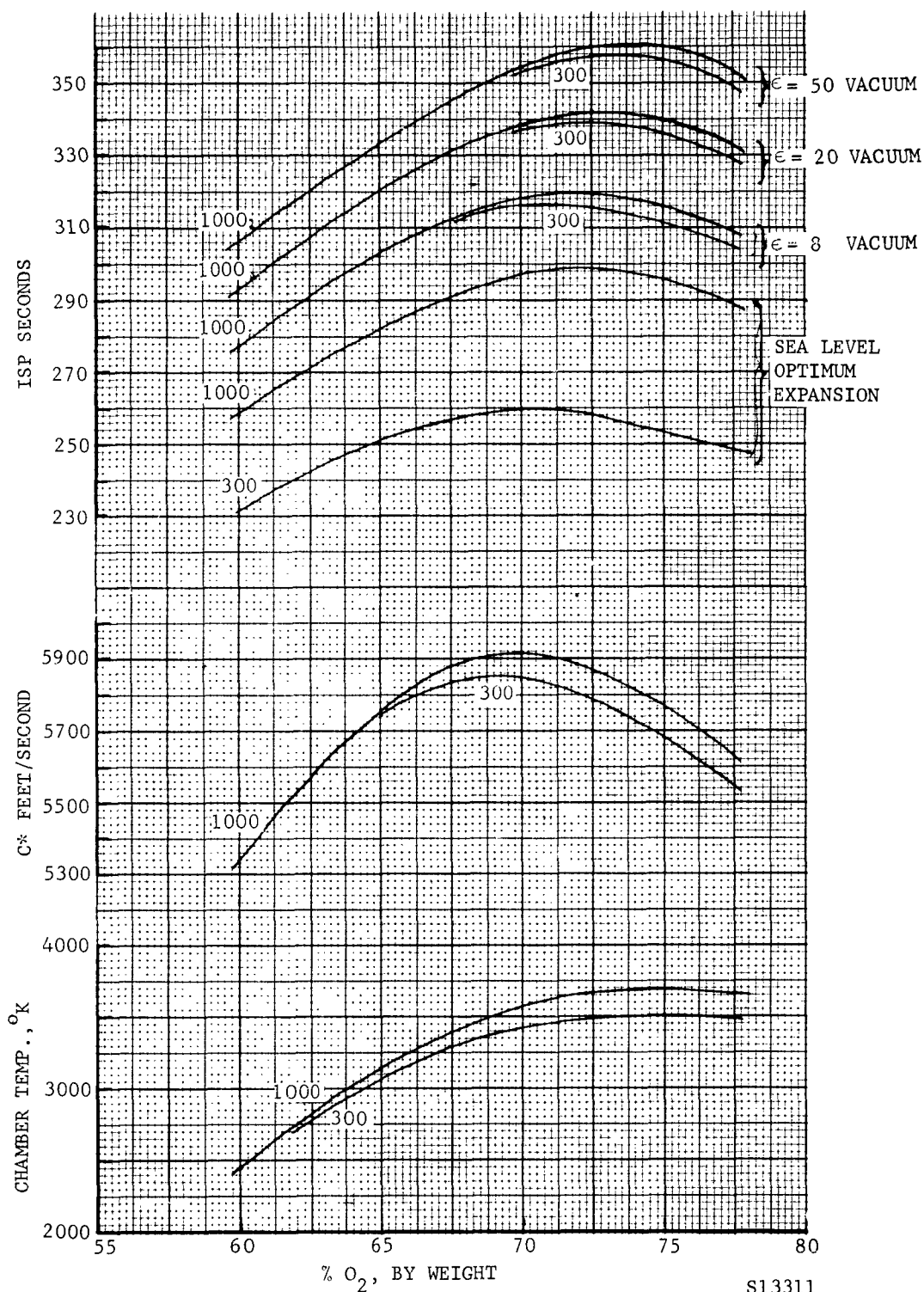


FIGURE 12b. $O_2 - H_2$ SYSTEM - SHIFTING EXPANSION



S13310

FIGURE 13a. O₂ - RP1 SYSTEM - FROZEN EXPANSION



S13311

FIGURE 13b. O₂ - RP1 SYSTEM - SHIFTING EXPANSION

SECTION 5

DETAILED DATA PRESENTATION

PRESENTATION AND NOMENCLATURE FOR MACHINE

In the following, computer output sheets are presented, arranged in order of increasing oxidizer/fuel ratio, with results given first at 1000 psia chamber pressure and then at 300 psia. Two computer output sheets are given for each chamber pressure and mixture ratio. The first computer sheet gives as a heading the mixture data, chamber pressure, heats of formation of propellants, the assumed temperature (the reference temperature) at which each ingredient is fed, the bulk density and the mixture ratio. Following this are the pressure profile data and compositions at each profile point. The second page gives performance data at interpolated whole number values of area ratio for both frozen and shifting expansion, from 1 through 50, and at sea level optimum expansion. All results assume zero divergence angle.

Nomenclature used is as follows:

TREF, DEG K	= propellant feed temperature, °K.
CHAMBER ENTROPY	= EU/100 grams = cal/100 grams -°K.
ENTHALPY (-)	= the negative of the enthalpy, kcal/100 gms of combustion products
CP	= specific heat at constant pressure, cal/gm-°K.
X BAR	= moles of gas per 100 grams of combustion products.

N	= total moles per 100 grams of propellant including the moles of condensed phase.
P_c/P	= chamber pressure divided by exhaust pressure.
I OPT	= specific impulse assuming the ambient pressure equals the exhaust pressure (optimum expansion)
DELVAC	= increment in specific impulse between I OPT and specific impulse under vacuum conditions.
DELVAC/P	= DELVAC divided by exhaust static pressure.
I SEA LVL	= specific impulse at the specified area ratio assuming a 14.696 psia ambient.
I AT 10000	= specific impulse at the specified area ratio assuming a 10.26 ₉₅ psia ambient.
I AT 50000	= the same, assuming a 1.70 ₅₈ psia ambient.
I VAC	= the same, assuming a vacuum ambient.
CF SEA LVL	= thrust coefficient at the specified area ratio at sea level.
CF VAC	= thrust coefficient at the specified area ratio under vacuum conditions.

Blanks are shown in C_p values where interpolation is thought to be hazardous. In these cases heat capacity as a function of area ratio or exhaust pressure can be estimated by examining the original pressure profile data (the first page of the output). The reasons for this were discussed in Section 3.

REFERENCES

1. White, W. B., Johnson, S. M. and Dantzig, G. B., Chem. Phys., 28, p. 751-755 (1958).
2. Kubert, B. R. and Stephanou, S. E., in "Kinetics, Equilibria and Performance of High Temperature Systems," p. 166, Butterworths, 1960.
3. Oliver, R. C., Kubert, B. R. and Hildenbrand, D. L., Final Report, Study of Metal Additives for Solid Propellants, Vol. I of II, Procedures, Contract NOrd 17980, 30 September 1961. Aeronutronic Publication No. C-1398.
4. Oliver, R. C., Stephanou, S. E. and Baier, R. W., Chem. Eng., p. 121, February 19, 1962.
5. Wilkins, R. L. and Weiher, J. D., "Propellant Performance Manual," Rocketdyne R-669, February 1, 1959.
6. Gordon, S. and Zeleznik, F. J., ARS Journal, 32, p. 1195-1202, August 1962.
7. Hildenbrand, D. L., Study of Metal Additives for Solid Propellants, 12th Quarterly Progress Report, Contract NOrd 17980, Aeronutronic Publication C-1010, October 15, 1960 (CONFIDENTIAL).
8. Hildenbrand, D. L., An Experimental Program for Obtaining Thermodynamic Properties of Propellant Combustion Products, Contract N0w 61-0905-C, Task 1C, 15 March 1962, Aeronutronic Publication U-1606.
9. COSPAR International Reference Atmosphere, 1961, Interscience Publishers, Inc., New York.
10. Stephanou, S. E., Oliver, R. C. and Larson, L., Theoretical Performance of Pentaborane-Hydrazine and Pentaborane-Hydrogen Peroxide Propellants, Aeronutronic Publication C-968, 15 August 1960 (CONFIDENTIAL).

$\text{ClF}_3 - \text{N}_2\text{H}_4$ SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.882 -44.35 55.
 298 N2*H4 1.004 12.05 45.

BULK DENSITY = 1.35 GM/CC
 MIXTURE RATIO = 1.222 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 279.73 EU/100GMS

CHAMBER

THROAT

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	546.5
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	546.5
TEMP, DEG K	2979.7	2410.2	1936.9	1544.3	1219.8	1058.7	954.5	740.9	571.9	440.0	338.5	258.3	2594.3
ENTHALPY (-)	9.46	36.19	57.74	74.97	88.69	95.27	99.46	107.85	114.35	119.56	124.19	126.21	27.63
CP	.4753	.4626	.4475	.4309	.4132	.4045	.3986	.3878	.3813	.3766	.3767	.3752	.4671
IMPLV OPT	152.48	204.93	238.76	262.53	273.22	279.80	292.56	302.07	309.20	314.55	318.69	325.71	
IMPLV VAC	226.75	249.34	269.15	284.36	291.43	295.85	304.46	310.97	315.89	319.60	322.49	322.68	
EPSILON	1.051	1.579	2.715	4.898	6.983	9.034	16.846	31.632	59.719	113.441	214.652	1.000	

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	553.3
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	553.3
TEMP, DEG K	2979.7	2464.9	1998.7	1599.1	1266.4	1100.7	993.4	772.8	598.0	464.6	425.8	407.2	2644.5
ENTHALPY (-)	9.46	36.44	58.47	76.20	90.32	97.12	101.44	110.13	116.87	122.09	126.34	130.28	27.40
X BAR	5.415	5.410	5.403	5.402	5.402	5.402	5.402	5.402	5.400	5.387	5.228	5.048	5.416
N	5.415	5.410	5.403	5.402	5.402	5.402	5.402	5.402	5.400	5.387	5.228	5.162	5.416
CP	.5885	.5816	.4559	.4333	.4151	.4061	.4000	.3889	.3857	.4272	18.0967	20.4274	.5276
IMPLV OPT	153.20	206.49	240.95	265.22	276.14	282.87	295.94	305.68	313.02	318.87	324.19	324.92	
IMPLV VAC	228.45	251.70	271.95	287.52	294.76	299.27	308.13	314.82	319.93	324.91	329.68	324.04	
EPSILON	1.055	1.592	2.742	4.955	7.071	9.155	17.099	32.167	61.149	134.133	305.953	1.000	

	0.134	.0033	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0058
24.92 CL	.0134	.0033	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0058
-13.50 CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.5814	.5916	.5945	.5948	.5949	.5949	.5949	.5949	.5949	.5949	.5949	.5949	.5891
.00 CL2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-64.50 F*H	1.7842	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7845
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0577	.0122	.0014	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020
79.20 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	1.5988	1.6139	1.6179	1.6184	1.6184	1.6183	1.6183	1.6178	1.6154	1.5954	1.5130	1.4283	1.6103
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0002	.0001	.0001	.0001	.0001	.0001	.0002	.0005	.0021	.0154	.0185	.0130	.0001
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.4040	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4039	1.4031	1.3964	1.3690	1.3407	1.4041
-75.38 CL*H4*N/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0519	.1138	.0000

SYSTEM LIQUID BIPROPELLANT										PC 1000. PSIA									
COMPONENT										DENSITY									
LEG K										GP/CC									
298 CL+F3										1.88									
298 N2+H2O										1.004									
										HEAT FORM									
										[KCAL/FORM.WT.]									
										WT. G/O									
										54.									
										45.									
FROZEN EXPANSION																			
C STAR = 5708.8 FI/SEC																			
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAL	DELVAL	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC					
			DEG R	KCAL/100GM	GP DEG		7/P	LVL	10000	SC000									
1.000	1.000	1000.000	297.7	-7.46	.475														
1.000	1.030	546.537	2594.3	-27.63	.467	125.1	97.0	.177	270.1	220.9	222.4	222.7	1.240	1.255					
2.000	10.459	95.615	1741.6	-66.43	.440	225.2	35.9	.375	255.6	255.3	258.5	259.1	1.429	1.460					
3.000	18.870	55.134	1482.9	-77.63	.428	243.6	28.6	.538	244.2	266.6	271.2	272.1	1.489	1.531					
4.000	29.910	33.434	1321.7	-84.45	.419	255.5	24.3	.725	249.1	272.3	278.5	279.7	1.516	1.576					
5.000	41.107	24.327	1209.8	-89.10	.413	265.2	21.6	.844	243.8	275.7	283.3	284.4	1.532	1.605					
6.000	54.256	18.497	1124.9	-92.59	.408	268.9	19.7	1.068	242.9	277.6	286.7	288.6	1.538	1.626					
7.000	68.303	14.641	1057.7	-95.52	.404	271.5	18.2	1.242	242.1	278.7	289.4	291.5	1.645						
8.000	83.538	11.971	1002.5	-97.54	.401	276.8	17.0	1.421		279.2	291.4	293.8	1.656						
9.000	99.446	10.056	956.0	-99.46	.399	279.7	16.1	1.597			293.0	295.8	1.667						
10.000	116.724	8.567	916.2	-100.98	.396	282.2	15.3	1.781			294.4	297.4	1.676						
11.000	134.963	7.409	881.4	-102.36	.395	284.3	14.6	1.966			295.5	298.8	1.684						
12.000	153.558	6.495	850.8	-103.56	.393	286.1	14.0	2.151			296.4	300.1	1.691						
13.000	173.520	5.763	823.6	-104.63	.392	287.7	13.4	2.335			297.2	301.2	1.697						
14.000	194.473	5.169	799.1	-105.59	.391	289.2	13.0	2.511			297.9	302.2	1.703						
15.000	215.664	4.680	776.9	-106.45	.389	290.5	12.6	2.685			298.5	303.0	1.708						
16.000	235.973	4.274	756.7	-107.24	.389	291.7	12.2	2.852			299.0	303.6	1.712						
17.000	254.744	3.976	738.2	-107.96	.388	292.7	11.8	3.019			299.4	304.6	1.717						
18.000	278.283	3.593	721.1	-108.62	.387	293.7	11.5	3.187			299.8	305.2	1.720						
19.000	302.501	3.166	705.3	-109.23	.386	294.6	11.2	3.357			300.1	305.9	1.724						
20.000	327.108	3.055	690.6	-109.80	.386	295.5	11.0	3.524			300.3	306.4	1.727						
21.000	352.609	2.856	676.9	-110.33	.385	296.2	10.7	3.685			300.5	307.0	1.730						
22.000	378.311	2.685	664.1	-110.82	.385	297.0	10.5	3.841			300.7	307.5	1.733						
23.000	404.321	2.473	652.0	-111.26	.384	297.4	10.3	4.001			300.8	307.9	1.735						
24.000	430.552	2.423	640.7	-111.72	.384	298.3	10.1	4.145			300.9	308.4	1.738						
25.000	456.921	2.189	630.0	-112.12	.383	298.9	9.9	4.285			301.0	308.8	1.740						
26.000	483.255	2.066	620.0	-112.51	.383	299.4	9.7	4.421			301.1	309.1	1.742						
27.000	509.748	1.762	610.4	-112.84	.383	299.9	9.5	4.557			301.2	309.5	1.744						
28.000	536.167	1.865	601.3	-113.23	.382	300.5	9.4	4.691			301.3	309.9	1.746						
29.000	562.448	1.778	592.7	-113.56	.382	300.9	9.3	4.825			301.3	310.2	1.748						
30.000	588.599	1.699	584.5	-113.87	.382	301.4	9.1	4.963			310.5		1.750						
31.000	614.601	1.627	576.6	-114.17	.381	301.8	9.0	5.101			310.8		1.752						
32.000	640.210	1.557	569.1	-114.45	.381	302.2	8.8	5.245			311.1		1.753						
33.000	673.187	1.485	561.9	-114.71	.381	302.6	8.7	5.384			311.3		1.755						
34.000	704.651	1.419	555.1	-114.99	.381	303.0	8.6	5.525			311.6		1.756						
35.000	736.576	1.358	548.5	-115.24	.381	303.4	8.5	5.657			311.8		1.758						
36.000	768.932	1.301	542.1	-115.50	.381	303.7	8.4	5.791			311.9		1.759						
37.000	801.683	1.247	536.0	-115.72	.380	304.0	8.3	5.926			312.3		1.760						
38.000	834.755	1.198	530.1	-115.94	.380	304.4	8.2	6.061			312.5		1.761						
39.000	868.275	1.152	524.5	-116.16	.380	304.7	8.1	6.202			312.7		1.763						
40.000	901.969	1.109	519.0	-116.36	.380	305.0	8.0	6.341			313.0		1.764						
41.000	935.962	1.068	513.8	-116.56	.380	305.2	7.9	6.481			313.2		1.765						
42.000	970.161	1.031	508.7	-116.76	.380	305.5	7.8	6.621			313.3		1.766						
43.000	1004.553	.995	503.8	-116.94	.380	305.8	7.7	6.775			313.5		1.767						
44.000	1039.168	.962	499.0	-117.12	.380	306.0	7.7	6.926			313.7		1.768						
45.000	1073.875	.931	494.4	-117.30	.380	306.3	7.6	7.075			313.9		1.769						
46.000	1108.680	.902	489.7	-117.47	.379	306.5	7.5	7.225			314.0		1.770						
47.000	1143.562	.874	485.4	-117.63	.379	306.8	7.4	7.374			314.2		1.771						
48.000	1178.451	.849	481.4	-117.76	.379	307.0	7.4	7.521			314.4		1.772						
49.000	1213.443	.824	477.3	-117.95	.379	307.3	7.3	7.667			314.5		1.773						
50.000	1248.556	.801	473.4	-118.10	.379	307.4	7.2	7.813			314.7		1.773						
6.993	68.046	14.696	1058.7	-95.27	.404	275.2	14.2	1.235	275.2	278.7	289.3	291.4	1.540	1.642					

SHIFTING EXPANSION													
C STAN = SPAS.H FE/SEL													
EPSILON	PC/P	P PSIA	ENTHALPY	CP CAL/G	OPF	FELVAL	FELVAL	I SEA	I SEA	I T	I VAC	CF SEA	CF VAC
			DEU K	KCAL/1000G	CM DEG		/P	LVL	AT 10000	AT 50000		LVL	
1.000	1.000	10000.000	2974.7	-74.4E	-589								
1.000	1.000	1.595 111	2974.7	-74.4E	-589	224.4	90.1	-1.79	221.4	221.7	224.4	1.251	1.236
1.000	10.245	97.606	1869.0	-67.0E	-443	124.4	36.9	-3.74	235.8	252.4	260.7	281.3	1.428
1.000	18.493	53.473	1362.6	-78.0E	-430	245.4	22.5	-5.94	266.7	269.1	281.8	276.7	1.489
5.000	29.437	34.904	1377.0	-65.7E	-421	254.4	24.9	-7.53	271.7	275.4	281.2	282.5	1.517
5.000	40.370	34.773	1261.7	-58.1E	-405	264.4	21.5	-8.89	274.5	276.5	280.2	287.7	1.535
6.000	53.376	18.455	1045.4	-49.4E	-311	271.4	20.2	-10.79	275.7	285.5	280.7	291.6	1.559
7.000	67.055	14.713	1165.1	-36.2E	-404	275.7	18.7	-12.54	276.1	281.7	292.4	294.6	1.581
8.000	81.944	12.204	1048.1	-49.25	-403	274.5	17.5	-14.45		282.3	294.5	297.0	
9.000	97.519	10.752	1000.2	-101.17	-460	282.5	16.5	-15.95					1.658
10.000	114.44	9.44	944.0	-162.9	-498	289.7	15.7	-17.97			297.6	300.7	1.678
11.000	132.167	7.566	923.1	-164.24	-594	287.1	15.0	-17.94			299.8	302.2	1.687
12.000	150.745	6.634	891.4	-185.49	-594	288.4	14.0	-17.70			299.7	303.4	1.694
13.000	169.859	5.886	863.2	-166.60	-593	296.7	13.7	-2.355			300.6	304.6	
14.000	189.458	5.277	837.8	-167.86	-593	292.2	13.0	-5.338			301.3	305.8	1.700
15.000	209.272	4.778	814.8	-168.56	-591	295.5	13.0	-7.712			301.9	306.5	1.711
16.000	229.220	4.363	793.8	-169.32	-590	294.7	12.6	-2.893			302.4	307.3	1.715
17.000	249.217	4.013	774.6	-170.06	-588	295.8	12.2	-3.047			302.9	308.1	1.720
18.000	271.907	3.677	756.8	-170.75	-588	296.8	11.9	-2.37			303.2	308.9	1.723
19.000	295.532	3.364	744.4	-171.59	-586	296.8	11.6	-1.81			303.5	309.4	1.730
20.000	319.747	3.127	725.1	-171.98	-586	296.6	11.5	-3.625			304.0	310.0	1.730
21.000	344.464	2.963	710.9	-172.55	-585	299.4	11.1	-3.818			304.6	310.5	1.735
22.000	369.592	2.766	697.7	-173.04	-585	300.2	10.8	-0.059			304.7	311.0	1.736
23.000	395.044	2.535	685.1	-173.53	-584	300.9	10.6	-0.199			304.8	311.5	1.741
24.000	420.717	2.377	673.1	-173.98	-584	301.5	10.4	-0.386			304.9	312.0	1.744
25.000	446.575	2.259	662.7	-174.44	-584	302.2	10.2	-0.569			304.9	312.4	1.741
26.000	472.500	2.116	651.8	-174.81	-584	302.7	10.1	-0.749			304.7	312.9	1.740
27.000	498.440	2.006	641.9	-175.14	-584	303.1	9.9	-0.925			304.6	313.2	1.746
28.000	524.396	1.922	632.5	-175.55	-585	303.5	9.7	-0.092			304.5	313.7	1.748
29.000	550.148	1.818	623.6	-175.89	-584	304.1	9.4	-0.263			304.9	313.9	1.752
30.000	575.832	1.737	615.1	-176.22	-585	304.7	9.4	-0.526			304.9	314.2	1.754
31.000	601.367	1.686	607.0	-176.53	-585	305.2	9.3	-0.584			304.5	314.5	1.755
32.000	626.737	1.565	597.1	-176.83	-586	305.5	9.2	-0.737			304.7	314.8	1.758
33.000	652.064	1.529	591.6	-177.11	-588	306.0	9.0	-0.922			304.8	315.0	1.759
34.000	676.932	1.456	584.1	-177.59	-588	306.4	8.9	-0.114			304.3	315.3	1.760
35.000	718.156	1.392	572.7	-177.65	-587	306.8	8.8	-0.506			304.6	315.6	1.762
36.000	749.821	1.334	570.2	-177.91	-592	307.1	8.7	-0.649			304.7	315.8	1.764
37.000	781.693	1.279	563.6	-178.15	-592	307.5	8.6	-0.811			304.7	316.1	1.764
38.000	814.450	1.228	557.4	-178.36	-589	307.8	8.5	-0.894			304.5	316.3	1.765
39.000	847.113	1.181	551.4	-178.61	-589	308.1	8.4	-0.740			304.6	316.5	1.768
40.000	880.185	1.136	545.6	-178.83	-583	308.4	8.3	-1.268			304.7	316.7	1.767
41.000	913.515	1.095	540.4	-179.04	-584	308.9	8.2	-0.404			304.9	316.9	1.769
42.000	947.065	1.059	534.7	-179.24	-587	309.0	8.1	-1.650			304.7	317.1	1.770
43.000	980.756	1.020	529.6	-179.43	-587	309.3	8.0	-1.839			304.7	317.3	1.771
44.000	1014.670	0.986	524.7	-179.62	-540	309.6	7.9	-0.028			304.7	317.5	1.772
45.000	1048.649	0.954	520.0	-179.80	-535	309.8	7.8	-0.215			304.7	317.7	1.774
46.000	1082.695	0.922	515.4	-179.98	-535	310.0	7.7	-0.404			304.8	317.8	1.774
47.000	1116.776	0.895	511.1	-120.15	-562	310.3	7.7	-0.804			308.0	318.0	1.775
48.000	1150.851	0.869	506.9	-120.32	-554	310.5	7.6	-0.586			308.2	318.2	1.776
49.000	1184.887	0.844	502.8	-120.48	-538	310.8	7.5	-0.896			308.3	318.3	1.777
50.000	1218.856	0.820	499.0	-120.63	-515	311.0	7.5	-1.195			308.4	318.4	1.778
			1000.0	-120.72	-506	277.7	18.6	-1.267	276.1	281.8	292.6	294.8	1.541

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA
 COMPONENT IMEF FORMULA DENSITY HEAT FORM WT. O/O
 LEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.88 -44.35 65.
 298 H2*H4 1.004 12.05 35.

BULK DENSITY = 1.440 GM/CC
 MIXTURE RATIO = 1.85/ LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRUPY 257.98 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	543.9
TEMP, DEG K	3502.4	2834.3	2281.4	1823.9	1446.2	1258.1	1136.0	884.2	683.1	525.2	403.0	309.0	3046.7
ENTHALPY (-)	18.02	45.71	68.06	86.00	100.29	107.18	111.57	120.49	127.23	132.50	136.54	139.64	36.98
CP	.4190	.4095	.3983	.3852	.3705	.3619	.3563	.3442	.3363	.3319	.3301	.3289	.4128
IMPELL CPT	155.20	208.65	243.19	267.53	279.51	285.27	298.42	308.23	315.58	321.11	325.28	328.42	
IMPELL VAC	230.85	253.94	274.26	289.92	297.22	301.77	310.69	317.41	322.47	326.30	329.21	328.67	
EPSILON	1.052	1.542	2.725	4.934	7.047	9.129	17.067	32.058	60.472	114.543	217.774	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	558.3
TEMP, DEG K	3502.4	2992.6	2501.5	2039.6	1634.7	1429.8	1295.9	1017.5	791.9	612.5	472.3	404.1	3177.1
ENTHALPY (-)	18.02	46.28	69.95	89.40	105.10	112.73	117.61	127.48	135.20	141.19	145.82	149.48	36.46
X HAK	4.791	4.728	4.695	4.684	4.682	4.682	4.682	4.682	4.682	4.682	4.681	4.599	4.748
N	4.791	4.728	4.695	4.684	4.682	4.682	4.682	4.682	4.682	4.682	4.681	4.625	4.748
CP	.6899	.5641	.4594	.4016	.3773	.3676	.3614	.3477	.3371	.3313	.3329	13.0082	.6102
IMPELL CPT	156.40	212.55	249.19	275.23	287.05	294.35	308.59	319.29	327.34	333.43	338.17	342.66	
IMPELL VAC	234.81	260.41	282.34	299.28	307.21	312.17	321.94	329.32	334.91	339.16	342.92	342.92	
EPSILON	1.063	1.634	2.848	5.190	7.440	9.664	18.179	34.348	65.087	123.733	257.640	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
28.92 CL	.0766	.0342	.0075	.0013	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0480
-13.50 CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.6260	.6687	.6935	.7017	.7029	.7030	.7030	.7030	.7030	.7030	.7030	.6769	.6548
.00 CL2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
18.86 F	.0057	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0021
-64.50 F*H	2.1034	2.1080	2.1090	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1070
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1359	.0562	.0147	.0019	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0811
79.20 F*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.7514	.7677	.7757	.7774	.7781	.7781	.7781	.7781	.7781	.7781	.7781	.7781	.7627
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 H2	1.0920	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921
-75.38 CL*F4*H/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0262	.0000

SYSTEM LIQUID R/PROPELLANT										PC 1000 PSIA		HEAT FROM		WT. D/O	
COMPONENT										DENSITY		(KCAL/FORM.WT.)			
DEG K										GM/CC		-44.35		65.	
298 CL+FT										1.004		12.05		35.	
298 N2+H2										FROZEN EXPANSION					
										C STAR = 5813.4 FT/SEC					
										CP CAL / I OPT DELVAC		I SEA		I AT	
										/P		LVL		10000	

PRESSURE PROFILE DATA
 SYSTEM LIQUID: HIPROPELLANT PC 10CC PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/B
 (EG K GM/CC (KCAL/FORM.WT.)
 29H CL-F1 1.88 -44.45 70.
 29H N2-H4 1.004 +12.05 50.

BULK DENSITY = 1.543 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 245.9C EU/100GMS

CHAMBER

THRUST

	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	543.4
TEMP, DEG K	3750.3	3029.4	2434.8	1944.7	1541.4	1340.7	1210.5	941.9	727.1	558.3	427.5	327.4	3257.0
ENTHALPY (-)	22.30	50.00	12.47	90.42	104.70	111.59	115.97	124.74	131.61	136.87	140.90	143.98	41.35
CP	.3894	.3810	.3715	.3603	.3474	.3345	.3236	.3122	.3011	.2905	.2805	.2704	.3880
IMPELL OPT	155.45	208.92	243.43	267.13	278.70	285.46	298.58	304.37	315.70	321.21	323.35	328.75	128.75
IMPELL VAC	231.15	254.19	274.47	290.10	297.39	301.93	310.84	317.53	322.57	326.38	329.26	331.03	227.03
EPSILON	1.051	1.579	2.719	4.922	7.030	9.107	11.017	12.949	14.891	16.795	18.616	20.350	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	560.0
TEMP, DEG K	3750.3	3252.5	2777.8	2513.0	1875.7	1647.6	1497.3	1182.6	925.2	718.0	554.2	426.8	3433.2
ENTHALPY (-)	22.30	50.00	74.99	95.21	111.77	119.87	125.07	135.63	143.93	150.40	155.41	159.27	40.77
X BAR	4.493	4.413	4.357	4.330	4.323	4.323	4.323	4.323	4.323	4.322	4.322	4.322	4.440
N	4.493	4.413	4.357	4.330	4.323	4.323	4.323	4.323	4.323	4.322	4.322	4.322	4.440
CP	.7551	.6540	.5084	.4098	.3623	.3493	.3425	.3285	.3166	.3083	.3037	.3047	.6800
IMPELL OPT	157.48	214.10	251.85	278.98	291.34	299.00	313.99	325.29	333.83	340.29	345.19	348.77	126.77
IMPELL VAC	236.27	262.97	286.23	304.12	312.48	317.72	328.06	335.92	341.86	346.38	349.81	350.73	230.73
EPSILON	1.066	1.661	2.936	5.390	7.748	10.082	12.046	13.612	14.824	15.624	16.059	16.189	1.000

	COMPOSITION SHIFTING (MOL/100 GM)												
28.92 CL	.1658	.0966	.0403	.0096	.0010	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.1216
-13.50 CL-F	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL-F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL-F	.5901	.6595	.7166	.7475	.7561	.7569	.7571	.7571	.7571	.7571	.7571	.7571	.6347
.00 CL2	.0006	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
18.86 F	.0172	.0051	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0087
-64.50 F-H	2.2520	2.2662	2.2705	2.2713	2.2713	2.2713	2.2713	2.2713	2.2713	2.2713	2.2713	2.2713	2.2625
58.60 F-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1566	.0789	.0289	.0062	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.1048
79.20 F-H	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 F2	.3727	.3696	.3642	.3597	.3582	.3580	.3580	.3580	.3580	.3580	.3579	.3579	.3571
40.30 F2-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 N2	.9359	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9361	.9360

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/D
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.88 -44.35 75.
 298 N2*H4 1.004 +12.05 25.

BULK DENSITY = 1.543 GM/CC
 MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 232.72 EU/100GMS

CHAMBER

THRUST

	IC00	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	542.1
PRESSURE, PSIA	1000	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	542.1
TEMP, DEG K	3928.0	3159.6	2529.3	2012.7	1589.7	1380.0	1244.3	965.2	742.8	568.7	434.3	331.7	3400.4
ENTHALPY (-)	26.58	53.86	75.77	93.25	107.12	113.79	118.03	126.53	133.09	138.14	141.97	144.92	45.37
CP	.3583	.3515	.3433	.3330	.3214	.3148	.3095	.2992	.2912	.2818	.2761	.2849	.3537
IMPLL OPT	154.07	206.87	240.84	264.70	275.45	282.06	294.87	304.41	311.53	316.67	320.86	327.87	127.87
IMPLL VAC	228.94	251.50	271.35	286.63	293.74	298.16	306.82	313.31	318.19	321.87	324.64	324.95	
EPSILON	1.050	1.573	2.700	4.873	6.949	8.992	16.759	31.382	58.980	111.220	210.713	1.000	

	IC00	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	561.8
PRESSURE, PSIA	1000	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	561.8
TEMP, DEG K	3928.0	3433.2	2965.9	2508.1	2050.4	1818.7	1673.6	1368.8	1092.5	854.4	662.2	511.0	3614.4
ENTHALPY (-)	26.58	54.71	78.74	99.05	115.82	124.08	129.42	140.49	149.41	156.44	161.92	166.15	44.70
X BAR	4.223	4.139	4.074	4.033	4.019	4.008	3.997	3.973	3.964	3.963	3.963	3.963	4.168
N	4.223	4.139	4.074	4.033	4.019	4.008	3.997	3.973	3.964	3.963	3.963	3.963	4.168
CP	.7764	.6599	.5435	.4184	.3582	.3792	.3897	.3532	.3058	.2884	.2816	.2783	.7035
IMPLL OPT	156.45	213.03	251.09	278.63	291.24	299.11	314.80	326.89	336.12	343.13	348.45	357.57	
IMPLL VAC	234.98	262.07	285.92	304.19	312.87	318.45	329.73	338.34	344.83	349.74	353.48	359.30	
EPSILON	1.068	1.676	2.990	5.512	7.974	10.473	20.317	39.138	74.751	142.558	272.103	1.000	

	IC00	396.1	158.5	63.10	25.12	14.70	10.00	3.991	1.585	.631	.251	.100	3050
28.92 CL	.3471	.2771	.1992	.1375	.1115	.0906	.0686	.0199	.0021	.0001	.0000	.0000	.3050
-13.50 CL*F	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
-38.87 CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*F	.4598	.5309	.6093	.6704	.6865	.6868	.6868	.6868	.6868	.6868	.6868	.6868	.5027
.CC CL2	.0018	.0015	.0013	.0016	.0066	.0168	.0279	.0523	.0612	.0622	.0622	.0622	.0016
18.86 F	.0664	.0254	.0075	.0017	.0033	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0374
-64.50 F*H	2.3666	2.4080	2.4260	2.4318	2.4332	2.4334	2.4335	2.4336	2.4336	2.4336	2.4336	2.4336	2.3958
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1065	.0504	.0161	.0022	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0690
79.20 F*H	.0021	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC F2	.0936	.0655	.0345	.0079	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0764
40.30 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.CC A2	.7799	.7800	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7800

SYSTEM LIQUID MONOPROPELLANT										PC 1000 PSIA									
COMPONENT										DENSITY									
REF. FORMULA										HEAT FORM									
CEG K										G/CC									
298 CL+FS										1.000									
298 HZ+H										1.000									
										-44.35									
										+12.05									
										75.									
										75.									

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.880 -44.35 80.
 298 N2*H4 1.004 +12.05 20.

BULK DENSITY = 1.601 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 217.4C EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	537.7
TEMP, DEG K	3588.8	2848.4	2244.5	1762.9	1370.8	1179.2	1056.6	808.3	615.3	467.1	354.5	267.5	5073.1
ENTHALPY (-)	30.85	54.71	73.59	88.46	100.06	105.58	109.05	115.95	121.22	125.23	128.25	130.58	47.52
CP	.3753	.3187	.3106	.3009	.2909	.2850	.2815	.2747	.2713	.2696	.2683	.2670	.3209
IMPUL OPT		144.05	192.82	223.85	245.37	254.96	260.81	272.08	280.38	286.53	291.08	294.54	120.41
IMPUL VAC		213.55	233.81	251.53	265.01	271.21	275.05	282.52	288.09	292.25	295.36	297.74	210.12
EPSILON		1.046	1.550	2.629	4.685	6.630	8.534	15.719	29.168	54.424	102.146	191.312	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	549.4
TEMP, DEG K	3588.8	2981.6	2515.6	2169.4	1896.7	1757.3	1662.2	1439.4	1204.9	964.1	754.5	587.0	3179.2
ENTHALPY (-)	30.85	55.15	75.19	91.98	106.25	113.58	118.45	128.90	137.69	144.84	150.48	154.88	47.17
X HAK	4.066	4.031	3.970	3.886	3.795	3.745	3.712	3.648	3.612	3.603	3.603	3.603	4.045
N	4.066	4.031	3.970	3.886	3.795	3.745	3.712	3.648	3.612	3.603	3.603	3.603	4.045
CP	.4342	.4558	.5632	.6687	.6960	.6650	.6231	.4790	.3381	.2772	.2650	.2610	.4354
IMPUL OPT		145.31	196.39	230.60	256.10	268.26	276.05	292.04	304.86	314.89	322.60	328.48	119.15
IMPUL VAC		216.82	240.36	262.21	280.39	289.47	295.38	307.59	317.20	324.43	329.88	334.04	212.47
EPSILON		1.057	1.633	2.948	5.694	8.496	11.375	22.983	45.845	88.986	170.736	327.693	1.000
COMPOSITION SHIFTING (MCL/100 GM)													
28.92 CL	.6703	.6831	.6216	.4958	.3447	.2581	.1997	.0837	.0180	.0013	.0000	.0000	.6857
-13.50 CL*F	.0099	.0180	.0327	.0510	.0690	.0782	.0840	.0941	.0986	.0995	.0995	.0995	.0144
-28.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*F	.1552	.0918	.0466	.0214	.0089	.0050	.0032	.0009	.0001	.0000	.0000	.0000	.1127
.00 CL2	.0149	.0361	.0822	.1486	.2213	.2620	.2892	.3433	.3742	.3822	.3828	.3829	.0263
18.86 F	.2510	.1737	.1134	.0699	.0395	.0263	.0188	.0063	.0010	.0001	.0000	.0000	.1988
-64.50 F*H	2.3348	2.4041	2.4496	2.4747	2.4874	2.4912	2.4931	2.4954	2.4961	2.4962	2.4963	2.4963	2.3825
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0048	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009
79.20 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
40.30 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
115.00 H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	.6240	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241

SYSTEM LIQUID BIPROPELLANT														PC ICCO PSIA				
COMPONENT		TREF FORMULA		DENSITY		HEAT FORM		WT. O/O										
LEG K		LEG K		GW/CC		1 BTU		44.35		80.		20.						
200 C14F5		200 C14F5		1.000		+12.05												
200 N2H4		200 N2H4		1.000		+12.05												
FROZEN EXPANSION																		
C STAR = 5160.5 FT/SEC																		
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP GM DEG	CAL/1 OPT	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC
1.000	1.000	1000.000	1500.0	-30.85	.525													
1.000	1.000	537.652	1073.1	-47.52	.521	120.4	89.7	.167	207.7	208.4	209.8	210.1	1.245	1.259				
2.000	1.000	90.491	1091.6	-51.84	.506	211.2	32.2	.355	238.2	239.8	242.8	243.4	1.428	1.459				
3.000	19.974	50.066	1062.7	-51.46	.299	229.7	25.4	.507	247.6	249.9	254.7	255.1	1.488	1.529				
4.000	31.758	31.449	1067.1	-97.25	.204	240.4	21.4	.681	251.8	254.8	260.6	261.0	1.509	1.569				
5.000	44.144	22.653	1332.6	-101.17	.290	247.3	18.9	.850	254.0	257.7	264.8	266.3	1.522	1.596				
6.000	58.556	17.078	1231.4	-104.05	.287	252.4	17.1	1.004	254.8	259.7	267.8	269.6	1.527	1.616				
7.000	72.000	13.512	1151.7	-104.56	.284	256.3	15.8	1.169	260.1	260.1	270.1	272.1	1.631					
8.000	90.755	11.019	1096.8	-108.20	.282	259.4	14.7	1.336	266.4	271.8	274.1		1.643					
9.000	108.599	9.208	1052.4	-109.73	.281	261.9	13.9	1.504		273.2	275.8		1.654					
10.000	127.935	7.816	985.9	-111.03	.279	264.1	13.1	1.678		274.4	277.2		1.661					
11.000	148.280	6.744	945.6	-112.16	.278	266.0	12.5	1.853		275.3	278.4		1.669					
12.000	169.356	5.903	910.1	-113.14	.277	267.5	12.0	2.025		276.1	279.5		1.675					
13.000	191.051	5.234	878.7	-114.01	.277	269.0	11.5	2.193		276.7	280.4		1.681					
14.000	213.041	4.694	850.5	-114.79	.276	270.2	11.1	2.356		277.3	281.3		1.686					
15.000	235.206	4.252	825.1	-115.49	.275	271.1	10.7	2.514		277.7	282.0		1.690					
16.000	258.306	3.871	802.0	-116.14	.275	272.4	10.3	2.673		278.1	282.7		1.694					
17.000	284.213	3.516	780.8	-116.74	.274	273.1	10.0	2.835		278.5	283.3		1.698					
18.000	310.917	3.216	761.4	-117.24	.274	274.1	9.8	3.003		278.7	283.9		1.701					
19.000	338.355	2.955	743.8	-117.73	.273	274.9	9.5	3.215		278.9	284.4		1.705					
20.000	366.344	2.730	726.4	-118.19	.273	275.6	9.3	3.394		279.1	284.9		1.707					
21.000	394.780	2.533	711.3	-118.63	.273	276.3	9.0	3.571		279.3	285.3		1.710					
22.000	423.543	2.361	696.8	-119.00	.273	276.9	8.8	3.745		279.4	285.6		1.713					
23.000	452.519	2.210	683.3	-119.37	.272	277.5	8.7	3.915		279.5	286.2		1.715					
24.000	481.008	2.076	670.6	-119.72	.272	278.0	8.5	4.082		279.6	286.5		1.717					
25.000	510.220	1.958	658.6	-120.00	.272	278.5	8.3	4.248		279.6	286.9		1.719					
26.000	539.780	1.853	647.3	-120.35	.272	279.0	8.2	4.401		279.7	287.2		1.721					
27.000	568.730	1.758	636.6	-120.64	.272	279.5	8.0	4.553		279.7	287.5		1.723					
28.000	597.532	1.674	626.5	-120.91	.271	279.9	7.9	4.700		279.8	287.8		1.725					
29.000	626.161	1.597	616.9	-121.18	.271	280.3	7.7	4.843		279.8	288.0		1.726					
30.000	654.241	1.517	607.7	-121.43	.271	280.7	7.6	4.981		279.9	288.3		1.728					
31.000	683.830	1.441	598.9	-121.66	.271	281.1	7.5	5.119		279.9	288.6		1.729					
32.000	729.019	1.372	590.6	-121.89	.271	281.4	7.4	5.277		279.9	288.8		1.731					
33.000	764.765	1.308	582.6	-122.11	.271	281.8	7.3	5.457		279.9	289.0		1.732					
34.000	801.022	1.248	574.9	-122.31	.271	282.1	7.2	5.631		279.9	289.2		1.733					
35.000	837.743	1.194	567.6	-122.51	.271	282.4	7.1	5.818		279.9	289.4		1.735					
36.000	874.883	1.145	560.6	-122.70	.271	282.7	7.0	6.007		279.9	289.6		1.736					
37.000	912.355	1.096	553.8	-122.88	.271	283.0	6.9	6.276		279.9	289.8		1.737					
38.000	950.232	1.052	547.1	-123.06	.270	283.3	6.8	6.543		279.9	290.0		1.738					
39.000	988.349	1.012	541.1	-123.23	.270	283.5	6.7	6.829		279.9	290.2		1.739					
40.000	1026.702	.974	535.0	-123.39	.270	283.7	6.6	7.104		279.9	290.4		1.740					
41.000	1065.248	.939	529.2	-123.55	.270	284.0	6.5	7.376		279.9	290.5		1.741					
42.000	1103.945	.906	523.6	-123.70	.270	284.2	6.5	7.647		279.9	290.7		1.742					
43.000	1142.754	.875	518.2	-123.85	.270	284.4	6.4	7.917		279.9	290.8		1.743					
44.000	1181.642	.846	513.0	-123.99	.270	284.6	6.3	8.183		279.9	291.0		1.744					
45.000	1220.570	.819	507.9	-124.12	.270	284.9	6.3	8.448		279.9	291.1		1.745					
46.000	1259.509	.794	503.0	-124.26	.270	285.1	6.2	8.710		279.9	291.3		1.746					
47.000	1298.451	.770	498.2	-124.39	.270	285.2	6.1	8.970		279.9	291.4		1.746					
48.000	1337.310	.748	493.6	-124.51	.270	285.4	6.1	9.228		279.9	291.5		1.747					
49.000	1376.124	.727	489.2	-124.63	.270	285.6	6.0	9.483		279.9	291.6		1.748					
50.000	1414.857	.707	484.8	-124.75	.270	285.8	6.0	9.736		279.9	291.8		1.749					
6.630	68.046	14.696	1179.2	-105.58	.285	255.0	16.3	1.106	255.0	259.9	269.3	271.2	1.528	1.625				

SHIFTING EXPANSION																		
C STAR = 5485.2 FT/SEC																		
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP GM DEG	CAL/1 OPT	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC	DELTA VAC
1.000	1.000	1000.000	3588.8	-30.85	.434													
1.000	1.000	540.171	3179.2	-47.17	.435	119.1	93.3	.170	210.0	210.7	212.2	212.5	1.251	1.236				
2.000	9.551	104.703	2369.8	-81.90	.406	211.4	37.5	.358	245.6	245.2	248.3	248.9	1.434	1.465				
3.000	16.299	61.952	2161.0	-92.41	.471	251.4	31.3	.511	255.3	257.5	261.9	262.8	1.503	1.547				
4.000	25.215	36.659	2032.6	-99.04	.493	243.6	27.6	.697	261.0	264.1	270.1	271.3	1.537	1.597				
5.000	34.020	29.394	1944.6	-103.69	.498	251.8	25.4	.865	264.5	268.1	275.7	277.2	1.557	1.632				
6.000	42.806	23.541	1877.6	-107.64	.494	257.1	23.1	1.021	266.7	271.2	279.9	281.7	1.570	1.658				
7.000	52.750	18.943	1823.1	-110.13	.484	262.6	22.6	1.194	267.1	273.0	283.2	285.2	1.576	1.679				
8.000	62.949	15.886	1777.5	-112.53	.472	266.6	21.6	1.362	268.2	274.2	285.9	288.2	1.579	1.697				
9.000	73.504	13.605	1738.7	-114.57	.458	269.9	20.8	1.530	275.0	288.1	290.7		1.711					
10.000	84.539	11.629	1703.7	-116.35	.443	272.7	20.1	1.701	275.4	289.9	292.8		1.724					
11.000	95.159	10.443	1672.9	-117.97	.429	275.2	19.5	1.870	275.5	291.5	294.7		1.735					
12.000	107.444	9.307	1645.1	-119.31	.414	277.4	19.0	2.042	275.9	292.9	296.4		1.746					
13.000	119.664	8.287	1615.7	-120.54	.399	279.2	18.5	2.218	276.1	293.1	296.9		1.757					
14.000	132.211	7.364	1586.2	-121.72	.385	281.2	18.0	2.392	276.2	293.2	297.3		1.767					
15.000	145.026	6.495	1557.4	-122.87	.371	282.8	17.7	2.571	276.3	293.3	300.5		1.769					
16.000	158.052	5.627	1534.2	-123.75	.358	284.3	17.4	2.747	276.4	293.4	301.6		1.776					
17.000	171.234	5.486	1535.1	-124.63	.345	285.6	17.1	2.921	276.5	293.5	302.7		1.782					
18.000	184.568	5.186	1527.1	-125.38	.332	286.8	16.8	3.096	276.6	293.6	303.8		1.787					
19.000	197.889	5.053	1500.0	-126.74	.321	288.1	16.5	3.262	276.7	293.7	304.9		1.795					
20.000	211.274	4.733	1483.1	-126.96	.310	289.2	16.2	3.428	276.8	293.8	305.4		1.798					
21.000	224.670	4.451	1460.8	-127.45	.300	290.2	16.0	3.591	276.9	293.9	306.2		1.802					
22.000	238.053	4.201	1453.4	-128.29	.289	291.1	15.8	3.751	277.0	294.0	306.9		1.807					
23.000	251.449	4.001	1444.9	-128.97	.279	292.1	15.5	3.907	277.1	294.1	307.6		1.811					
24.000	266.034	3.750	1425.1	-129.49	.269	292.9	15.3	4.067	277.2	294.2	308.3		1.815					
25.000	282.088	3.545	1411.7	-130.04	.260	293.7	15.1	4.268	277.3	294.3	308.9		1.818					
26.000	297.779	3.358	1398.7	-130.57	.251	294.5	14.9	4.449	277.4	294.4	309.5		1.822					
27.000	313.464	3.185	1385.8	-131.07	.243	295.3	14.7	4.629	277.5	294.5	310.1		1.825					
28.000	329.793	3.032	1373.9	-131.55	.235	296.0	14.6	4.810	277.6	294.6	310.6		1.828					
29.000	346.072	2.890	1362.2	-132.01	.228	296.7	14.4	4.990	277.7	294.7	311.1		1.831					
30.000	362.506	2.759	1350.8	-132.46	.220	297.3	14.3	5.169	277.8	294.8	311.6		1.834					
31.000	379.075	2.638	1339.7	-132.88	.213	297.9	14.1	5.348	277.9	294.9	312.0		1.837					
32.000	395.749	2.526	1328.9	-133.28	.206	298.5	14.0	5.526	278.0	295.0	312.5		1.840					
33.000	412.541	2.424	1318.5	-133.68	.200	299.1	13.8	5.700	278.1	295.1	313.2		1.842					
34.000	429.433	2.329	1308.3	-134.05	.194	299.6	13.7	5.874	278.2	295.2	313.3		1.844					
35.000	446.430	2.240	1298.4	-134.42	.188	300.2	13.5	6.047	278.3	295.3	313.7		1.847					
36.000	463.536	2.158	1288.7	-134.77	.182	300.7	13.4	6.219	278.4	295.4	314.1		1.849					
37.000	480.318	2.082	1279.4	-135.11	.177	301.2	13.3	6.386	278.5	295.5	314.5		1.851					
38.000	497.555	2.011	1270.2	-135.44	.172	301.6	13.2	6.553	278.6	295.6	314.8		1.853					
39.000	514.405	1.944	1262.2	-135.75	.167	302.1	13.1	6.717	278.7	295.7	315.1		1.855					
40.000	531.461	1.881	1252.5	-136.06	.162	302.5	12.9	6.880	278.8	295.8	315.5		1.857					
41.000	548.519	1.820	1243.9	-136.36	.158	302.9	12.8	7.043	278.9	295.9	315.8		1.859					
42.000	565.559	1.760	1235.5	-136.65	.153	303.4	12.7	7.198	279.0	296.0	316.1		1.861					
43.000	582.592	1.701	1227.3	-136.93	.149	303.8	12.6	7.355	279.1	296.1	316.4		1.863					
44.000	599.469	1.648	1219.1	-137.20	.145	304.2	12.5	7.509	279.2	296.2	316.7		1.864					
45.000	616.661	1.596	1211.1	-137.46	.141	304.6	12.4	7.661	279.3	296.3	317.0		1.866					
46.000	633.925	1.577	1203.6	-137.73	.138	304.9	12.3	7.815	279.4	296.4	317.2		1.868					
47.000	653.568	1.530	1195.8	-137.98	.135	305.3	12.2	7.994	279.5	296.5	317.5		1.869					
48.000	673.357	1.485	1188.2	-138.22	.132	305.6	12.1	8.172	279.6	296.6	317.8		1.871					
49.000	693.346	1.442	1180.6	-138.46	.129	306.0	12.0	8.351	279.7	296.7	318.0		1.872					
50.000	713.528	1.400	1173.2	-138.69	.126	306.3	11.9	8.530	279.8	296.8	318.3		1.874					
51.000	733.904	1.358	1165.7	-138.91	.123	306.6	11.8	8.710	279.9	296.9	318.6		1.876					
52.000	754.484	1.316	1157.3	-139.13	.120	306.9	11.7	8.890	280.0	297.0	318.9		1.878					
53.000	775.268	1.274	1149.0	-139.35	.117	307.2	11.6	9.071	280.1	297.1	319.2		1.880					
54.000	796.256	1.232	1140.8	-139.56	.114	307.5	11.5	9.253	280.2	297.2	319.5		1.882					
55.000	817.448	1.190	1132.6	-139.77	.111	307.8	11.4	9.436	280.3	297.3	319.8		1.884					
56.000	838.844	1.148	1124.5	-139.97	.108	308.1	11.3	9.620	280.4	297.4	320.1		1.886					
57.000	860.444	1.106	1116.4	-140.17	.105	308.4	11.2	9.805	280.5	297.5	320.4		1.888					
58.000	882.248	1.064	1108.4	-140.36	.102	308.7	11.1	9.991	280.6	297.6	320.7		1.890					
59.000	904.256	1.022	1100.5	-140.55	.100	309.0	11.0	10.178	280.7	297.7	321.0		1.892					
60.000	926.468	0.980	1092.7	-140.73	.097	309.3	10.9	10.366	280.8	297.8	321.3		1.894					
61.000	948.884	0.938	1085.0	-140.91	.094	309.6	10.8	10.555	280.9	297.9	321.6		1.896					
62.000	971.504	0.896	1077.4	-141.08	.091	309.9	10.7	10.745	281.0	298.0	321.9		1.898					
63.000	994.328	0.854	1069.9	-141.25	.088	310.2	10.6	10.936	281.1	298.1	322.2		1.900					
64.000	1017.356	0.812	1062.5	-141.41	.085	310.5	10.5	11.128	281.2	298.2	322.5		1.902					
65.000	1040.588	0.770	1055.2	-141.57	.082	310.8	10.4	11.321	281.3	298.3	322.8		1.904					
66.000	1064.024	0.728	1048.0	-141.72	.079	311.1	10.3	11.515	281.4	298.4	323.1		1.906					
67.000	1087.664	0.686	1040.9	-141.87	.076	311.4	10.2	11.710	281.5	298.5	323.4		1.908					
68.000	1111.508	0.644	1033.9	-142.02	.073	311.7	10.1	11.906	281.6	298.6	323.7		1.910					
69.000	1135.556	0.602	1027.0	-142.16	.070	312.0	10.0	12.103	281.7	298.7	324.0		1.912					
70.000	1159.808	0.560	1020.2	-142.30	.067	312.3	9.9	12.301	281.8	298.8	324.3		1.914					
71.000	1184.264	0.518	1013.5	-142.44	.064	312.6	9.8	12.500	281.9	298.9	324.6		1.916					
72.000	1208.924	0.476	1006.9	-142.57	.061	312.9	9.7	12.699	282.0	299.0	324.9		1.918					
73.000	1233.788	0.434	1000.4	-142.70	.058	313.2	9.6	12.899	282.1	299.1	325.2		1.920					
74.000	1258.856	0.392	994.0	-142.83	.055	313.5	9.5	13.099	282.2	299.2	325.5		1.922					
75.000	1284.128	0.350	987.7	-142.95	.052	313.8	9.4											

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/O
 LEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.00 -44.35 55.
 298 N2*H4 1.004 +12.05 45.

BULK DENSITY = 1.350 GM/CC
 MIXTURE RATIO = 1.222 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 292.76 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.3
TEMP, DEG K	2935.0	2459.4	2017.6	1659.1	1421.4	1355.2	1098.8	895.0	708.8	565.3	449.9	358.1	2551.4
ENTHALPY (-)	9.46	32.73	52.02	67.93	78.17	80.97	91.59	100.17	107.06	112.57	116.96	120.44	27.52
CP	.4747	.4637	.4505	.4363	.4247	.4213	.4072	.3954	.3870	.3817	.3794	.3777	.4663
IMPUL OPT	142.26	192.41	225.53	244.48	249.42	267.29	280.91	291.38	299.50	305.81	310.71	312.33	125.33
IMPUL VAC	223.12	241.86	260.22	271.90	275.04	286.68	295.77	302.85	308.40	312.75	316.15	321.33	
EPSILON	1.021	1.391	2.173	3.174	3.573	6.021	10.276	17.669	30.535	52.944	92.455	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.3
TEMP, DEG K	2935.0	2517.3	2115.6	1751.1	1504.7	1435.8	1168.2	944.0	758.1	606.3	484.2	408.3	2623.0
ENTHALPY (-)	9.46	33.03	52.95	69.54	80.26	83.20	94.36	103.41	110.70	116.54	121.21	124.96	27.38
X BAR	5.455	5.419	5.405	5.402	5.402	5.402	5.402	5.402	5.402	5.402	5.399	5.345	5.425
N	5.455	5.419	5.405	5.402	5.402	5.402	5.402	5.402	5.402	5.402	5.399	5.360	5.425
CP	.6582	.5435	.4743	.4426	.4266	.4245	.4096	.3971	.3878	.3826	.3865	18.1910	.5689
IMPUL OPT	143.19	194.51	228.62	248.18	253.28	271.77	285.88	296.77	305.21	311.79	316.98	324.83	
IMPUL VAC	225.55	245.34	264.39	276.49	279.75	291.84	301.30	308.70	314.48	319.04	322.93	323.39	
EPSILON	1.025	1.409	2.208	3.231	3.640	6.146	10.513	18.114	31.366	54.576	94.815	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
28.92 CL	.0211	.0070	.0014	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0097
-13.5C CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.5737	.5879	.5935	.5947	.5949	.5949	.5949	.5949	.5949	.5949	.5949	.5805	.5852
.00 CL2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-64.5C F*H	1.7840	1.7845	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7846	1.7845
58.6C F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.1C H	.0035	.0263	.0050	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0369
79.2C F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	1.5676	1.6089	1.6167	1.6183	1.6185	1.6185	1.6185	1.6185	1.6183	1.6177	1.6136	1.5762	1.6049
40.3C H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 H3*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0006	.0033	.0139	.0000
113.0C N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4041	1.4039	1.4025	1.3900	1.4041
-75.38 CL*H4*N/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0143	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300 PSIA		DENSITY		HEAT FORM		WT. 6/8	
COMPONENT										REF FORMULA		GN/CC		(KCAL/POUN.WT.)		SS.	
										298 CL=F3		1.004		-44.35		45.	
										298 N2=H2		1.004		+12.05			
										FROZEN EXPANSION		C STAR = 5473.7 FT/SEC					
										CP CAL/ I OPT DELVAC DELVAC		I SEA		I AT		I VAC	
										GP DEG		LVL		10000		CF SEA CF VAC	
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I OPT	DELVAC	DELVAC	I SEA	I AT	I VAC	CF SEA	CF VAC	LVL	LVL	LVL	LVL	LVL
			DEG R	KCAL/100GM	GP DEG												
1.000	1.000	300.000	2935.0	-9.48	.475	125.3	96.0	1.584	212.7	215.3	220.3	221.3	1.206	1.255			
2.000	1.837	163.317	2550.4	-27.32	.460	221.3	36.0	1.210	239.6	244.9	255.3	257.4	1.359	1.459			
3.000	10.082	29.757	1712.7	-65.40	.439	242.0	20.3	1.767	244.4	252.2	267.3	270.3	1.586	1.533			
4.000	18.719	16.217	1454.0	-76.78	.426	253.8	24.1	2.357									
5.000	29.384	10.210	1295.1	-83.46	.418	255.8	21.3	2.957									
6.000	41.572	7.216	1186.0	-88.10	.412	261.6	21.3	3.578									
7.000	54.483	5.505	1100.4	-91.93	.407	267.2	19.4	4.199									
8.000	69.341	4.324	1034.0	-94.22	.404	271.5	17.9	4.760									
9.000	85.267	3.527	979.6	-96.41	.401	275.0	16.8	5.265									
10.000	101.216	2.964	933.9	-98.23	.398	277.9	15.8	5.735									
11.000	117.487	2.553	894.8	-99.79	.396	280.5	15.1	6.169									
12.000	135.462	2.215	860.7	-101.13	.394	282.4	14.4	6.569									
13.000	154.774	1.938	830.7	-102.31	.393	284.2	13.8	6.939									
14.000	174.717	1.717	803.9	-103.36	.391	285.8	13.3	7.272									
15.000	195.111	1.538	779.8	-104.30	.390	287.2	12.8	7.574									
16.000	215.801	1.390	758.1	-105.15	.389	288.5	12.4	7.841									
17.000	236.660	1.268	738.3	-105.92	.388	289.7	12.0	8.079									
18.000	257.605	1.165	720.1	-106.62	.387	290.7	11.7	8.299									
19.000	278.426	1.074	703.3	-107.27	.387	291.7	11.4	8.501									
20.000	303.367	.989	687.8	-107.87	.386	292.6	11.1	8.685									
21.000	327.900	.915	673.4	-108.43	.386	293.4	10.8	8.859									
22.000	352.947	.850	660.0	-108.94	.385	294.2	10.6	9.024									
23.000	378.432	.793	647.5	-109.43	.385	294.9	10.4	9.180									
24.000	404.261	.742	635.7	-109.90	.384	295.6	10.1	9.328									
25.000	430.424	.697	624.6	-110.35	.384	296.2	9.9	9.465									
26.000	456.768	.657	614.1	-110.78	.383	296.8	9.8	9.594									
27.000	483.348	.621	604.2	-111.18	.383	297.3	9.6	9.714									
28.000	510.026	.588	594.9	-111.54	.383	297.9	9.4	9.824									
29.000	536.764	.559	586.0	-111.78	.382	298.4	9.3	9.924									
30.000	563.629	.532	577.6	-112.10	.382	298.8	9.1	10.019									
31.000	590.509	.508	569.5	-112.41	.382	299.3	9.0	10.109									
32.000	618.853	.485	561.8	-112.71	.382	299.7	8.8	10.194									
33.000	648.201	.462	554.5	-112.99	.381	300.1	8.7	10.274									
34.000	678.584	.441	547.4	-113.25	.381	300.5	8.6	10.349									
35.000	711.233	.422	540.7	-113.51	.381	300.9	8.5	10.419									
36.000	746.851	.404	534.2	-113.76	.381	301.2	8.4	10.484									
37.000	784.629	.387	528.0	-113.99	.381	301.6	8.3	10.544									
38.000	824.534	.372	522.1	-114.22	.381	301.9	8.2	10.599									
39.000	866.574	.357	516.3	-114.44	.381	302.2	8.1	10.650									
40.000	910.759	.344	510.8	-114.65	.380	302.5	8.0	10.696									
41.000	957.100	.331	505.5	-114.85	.380	302.8	7.9	10.737									
42.000	1005.603	.319	500.3	-115.05	.380	303.1	7.8	10.774									
43.000	1056.267	.308	495.4	-115.24	.380	303.3	7.7	10.806									
44.000	1108.102	.298	490.6	-115.42	.380	303.6	7.6	10.834									
45.000	1161.120	.288	485.9	-115.60	.380	303.9	7.5	10.857									
46.000	1215.340	.279	481.4	-115.77	.380	304.1	7.5	10.874									
47.000	1270.763	.271	477.0	-115.93	.380	304.3	7.4	10.892									
48.000	1328.391	.263	472.8	-116.09	.380	304.6	7.3	10.909									
49.000	1388.224	.255	468.7	-116.25	.380	304.8	7.3	10.925									
50.000	1449.260	.248	464.7	-116.40	.380	305.0	7.2	10.942									
51.000	1511.496	.241	460.9	-116.55	.380	305.2	7.1	10.958									
52.000	1574.934	.234	457.2	-116.70	.380	305.4	7.1	10.974									
53.000	1639.574	.228	453.6	-116.85	.380	305.6	7.0	10.989									
54.000	1705.414	.221	450.1	-117.00	.380	305.8	7.0	11.004									
55.000	1772.454	.215	446.7	-117.13	.380	306.0	6.9	11.019									
56.000	1840.694	.209	443.3	-117.27	.380	306.2	6.9	11.034									
57.000	1910.134	.203	440.0	-117.40	.380	306.4	6.8	11.049									
58.000	1980.774	.197	436.8	-117.53	.380	306.6	6.8	11.064									
59.000	2052.614	.191	433.6	-117.66	.380	306.8	6.7	11.079									
60.000	2125.654	.185	430.5	-117.79	.380	307.0	6.7	11.094									
61.000	2199.894	.179	427.4	-117.92	.380	307.2	6.6	11.109									
62.000	2275.334	.173	424.4	-118.05	.380	307.4	6.6	11.124									
63.000	2351.974	.167	421.4	-118.18	.380	307.6	6.5	11.139									
64.000	2429.814	.161	418.4	-118.31	.380	307.8	6.5	11.154									
65.000	2508.854	.155	415.4	-118.44	.380	308.0	6.4	11.169									
66.000	2589.094	.149	412.4	-118.57	.380	308.2	6.4	11.184									
67.000	2670.534	.143	409.4	-118.70	.380	308.4	6.3	11.199									
68.000	2753.174	.137	406.4	-118.83	.380	308.6	6.3	11.214									
69.000	2837.014	.131	403.4	-118.96	.380	308.8	6.2	11.229									
70.000	2922.054	.125	400.4	-119.09	.380	309.0	6.2	11.244									
71.000	3008.294	.119	397.4	-119.22	.380	309.2	6.1	11.259									
72.000	3095.734	.113	394.4	-119.35	.380	309.4	6.1	11.274									
73.000	3184.374	.107	391.4	-119.48	.380	309.6	6.0	11.289									
74.000	3274.214	.101	388.4	-119.61	.380	309.8	6.0	11.304									
75.000	3365.254	.095	385.4	-119.74	.380	310.0	5.9	11.319									
76.000	3457.494	.089	382.4	-119.87	.380	310.2	5.9	11.334									
77.000	3550.934	.083	379.4	-119.99	.380	310.4	5.8	11.349									
78.000	3645.574	.077	376.4	-120.12	.380	310.6	5.8	11.364									
79.000	3741.414	.071	373.4	-120.25	.380	310.8	5.7	11.379									
80.000	3838.454	.065	370.4	-120.38	.380	311.0	5.7	11.394									

PRESSURE PROFILE DATA
 SYSTEM LIQUID NITROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 CEG K CM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.880 -44.35 65.
 298 N2*H4 1.004 +12.05 35.

BULK DENSITY = 1.440 GM/CC
 MIXTURE RATIO = 1.857 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 269.49 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.3
TEMP, DEG K	3391.2	2816.2	2329.1	1916.6	1643.8	1567.9	1273.7	1027.4	823.2	656.3	521.6	415.8	2945.7
ENTHALPY (-)	18.02	41.82	61.56	77.85	88.33	91.20	102.10	110.92	118.01	123.68	128.19	131.77	36.51
CP	.4178	.4097	.4000	.3891	.3795	.3768	.3656	.3523	.3428	.3367	.3332	.3317	.4117
IMPLL OPT		143.91	194.62	228.13	247.32	252.32	270.46	284.28	294.93	303.18	309.59	314.58	126.81
IMPLL VAC		225.69	244.63	263.24	275.09	278.29	290.14	299.38	306.60	312.23	316.63	320.08	223.88
EPSILON		1.021	1.391	2.174	3.179	3.581	6.044	10.329	17.766	30.687	53.163	92.475	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	168.1
TEMP, DEG K	3391.2	2998.2	2610.5	2272.3	1934.7	1851.5	1522.6	1241.6	1005.3	808.5	647.0	516.2	3105.7
ENTHALPY (-)	18.02	42.39	63.53	81.59	93.48	96.76	109.30	119.57	127.91	134.64	140.05	144.36	35.99
X BAR	4.834	4.761	4.713	4.690	4.684	4.683	4.682	4.682	4.682	4.682	4.682	4.682	4.779
A	4.834	4.761	4.713	4.690	4.684	4.683	4.682	4.682	4.682	4.682	4.682	4.682	4.779
CP	.8105	.6725	.5376	.4396	.4001	.3925	.3726	.3585	.3471	.3376	.3317	.3288	.7120
IMPLL OPT		145.61	198.97	235.17	256.21	261.72	281.79	297.22	309.19	319.52	325.81	331.53	125.04
IMPLL VAC		230.37	252.43	273.49	286.79	290.37	303.66	314.13	322.35	328.79	333.85	337.85	227.66
EPSILON		1.030	1.447	2.310	3.407	3.845	6.539	11.259	19.515	33.928	59.110	103.209	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
28.92 CL	.1049	.0581	.0237	.0060	.0014	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0701
-13.50 CL*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.5978	.6448	.6792	.6970	.7017	.7022	.7030	.7030	.7030	.7030	.7030	.7030	.6428
.00 CL2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
18.86 F	.0070	.0019	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0028
-64.50 F*H	2.1021	2.1072	2.1088	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1091	2.1063
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1906	.0982	.0375	.0089	.0019	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.1208
19.20 F*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.7389	.7591	.7715	.7767	.7779	.7780	.7782	.7782	.7782	.7781	.7781	.7778	.7543
40.30 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
115.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.0920	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0921	1.0920	1.0921

SYSTEM LIQUID BIPROPELLANT										PC 300		PSIA		HEAT FORM		WT. 0/0	
COMPONENT										DENSITY		G/CC		KCAL/FORM.WT.1			
298 CL+FS										1.880		-44.35		65.			
298 H2+HN										1.004		+12.05		55.			
FROZEN EXPANSION										C STAR = 5737.7 FT/SEC							
										I SEA		I AT		I AT		I VAC	
										LVL		10000		50000		CF SEA	
										CF VAC		LVL					
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	1 OPT	DELTVAC	DELTVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC			
			DEG K	KCAL/100GM	GM DEG			/P	LVL	10000	50000	LVL					
1.000	1.000	300.000	3391.2	-18.02	.418												
1.000	1.037	163.295	2945.7	-36.51	.412	174.8	97.1	.594	215.1	217.8	222.9	225.9	1.206	1.255			
2.000	10.078	29.769	1978.5	-75.44	.391	223.9	36.4	1.224	242.3	247.7	250.2	260.3	1.359	1.460			
3.000	18.475	16.045	1682.2	-86.87	.381	244.7	28.7	1.787	247.2	255.1	270.4	275.5	1.586	1.753			
4.000	29.248	10.250	1500.5	-93.73	.374	250.7	24.4	2.385				277.0	281.1	1.576			
5.000	41.367	7.252	1373.3	-98.45	.368	264.5	21.7	2.990				281.1	286.2	1.605			
6.000	54.196	5.555	1277.4	-101.97	.364	270.2	19.8	3.588				283.9	290.0	1.626			
7.000	68.465	4.355	1201.1	-104.73	.360	274.7	18.3	4.195				285.8	292.9	1.645			
8.000	84.477	3.551	1136.4	-106.97	.357	278.2	17.1	4.814				287.1	295.3	1.656			
9.000	100.500	2.985	1086.0	-108.95	.355	281.1	16.1	5.406				288.0	297.2	1.667			
10.000	114.655	2.572	1040.9	-110.44	.353	283.4	15.3	5.946				288.7	298.9	1.676			
11.000	134.363	2.233	1001.5	-111.83	.351	285.7	14.6	6.560				289.1	300.3	1.684			
12.000	153.455	1.954	964.7	-113.05	.349	287.5	14.0	7.187				289.3	301.6	1.691			
13.000	173.267	1.731	935.6	-114.13	.348	289.2	13.5	7.807				289.4	302.7	1.697			
14.000	193.504	1.550	907.7	-115.10	.347	290.6	13.0	8.417				303.7	1.703				
15.000	214.053	1.402	882.5	-115.97	.345	291.9	12.6	9.011				304.5	1.712				
16.000	234.750	1.278	859.4	-116.77	.344	293.1	12.3	9.588				305.3	1.717				
17.000	255.630	1.174	838.3	-117.49	.343	294.2	11.9	10.146				306.1	1.716				
18.000	277.057	1.083	818.8	-118.16	.343	295.2	11.6	10.707				306.8	1.720				
19.000	300.841	.997	800.7	-118.78	.342	296.1	11.3	11.333				307.4	1.724				
20.000	325.183	.923	785.9	-119.34	.341	296.9	11.0	11.944				307.9	1.727				
21.000	350.046	.857	768.3	-119.89	.341	297.7	10.8	12.582				308.5	1.730				
22.000	375.357	.799	753.6	-120.39	.340	298.4	10.6	13.202				309.0	1.733				
23.000	401.042	.748	739.9	-120.86	.340	299.1	10.3	13.816				309.4	1.735				
24.000	427.034	.703	726.9	-121.29	.339	299.7	10.1	14.424				309.9	1.738				
25.000	453.270	.662	714.7	-121.71	.339	300.3	9.9	15.023				310.3	1.740				
26.000	479.696	.625	703.2	-122.10	.338	300.9	9.8	15.613				310.7	1.742				
27.000	506.243	.593	692.2	-122.47	.338	301.4	9.6	16.193				311.0	1.744				
28.000	532.944	.563	681.9	-122.82	.338	301.9	9.4	16.762				311.4	1.746				
29.000	559.446	.539	672.0	-123.15	.337	302.3	9.3	17.321				311.7	1.747				
30.000	586.486	.512	662.4	-123.47	.337	302.9	9.1	17.870				312.0	1.750				
31.000	614.275	.488	653.6	-123.77	.337	303.3	9.0	18.437				312.3	1.751				
32.000	644.447	.466	645.0	-124.06	.336	303.7	8.9	19.002				312.6	1.753				
33.000	675.080	.446	636.8	-124.34	.336	304.1	8.7	19.587				312.9	1.754				
34.000	706.144	.425	628.9	-124.60	.336	304.5	8.6	20.172				313.1	1.756				
35.000	737.406	.407	621.3	-124.86	.336	304.9	8.5	20.737				313.4	1.757				
36.000	769.434	.390	614.0	-125.10	.335	305.2	8.4	21.300				313.6	1.759				
37.000	801.599	.374	607.1	-125.34	.335	305.5	8.3	21.881				313.8	1.760				
38.000	834.003	.360	600.3	-125.56	.335	305.9	8.2	22.400				314.1	1.761				
39.000	866.812	.346	593.8	-125.78	.335	306.2	8.1	22.915				314.3	1.762				
40.000	899.802	.333	587.6	-125.99	.335	306.5	8.0	23.427				314.5	1.763				
41.000	933.011	.322	581.6	-126.19	.335	306.8	7.9	23.935				314.7	1.765				
42.000	966.411	.310	575.7	-126.39	.334	307.0	7.8	24.439				314.9	1.766				
43.000	999.978	.300	570.1	-126.57	.334	307.3	7.8	24.937				315.1	1.767				
44.000	1033.689	.290	564.6	-126.76	.334	307.6	7.7	25.431				315.2	1.768				
45.000	1067.524	.281	559.4	-126.93	.334	307.8	7.6	25.919				315.4	1.769				
46.000	1101.443	.272	554.2	-127.10	.334	308.1	7.5	26.401				315.6	1.770				
47.000	1135.449	.264	549.1	-127.27	.334	308.3	7.4	26.877				315.7	1.771				
48.000	1169.588	.257	544.5	-127.43	.334	308.5	7.4	27.349				315.9	1.771				
49.000	1203.748	.249	539.8	-127.59	.334	308.7	7.3	27.814				316.0	1.772				
50.000	1237.959	.242	535.2	-127.74	.334	308.9	7.2	28.273	247.5	255.7	271.9	275.1	1.587	1.543			
5.179	20.414	14.696	1643.8	-88.33	.379	247.5	27.8	1.890									

SHIFTING EXPANSION																
C STAR = 5894.1 FT/SEC																
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	1 OPT	DELTVAC	DELTVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
			DEG K	KCAL/100GM	GM DEG			/P	LVL	10000	50000	LVL				
1.000	1.000	300.000	3391.2	-18.02	.410											
1.000	1.165	168.054	3105.7	-35.99	.412	125.0	102.6	.411	218.7	221.4	226.6	227.7	1.243	1.194		
2.000	9.241	32.443	2331.2	-76.88	.402	226.8	41.1	1.265	249.2	254.8	265.7	267.8	1.361	1.462		
3.000	16.820	17.835	2025.4	-89.83	.410	250.0	32.8	1.839	255.7	263.9	279.6	282.8	1.596	1.544		
4.000	26.162	11.676	1825.1	-97.79	.390	263.4	26.0	2.444				266.4	279.3	1.591		
5.000	36.864	8.148	1681.7	-105.32	.381	274.8	21.5	3.070				272.2	297.1	1.623		
6.000	48.351	6.200	1572.1	-107.45	.375	276.9	22.8	3.679				275.5	301.7	1.647		
7.000	60.445	4.931	1484.5	-110.71	.371	284.0	21.2	4.291				277.8	305.1	1.666		
8.000	74.631	4.020	1412.3	-113.36	.367	288.0	19.8	4.935				279.5	307.9	1.681		
9.000	89.554	3.372	1351.2	-115.41	.364	291.9	18.3	5.564				280.7	311.1	1.693		
10.000	105.539	2.897	1298.6	-117.52	.361	294.2	17.9	6.165				301.4	312.1	1.704		
11.000	118.179	2.535	1252.7	-119.17	.359	296.4	17.1	6.735				302.3	313.7	1.713		
12.000	134.338	2.233	1211.9	-120.63	.357	298.8	16.4	7.352				302.7	315.2	1.721		
13.000	151.587	1.979	1175.5	-121.93	.355	300.7	15.8	7.995				302.8	316.5	1.728		
14.000	169.352	1.749	1132.7	-123.50	.353	302.7	15.0	8.627				302.9	317.8	1.734		
15.000	187.505	1.604	1112.8	-125.15	.352	303.9	14.8	9.263				318.7		1.740		
16.000	205.922	1.457	1085.5	-125.11	.351	305.2	14.4	9.880				319.6		1.745		
17.000	224.524	1.334	1060.4	-125.99	.350	308.4	14.0	10.488				320.5		1.749		
18.000	243.219	1.235	1037.3	-126.80	.349	311.6	13.6	11.084				321.4		1.753		
19.000	261.948	1.145	1015.4	-127.54	.348	308.7	13.3	11.631				322.0		1.758		
20.000	281.631	1.064	995.7	-128.24	.347	309.7	13.0	12.228				322.7		1.761		
21.000	303.234	.989	974.9	-128.89	.346	310.4	12.7	12.812				323.3		1.765		
22.000	325.103	.923	959.3	-129.50	.345	311.6	12.5	13.512				323.7		1.768		
23.000	347.382	.867	942.7	-130.07	.344	312.2	12.2	14.196				324.4		1.772		
24.000	370.023	.811	927.1	-130.60	.343	313.0	12.0	14.789				325.0		1.776		
25.000	392.969	.763	912.4	-131.11	.342	313.3	11.8	15.321				325.4		1.779		
26.000	416.173	.721	898.4	-131.59	.342	314.3	11.6	15.804				325.9		1.779		
27.000	439.589	.682	885.1	-132.04	.341	315.0	11.4	16.246				326.4		1.781		
28.000	463.174	.643	872.5	-132.47	.341	315.5	11.2	16.728				326.7		1.784		
29.000	486.897	.616	860.5	-132.88	.340	316.1	11.0	17.081				327.1		1.786		
30.000	510.721	.587	849.0	-133.27	.339	316.4	10.9	17.475				327.5		1.788		
31.000	534.624	.561	838.0	-133.64	.339	317.2	10.7	17.9059				327.8		1.790		
32.000	558.585	.535	827.5	-133.98	.338	317.6	10.5	18.326				328.0		1.792		
33.000	582.594	.515	817.5	-134.34	.338	318.1	10.4	20.201				328.5		1.793		
34.000	606.629	.494	807.8	-134.67	.338	318.4	10.3	20.764				328.6		1.795		
35.000	631.680	.473	798.5	-134.98	.337	319.0	10.1	21.805				329.1		1.797		
36.000	640.904	.454	789.6	-135.28	.337	319.8	10.0	22.004				329.4		1.798		
37.000	688.478	.436	781.0	-135.57	.336	319.8	9.9	22.688				329.7		1.800		
38.000	716.381	.419	772.7	-135.85	.336	320.2	9.8	23.329				329.9		1.801		
39.000	744.589	.403	764.8	-136.12	.336	320.5	9.7	23.970				330.2		1.802		
40.000	773.082	.388	757.1	-136.37	.336	320.7	9.5	24.400				330.4		1.803		
41.000	801.859	.374	749.4	-136.62	.335	321.2	9.4	24.946				330.7		1.805		
42.000	830.630	.361	742.4	-136.87	.335	321.5	9.3	25.881				330.9		1.806		
43.000	860.043	.349	735.4	-137.10	.335	321.9	9.2	26.513				331.1		1.807		
44.000	889.856	.337	728.7	-137.33	.334	322.7	9.2	27.163				331.3		1.809		
45.000	919.061	.325	722.1	-137.54	.334	322.7	9.1	27.834				331.4		1.810		
46.000	948.769	.314	715.8	-137.74	.334	322.7	9.0	28.390				331.7		1.811		
47.000	978.694	.307	709.6	-137.94	.334	323.0	9.0	29.008				331.9		1.812		
48.000	1008.714	.297	703.6	-138.16	.334	323.3	8.8	29.621				332.1		1.813		
49.000	1038.945	.289	697.8	-138.34	.333	323.6	8.7	30.222				332.4		1.814		
50.000	1069.072	.282	692.2	-138.50	.333	323.8	8.6	30.833				332.5		1.815		
3.462	20.143	6.046	1934.7	-93.48	.400	254.2	30.6	2.081	256.2	265.4	283.2	286.8	1.399	1.516		

PRESSURE PROFILE DATA				
SYSTEM LIQUID BIPROPELLANT COMPONENT	TREF FORMULA	PC 300	PSIA	
	CEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. C/O
SYSTEM LIQUID BIPROPELLANT		PC 300	PSIA	
298 CLOF3		1.880	-44.35	70.
298 A2=H4		1.004	+12.05	30.

BULK DENSITY = 1.490 GM/CC
MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

CHAMBER ENTROPY 256.71 EU/100GMS

CLAMBER

THREAT

FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.3
TEMP, DEG K	3603.8	2986.4	2465.2	2025.5	1735.5	1654.8	1334.3	1082.2	866.7	689.7	547.2	453.3	3125.3
ENTHALPY (-)	22.30	46.06	65.72	81.91	92.32	95.17	105.98	114.72	121.74	127.34	131.68	135.33	40.75
CP	.3882	.3810	.3728	.3630	.3548	.3521	.3408	.3297	.3205	.3145	.3110	.3093	.3830
IMPLL CPT	143.76	194.45	227.72	246.81	251.79	269.81	283.55	294.12	302.50	308.64	313.58	316.70	126.70
IMPLL VAC	225.38	244.18	262.67	274.44	277.61	289.37	298.55	305.69	311.26	315.61	319.01	323.62	
EPSILON	1.021	1.388	2.168	3.167	3.567	6.016	10.272	17.652	30.453	52.695	91.459	1.000	

	SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	169.5	
TEMP, DEG K	3603.8	3221.0	2854.0	2447.8	2202.6	2116.4	1759.6	1444.0	1175.3	949.8	762.6	609.6	3528.0	
ENTHALPY (-)	22.50	46.73	68.11	86.69	99.12	102.58	115.90	126.88	135.87	143.15	149.02	153.72	40.08	
X BAR	4.545	4.461	4.394	4.350	4.332	4.329	4.324	4.323	4.323	4.323	4.323	4.322	4.483	
N	4.545	4.461	4.394	4.350	4.332	4.329	4.323	4.323	4.323	4.323	4.323	4.322	4.483	
CP	.8850	.7645	.6297	.4967	.4184	.4015	.3582	.3403	.3263	.3178	.3098	.3051	.8003	
IMPLL OPT	145.78	199.63	236.68	258.51	264.27	285.55	301.64	314.52	324.24	332.07	338.12	342.36		
IMPLL VAC	230.94	253.94	276.21	290.42	294.24	308.40	319.57	328.29	335.19	340.61	344.86	348.08		
EPSILON	1.032	1.065	2.375	3.544	4.010	6.668	11.873	20.651	36.026	62.912	109.978	1.000		

COMPOSITION SHIFTING (MCL/100 GM)

[illegible]

SYSTEM LIQUID BIPROPELLANT PC 300 PSIA
COMPONENT TREF FORMULA DENSITY HEAT FORM WT. B/B
DEG K GR/CC (KCAL/FORM-WT.)
SYSTEM LIQUID BIPROPELLANT PC 300 PSIA
254 1.000 -44.35 70.
1.000 1.000 +12.05 30.

SHIFTER EXPANSION
C STAR = 5729.1 FT/SEC

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GR	CP CAL/GR DEG	I OPT DELVAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA	CF VAC
1.000	1.000	300.000	300.0	-22.30	.585	126.7	96.9	.594	218.9	217.5	222.6	1.256
1.000	1.037	163.72	3125.3	-40.75	.583	126.7	96.9	.594	218.9	217.5	222.6	1.256
2.000	10.118	29.651	2088.9	-79.61	.565	223.6	56.2	1.222	241.9	247.3	257.0	1.359
3.000	18.783	15.972	1773.6	-90.97	.556	244.4	28.5	1.784	246.7	254.6	269.9	1.385
4.000	29.469	10.182	1580.6	-97.76	.550	256.3	24.2	2.380	246.7	254.6	269.9	1.385
5.000	41.655	7.202	1445.9	-102.46	.545	264.1	21.5	2.996	246.7	254.6	269.9	1.385
6.000	54.500	5.498	1344.4	-105.93	.541	269.7	19.6	3.562	246.7	254.6	269.9	1.385
7.000	69.417	4.322	1263.7	-108.67	.538	274.1	18.1	4.189	246.7	254.6	269.9	1.385
8.000	85.123	3.524	1197.5	-110.89	.535	277.6	16.9	4.807	246.7	254.6	269.9	1.385
9.000	101.275	2.942	1141.8	-112.75	.532	280.5	16.0	5.397	246.7	254.6	269.9	1.385
10.000	117.545	2.552	1094.1	-114.33	.530	283.0	15.2	5.952	246.7	254.6	269.9	1.385
11.000	135.530	2.214	1052.4	-115.70	.528	285.1	14.5	6.553	246.7	254.6	269.9	1.385
12.000	154.850	1.937	1015.6	-116.91	.527	286.9	13.9	7.178	246.7	254.6	269.9	1.385
13.000	174.810	1.716	982.8	-117.98	.525	288.5	13.4	7.797	246.7	254.6	269.9	1.385
14.000	195.233	1.537	953.3	-118.93	.524	289.9	12.9	8.404	246.7	254.6	269.9	1.385
15.000	215.945	1.389	926.6	-119.80	.523	291.2	12.5	8.996	246.7	254.6	269.9	1.385
16.000	236.882	1.266	902.2	-120.59	.522	292.4	12.1	9.570	246.7	254.6	269.9	1.385
17.000	257.952	1.163	879.8	-121.30	.521	293.5	11.8	10.125	246.7	254.6	269.9	1.385
18.000	279.047	1.072	859.2	-121.94	.520	294.5	11.5	10.665	246.7	254.6	269.9	1.385
19.000	303.869	.987	840.1	-122.58	.520	295.4	11.2	11.191	246.7	254.6	269.9	1.385
20.000	328.492	.913	822.4	-123.14	.519	296.2	10.9	11.744	246.7	254.6	269.9	1.385
21.000	353.639	.848	805.9	-123.67	.518	297.0	10.7	12.266	246.7	254.6	269.9	1.385
22.000	379.205	.791	790.4	-124.16	.518	297.7	10.4	12.764	246.7	254.6	269.9	1.385
23.000	405.205	.740	775.8	-124.62	.517	298.4	10.2	13.247	246.7	254.6	269.9	1.385
24.000	431.481	.695	762.1	-125.06	.517	299.0	10.0	13.702	246.7	254.6	269.9	1.385
25.000	457.999	.655	749.2	-125.47	.516	299.6	9.8	14.149	246.7	254.6	269.9	1.385
26.000	484.706	.619	737.0	-125.85	.516	300.1	9.6	14.586	246.7	254.6	269.9	1.385
27.000	511.554	.584	725.5	-126.22	.516	300.7	9.5	15.005	246.7	254.6	269.9	1.385
28.000	538.507	.557	714.5	-126.56	.515	301.2	9.3	15.429	246.7	254.6	269.9	1.385
29.000	565.537	.530	704.0	-126.89	.515	301.6	9.2	15.846	246.7	254.6	269.9	1.385
30.000	592.628	.506	694.1	-127.21	.515	302.1	9.0	16.252	246.7	254.6	269.9	1.385
31.000	619.807	.483	684.6	-127.51	.514	302.5	8.9	16.649	246.7	254.6	269.9	1.385
32.000	647.040	.460	675.5	-127.79	.514	302.9	8.8	17.041	246.7	254.6	269.9	1.385
33.000	674.313	.439	666.8	-128.06	.514	303.3	8.6	17.425	246.7	254.6	269.9	1.385
34.000	701.600	.420	658.4	-128.32	.514	303.7	8.5	17.802	246.7	254.6	269.9	1.385
35.000	728.948	.402	650.4	-128.56	.513	304.1	8.4	18.172	246.7	254.6	269.9	1.385
36.000	756.367	.385	642.8	-128.82	.513	304.4	8.3	18.539	246.7	254.6	269.9	1.385
37.000	783.813	.370	635.4	-129.05	.513	304.7	8.2	18.902	246.7	254.6	269.9	1.385
38.000	811.373	.355	628.3	-129.27	.513	305.1	8.1	19.262	246.7	254.6	269.9	1.385
39.000	839.028	.342	621.4	-129.49	.513	305.4	8.0	19.619	246.7	254.6	269.9	1.385
40.000	866.767	.329	614.8	-129.69	.512	305.7	7.9	19.972	246.7	254.6	269.9	1.385
41.000	894.559	.318	608.4	-129.88	.512	305.9	7.8	20.322	246.7	254.6	269.9	1.385
42.000	922.397	.307	602.3	-130.06	.512	306.2	7.7	20.669	246.7	254.6	269.9	1.385
43.000	950.240	.296	596.3	-130.27	.512	306.5	7.6	21.012	246.7	254.6	269.9	1.385
44.000	978.087	.286	590.5	-130.47	.512	306.7	7.5	21.352	246.7	254.6	269.9	1.385
45.000	1005.937	.276	585.0	-130.62	.512	307.0	7.5	21.689	246.7	254.6	269.9	1.385
46.000	1033.787	.269	579.5	-130.79	.512	307.2	7.4	22.022	246.7	254.6	269.9	1.385
47.000	1061.637	.261	574.3	-130.96	.512	307.5	7.3	22.352	246.7	254.6	269.9	1.385
48.000	1089.487	.253	569.2	-131.11	.511	307.7	7.3	22.679	246.7	254.6	269.9	1.385
49.000	1117.337	.246	564.3	-131.27	.511	307.9	7.2	22.999	246.7	254.6	269.9	1.385
50.000	1145.187	.239	559.5	-131.42	.511	308.1	7.1	23.316	246.7	254.6	269.9	1.385
51.000	1173.037	.231	554.8	-131.56	.510	308.3	7.0	23.629	246.7	254.6	269.9	1.385
52.000	1200.887	.224	550.2	-131.69	.510	308.5	6.9	23.939	246.7	254.6	269.9	1.385
53.000	1228.737	.217	545.7	-131.81	.510	308.7	6.8	24.246	246.7	254.6	269.9	1.385
54.000	1256.587	.210	541.3	-131.92	.510	308.9	6.7	24.550	246.7	254.6	269.9	1.385
55.000	1284.437	.203	537.0	-132.03	.510	309.1	6.6	24.852	246.7	254.6	269.9	1.385
56.000	1312.287	.196	532.8	-132.13	.510	309.3	6.5	25.152	246.7	254.6	269.9	1.385
57.000	1340.137	.190	528.7	-132.22	.510	309.5	6.4	25.450	246.7	254.6	269.9	1.385
58.000	1367.987	.183	524.7	-132.31	.510	309.7	6.3	25.746	246.7	254.6	269.9	1.385
59.000	1395.837	.177	520.8	-132.39	.510	309.9	6.2	26.040	246.7	254.6	269.9	1.385
60.000	1423.687	.170	516.9	-132.47	.510	310.1	6.1	26.332	246.7	254.6	269.9	1.385
61.000	1451.537	.164	513.1	-132.54	.510	310.3	6.0	26.622	246.7	254.6	269.9	1.385
62.000	1479.387	.158	509.4	-132.61	.510	310.5	5.9	26.910	246.7	254.6	269.9	1.385
63.000	1507.237	.152	505.8	-132.67	.510	310.7	5.8	27.196	246.7	254.6	269.9	1.385
64.000	1535.087	.146	502.3	-132.73	.510	310.9	5.7	27.480	246.7	254.6	269.9	1.385
65.000	1562.937	.140	498.9	-132.78	.510	311.1	5.6	27.762	246.7	254.6	269.9	1.385
66.000	1590.787	.134	495.6	-132.83	.510	311.3	5.5	28.042	246.7	254.6	269.9	1.385
67.000	1618.637	.128	492.4	-132.87	.510	311.5	5.4	28.320	246.7	254.6	269.9	1.385
68.000	1646.487	.122	489.3	-132.91	.510	311.7	5.3	28.596	246.7	254.6	269.9	1.385
69.000	1674.337	.116	486.3	-132.94	.510	311.9	5.2	28.870	246.7	254.6	269.9	1.385
70.000	1702.187	.110	483.4	-132.97	.510	312.1	5.1	29.142	246.7	254.6	269.9	1.385
71.000	1730.037	.104	480.6	-132.99	.510	312.3	5.0	29.412	246.7	254.6	269.9	1.385
72.000	1757.887	.108	477.9	-133.01	.510	312.5	4.9	29.680	246.7	254.6	269.9	1.385
73.000	1785.737	.102	475.3	-133.02	.510	312.7	4.8	29.946	246.7	254.6	269.9	1.385
74.000	1813.587	.106	472.8	-133.03	.510	312.9	4.7	30.210	246.7	254.6	269.9	1.385
75.000	1841.437	.100	470.4	-133.04	.510	313.1	4.6	30.472	246.7	254.6	269.9	1.385
76.000	1869.287	.104	468.0	-133.04	.510	313.3	4.5	30.732	246.7	254.6	269.9	1.385
77.000	1897.137	.108	465.7	-133.04	.510	313.5	4.4	31.000	246.7	254.6	269.9	1.385
78.000	1924.987	.102	463.4	-133.04	.510	313.7	4.3	31.266	246.7	254.6	269.9	1.385
79.000	1952.837	.106	461.2	-133.03	.510	313.9	4.2	31.530	246.7	254.6	269.9	1.385
80.000	1980.687	.100	459.0	-133.02	.510	314.1	4.1	31.792	246.7	254.6	269.9	1.385
81.000	2008.537	.104	456.9	-133.01	.510	314.3	4.0	32.052	246.7	254.6	269.9	1.385
82.000	2036.387	.108	454.8	-133.00	.510	314.5	3.9	32.310	246.7	254.6	269.9	1.385
83.000	2064.237	.102	452.8	-132.99	.510	314.7	3.8	32.566	246.7	254.6	269.9	1.385
84.000	2092.087	.106	450.8	-132.97	.510	314.9	3.7	32.820	246.7	254.6	269.9	1.385
85.000	2119.937	.100	448.9	-132.96	.510	315.1	3.6	33.072	246.7	254.6	269.9	1.385
86.000	2147.787	.104	447.0	-132.94	.510	315.3	3.5	33.322	246.7	254.6	269.9	1.385
87.000	2175.637	.108	445.2	-132.92	.510	315.5	3.4	33.570	246.7	254.6	269.9	1.385
88.000	2203.487	.102	443.4	-132.90	.510	315.7	3.3	33				

PRESSURE PROFILE DATA
 SYSTEM LIQUID HYDROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.880 -44.35 75.
 298 H2*H4 1.004 +12.05 25.

BULK DENSITY = 1.543 GM/CC
 MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 242.28 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	162.8
TEMP, DEG K	3765.6	3108.4	2556.3	2093.1	1788.7	1704.2	1378.7	1107.6	884.0	701.9	555.4	438.7	3253.6
ENTHALPY (-)	26.58	49.82	69.10	84.86	94.97	97.74	108.19	116.61	123.36	128.73	132.99	136.36	44.77
CP	.3578	.3515	.3444	.3356	.3264	.3200	.3159	.3059	.2977	.2925	.2894	.2879	.3531
IMPLL OPT	142.40	172.33	225.17	243.93	248.81	266.45	279.87	290.17	298.11	304.26	309.04	314.29	125.80
IMPLL VAC	223.07	241.45	259.52	271.03	274.12	285.57	294.49	301.43	306.81	311.01	314.29	314.29	221.38
EPSILON	1.020	1.383	2.154	3.141	3.535	5.947	10.130	17.365	29.887	51.600	89.357	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	169.1
TEMP, DEG K	3765.6	3382.5	3017.8	2663.0	2387.6	2301.4	1925.3	1609.5	1358.2	1126.6	914.1	734.1	3489.5
ENTHALPY (-)	26.58	50.63	71.78	90.28	102.76	106.27	119.80	131.04	140.44	148.29	154.71	159.88	44.08
X FAK	4.275	4.191	4.121	4.066	4.037	4.032	4.021	4.004	3.979	3.965	3.963	3.963	4.214
N	4.275	4.191	4.121	4.066	4.037	4.032	4.021	4.004	3.979	3.965	3.963	3.963	4.214
CP	.4999	.7821	.6659	.5445	.4417	.4101	.3496	.3913	.3766	.3185	.2925	.2840	.8153
IMPLL OPT	144.66	198.31	235.40	257.44	263.29	284.77	301.45	314.73	325.59	333.86	340.54	347.41	123.41
IMPLL VAC	229.39	252.52	275.16	289.81	293.76	308.28	319.94	329.58	337.26	343.24	347.93	347.93	226.42
EPSILON	1.032	1.471	2.403	3.616	4.100	7.044	12.336	22.063	39.288	69.147	121.224	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
28.92 CL	.4020	.3388	.2642	.1898	.1450	.1357	.1165	.0830	.0325	.0057	.0004	.0000	.3584
-13.50 CL*F	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*H	.4068	.4765	.5455	.6201	.6646	.6736	.6865	.6868	.6868	.6868	.6868	.6868	.4508
.00 CL2	.0010	.0008	.0007	.0007	.0008	.0009	.0041	.0207	.0460	.0594	.0620	.0622	.0009
14.86 F	.0722	.0324	.0122	.0037	.0015	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0415
-64.50 F*H	2.3611	2.4010	2.4213	2.4298	2.4323	2.4326	2.4334	2.4335	2.4336	2.4336	2.4336	2.4336	2.3919
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1498	.0861	.0396	.0124	.0030	.0017	.0000	.0000	.0000	.0000	.0000	.0000	.1027
79.20 F*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.1013	.0814	.0569	.0290	.0102	.0062	.0002	.0000	.0000	.0000	.0000	.0000	.0874
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 H	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 H2	.7799	.7800	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7801	.7800

SYSTEM LIQUID BIPROPELLANT										PC 300		PSIA		DENSITY		HEAT FORM		WT. O/D	
COMPONENT										THEF FORMULA		GP/CC		(KCAL/FORM.WT.)					
										DEG K		1.88		-44.35		75.			
										298 CL=63		1.004		+12.05		25.			
										298 N2=H4									
										FROZEN EXPANSION									
										C STAR = 5400.5 FT/SEC									
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC					
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL	LVL					
1.000	1.000	300.000	3765.6	-26.58	.358		125.8	95.6	.587	212.8	215.4	220.4	221.4	1.208	1.257				
2.000	10.194	29.430	2134.7	-82.80	.137	221.5	35.5	1.207	239.3	244.6	254.9	257.0	1.359	1.459					
3.000	10.014	15.778	1822.8	-93.85	.129	241.9	27.8	1.764	243.8	251.6	266.8	269.8	1.385	1.532					
4.000	29.911	10.030	1620.3	-100.46	.124	253.5	23.6	2.354	273.1	277.1	287.1	289.1	1.574	1.602					
5.000	42.337	7.086	1479.5	-104.99	.119	261.2	20.9	2.953	277.1	282.1	289.7	290.7	1.602	1.622					
6.000	55.544	5.401	1373.7	-108.34	.114	266.7	19.0	3.524	281.5	286.5	290.7	291.7	1.639	1.651					
7.000	70.745	4.241	1269.7	-110.99	.113	271.0	17.6	4.146	282.7	287.7	290.8	291.8	1.651	1.666					
8.000	86.794	3.454	1220.8	-113.13	.110	274.4	16.4	4.754	283.6	288.6	291.7	292.7	1.670	1.686					
9.000	103.252	2.904	1163.0	-114.91	.108	277.2	15.5	5.334	284.3	289.3	292.7	293.7	1.692	1.710					
10.000	119.826	2.504	1113.5	-116.43	.104	279.6	14.7	5.879	284.8	289.8	292.7	293.7	1.671	1.699					
11.000	138.552	2.165	1070.3	-117.75	.104	281.6	14.0	6.406	284.8	289.8	292.7	293.7	1.679	1.699					
12.000	158.369	1.894	1032.2	-118.91	.103	283.4	13.5	7.103	284.8	289.8	292.7	293.7	1.686	1.699					
13.000	178.823	1.678	998.3	-119.94	.102	285.0	12.9	7.714	284.8	289.8	292.7	293.7	1.686	1.699					
14.000	199.731	1.507	967.8	-120.86	.101	286.4	12.5	8.312	284.8	289.8	292.7	293.7	1.686	1.699					
15.000	220.935	1.358	940.1	-121.69	.100	287.6	12.1	8.893	284.8	289.8	292.7	293.7	1.686	1.699					
16.000	242.313	1.238	915.0	-122.44	.099	288.8	11.7	9.456	284.8	289.8	292.7	293.7	1.686	1.699					
17.000	263.788	1.137	891.9	-123.13	.098	289.8	11.4	10.000	284.8	289.8	292.7	293.7	1.686	1.699					
18.000	286.992	1.045	870.7	-123.76	.097	290.8	11.1	10.586	284.8	289.8	292.7	293.7	1.686	1.699					
19.000	311.751	.962	851.0	-124.34	.097	291.6	10.8	11.204	284.8	289.8	292.7	293.7	1.686	1.699					
20.000	337.072	.890	832.7	-124.89	.096	292.4	10.5	11.822	284.8	289.8	292.7	293.7	1.686	1.699					
21.000	362.958	.827	815.7	-125.39	.096	293.2	10.3	12.436	284.8	289.8	292.7	293.7	1.686	1.699					
22.000	389.248	.771	799.7	-125.86	.095	293.9	10.1	13.046	284.8	289.8	292.7	293.7	1.686	1.699					
23.000	415.926	.721	784.8	-126.30	.095	294.5	9.8	13.649	284.8	289.8	292.7	293.7	1.686	1.699					
24.000	442.900	.677	770.7	-126.72	.094	295.2	9.6	14.244	284.8	289.8	292.7	293.7	1.686	1.699					
25.000	470.107	.634	757.4	-127.11	.094	295.7	9.5	14.830	284.8	289.8	292.7	293.7	1.686	1.699					
26.000	497.492	.603	744.9	-127.48	.094	296.3	9.3	15.406	284.8	289.8	292.7	293.7	1.686	1.699					
27.000	525.008	.571	733.0	-127.82	.093	296.8	9.1	15.972	284.8	289.8	292.7	293.7	1.686	1.699					
28.000	552.621	.543	721.7	-128.15	.093	297.3	9.0	16.527	284.8	289.8	292.7	293.7	1.686	1.699					
29.000	580.309	.517	711.0	-128.47	.093	297.7	8.8	17.071	284.8	289.8	292.7	293.7	1.686	1.699					
30.000	608.401	.493	700.8	-128.77	.092	298.2	8.7	17.615	284.8	289.8	292.7	293.7	1.686	1.699					
31.000	636.902	.469	691.0	-129.05	.092	298.6	8.6	18.232	284.8	289.8	292.7	293.7	1.686	1.699					
32.000	665.109	.447	681.7	-129.32	.092	299.0	8.4	18.849	284.8	289.8	292.7	293.7	1.686	1.699					
33.000	693.188	.427	672.8	-129.58	.092	299.4	8.3	19.467	284.8	289.8	292.7	293.7	1.686	1.699					
34.000	721.705	.408	664.2	-129.83	.092	299.7	8.2	20.084	284.8	289.8	292.7	293.7	1.686	1.699					
35.000	750.623	.390	656.0	-130.07	.091	300.1	8.1	20.699	284.8	289.8	292.7	293.7	1.686	1.699					
36.000	779.610	.374	648.2	-130.30	.091	300.4	8.0	21.313	284.8	289.8	292.7	293.7	1.686	1.699					
37.000	808.650	.359	640.4	-130.52	.091	300.7	7.9	21.924	284.8	289.8	292.7	293.7	1.686	1.699					
38.000	837.640	.345	633.3	-130.73	.091	301.0	7.8	22.532	284.8	289.8	292.7	293.7	1.686	1.699					
39.000	866.640	.332	626.3	-130.94	.091	301.3	7.7	23.135	284.8	289.8	292.7	293.7	1.686	1.699					
40.000	895.640	.320	619.5	-131.15	.091	301.6	7.6	23.735	284.8	289.8	292.7	293.7	1.686	1.699					
41.000	924.640	.308	613.0	-131.35	.090	301.9	7.5	24.330	284.8	289.8	292.7	293.7	1.686	1.699					
42.000	953.640	.296	606.7	-131.55	.090	302.1	7.4	24.920	284.8	289.8	292.7	293.7	1.686	1.699					
43.000	982.640	.288	600.6	-131.68	.090	302.4	7.3	25.505	284.8	289.8	292.7	293.7	1.686	1.699					
44.000	1011.640	.278	594.7	-131.86	.090	302.6	7.2	26.084	284.8	289.8	292.7	293.7	1.686	1.699					
45.000	1040.640	.270	589.0	-132.02	.090	302.9	7.2	26.658	284.8	289.8	292.7	293.7	1.686	1.699					
46.000	1069.640	.261	583.5	-132.15	.090	303.1	7.1	27.225	284.8	289.8	292.7	293.7	1.686	1.699					
47.000	1098.640	.253	578.1	-132.34	.090	303.3	7.0	27.786	284.8	289.8	292.7	293.7	1.686	1.699					
48.000	1127.640	.246	572.9	-132.49	.090	303.5	7.0	28.342	284.8	289.8	292.7	293.7	1.686	1.699					
49.000	1156.640	.239	567.9	-132.63	.090	303.7	6.9	28.891	284.8	289.8	292.7	293.7	1.686	1.699					
50.000	1185.640	.233	563.0	-132.78	.089	304.0	6.8	29.435	284.8	289.8	292.7	293.7	1.686	1.699					
5.141	20.414	14.696	1788.7	-94.77	.328	243.9	27.1	1.844	243.9	252.1	267.9	271.0	1.385	1.535					

SHIFTING EXPANSION															
C STAR = 5879.7 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL	LVL	
1.000	1.000	300.000	3765.6	-26.58	.358		125.8	103.0	.409	217.5	220.2	225.4	226.4	1.239	1.190
2.000	8.642	165.929	2784.4	-80.25	.588	221.5	35.5	1.267	249.0	254.6	265.5	267.6	1.363	1.465	
3.000	15.550	19.293	2513.4	-97.30	.489	248.1	31.4	1.554	256.5	264.6	280.4	283.5	1.404	1.551	
4.000	23.715	12.656	2188.4	-107.35	.476	262.2	30.8	2.136		268.0	280.4	293.0	296.0	1.603	
5.000	31.113	6.313	2162.1	-111.12	.471	271.2	29.7	2.715			294.5	304.4	309.0	1.995	
6.000	43.841	4.502	2034.3	-116.05	.356	279.0	25.4	3.261			298.1	304.4		1.665	
7.000	54.289	6.856	1929.5	-119.66	.350	284.6	23.6	3.675			300.9	309.0		1.686	
8.000	66.358	9.321	1867.1	-122.57	.355	284.6	22.2	4.709			302.8	311.2		1.703	
9.000	78.959	12.561	1804.5	-125.07	.351	285.0	21.1	5.505			304.5	317.1		1.717	
10.000	91.689	14.265	1719.2	-127.11	.373	295.8	20.1	6.171			305.4	315.9		1.729	
11.000	104.835	2.862	1668.1	-128.94	.382	298.4	19.4	6.766			306.3	317.8		1.739	
12.000	117.691	2.940	1623.3	-130.54	.389	300.7	18.7	7.331			306.9	319.4		1.748	
13.000	130.158	2.913	1584.5	-131.97	.397	302.7	18.1	7.867			307.3	320.9		1.756	
14.000	142.673	2.907	1550.2	-133.25	.393	304.6	17.6	8.392			307.6	322.4		1.763	
15.000	161.083	1.854	1519.2	-134.42	.392	306.3	17.1	9.237			307.7	323.7		1.770	
16.000	177.250	1.693	1491.0	-135.48	.391	307.2	16.7	9.875			307.8	325.5		1.776	
17.000	192.827	1.556	1465.0	-136.46	.390	309.2	16.3	10.501			307.8	325.5		1.783	
18.000	208.040	1.440	1441.0	-137.36	.388	311.4	16.0	11.114			307.8	325.5		1.790	
19.000	224.094	1.339	1418.6	-138.20	.385	313.6	15.7	11.712			307.8	325.5		1.795	
20.000	239.686	1.252	1397.7	-138.99	.383	312.4	15.4	12.293			307.8	325.5		1.799	
21.000	255.208	1.176	1378.0	-139.71	.380	313.7	15.1	12.858			307.8	325.5		1.799	
22.000	270.662	1.102	1359.3	-140.36	.377	315.6	14.9	13.409			307.8	325.5		1.803	
23.000	286.219	1.041	1340.9	-140.96	.374	315.4	14.6	13.943			307.8	325.5		1.807	
24.000	316.238	.980	1323.1	-141.67	.369	316.4	14.4	14.674			307.8	325.5		1.810	
25.000	352.360	.924	1306.6	-142.26	.365	317.2	14.2	15.311			307.8	325.5		1.813	
26.000	383.155	.874	1290.6	-142.82	.361	318.0	14.0	15.946			307.8	325.5		1.816	
27.000	413.994	.827	1275.2	-143.35	.357	317.5	13.7	16.580			307.8	325.5		1.819	
28.000	444.151	.787	1260.5	-143.85	.354	319.4	13.5	17.210			307.8	325.5		1.822	
29.000	474.300	.749	1246.4	-144.35	.350	320.1	13.4	17.837			307.8	325.5		1.825	
30.000	499.717	.715	1232.8	-144.79	.346	320.7	13.2	18.458			307.8	325.5		1.827	
31.000	539.280	.683	1219.7	-145.23	.343	321.3	13.0	19.074			307.8	325.5		1.829	
32.000	578.947	.654	1207.1	-145.64	.340	321.9	12.8	19.684			307.8	325.5		1.832	
33.000	618.761	.627	1194.9	-146.06	.336	322.4	12.7	20.289			307.8	325.5		1.834	
34.000	658.647	.602	1183.1	-146.45	.333	322.9	12.6	20.886			307.8	325.5		1.836	
35.000	698.612	.578	1171.7	-146.83	.330	323.4	12.4	21.477			307.8	325.5		1.838	
36.000	738.646	.557	1160.6	-147.19	.327	323.9	12.3	22.063			307.8	325.5		1.840	
37.000	758.738	.537	1149.9	-147.53	.324	324.4	12.2	22.638			307.8	325.5		1.842	
38.000	778.668	.518	1139.5	-147.87	.322	324.8	12.0	23.208			307.8	325.5		1.843	
39.000	799.092	.501	1129.4	-148.19	.319	325.5	11.9	23.772			307.8	325.5		1.845	
40.000	820.855	.485	1119.5	-148.51	.317	325.7	11.8	24.331			307.8	325.5		1.846	
41.000	843.338	.468	1109.8	-148.81	.316	326.1	11.7	24.911			307.8	325.5		1.848	
42.000	866.132	.450	1100.4	-149.11	.314	326.6	11.6	25.541			307.8	325.5		1.850	
43.000	889.175	.435	1091.2	-149.39	.313	326.9	11.4	26.285			307.8	325.5		1.851	
44.000	912.455	.421	1082.1	-149.67	.311	327.2	11.3	26.994			307.8	325.5		1.853	
45.000	935.941	.405	1073.1	-149.94	.310	327.5	11.2	27.715			307.8	325.5		1.854	
46.000	959.683	.393	1065.1	-150.20	.309	327.9	11.1	28.418			307.8	325.5		1.855	
47.000	983.609	.383	1056.9	-150.46	.308	328.3	11.0	29.145			307.8	325.5		1.857	
48.000	1007.729	.371	1048.8	-150.70	.306	328.6	10.9	29.845			307.8	325.5		1.858	
49.000	1032.039	.360	1040.9	-150.94	.305	329.0	10.8	30.545			307.8	325.5		1.859	
50.000	1056.571	.350	1033.2	-151.17	.304	329.2	10.8	30.999			307.8	325.5		1.860	
3.614	20.014	14.696	2386.7	-102.76	.442	257.4	32.4	2.203	257.4	267.2	286.1	289.8	1.409	1.586	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPHOPPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 CL*F3 1.88 -44.35 80.
 298 N2*H4 1.004 +12.05 20.

BULK DENSITY = 1.601 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRCPY 227.16 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	161.9
TEMP, DEG K	3523.0	2887.2	2349.8	1902.9	1612.2	1532.0	1225.1	973.5	769.5	606.3	476.8	374.8	3025.4
ENTHALPY (-)	30.85	51.67	68.65	82.44	91.19	93.57	102.51	109.63	115.28	119.74	123.25	126.00	47.25
CP	.3250	.3193	.3124	.3045	.2976	.2957	.2866	.2795	.2745	.2717	.2704	.2692	.3206
INPUL OPT		134.56	181.33	211.84	229.11	233.59	249.68	261.79	271.01	278.07	283.51	287.69	119.42
INPUL VAC		210.4	227.13	243.60	253.98	256.77	267.02	274.93	281.05	285.78	289.45	292.30	208.97
EPSILON		1.618	1.569	2.114	3.061	3.437	5.726	9.665	16.434	28.106	48.271	83.288	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.9
TEMP, DEG K	3523.0	3004.1	2552.0	2212.9	2013.3	1960.1	1757.2	1580.3	1412.4	1236.7	1042.3	849.4	5133.8
ENTHALPY (-)	30.85	52.04	69.90	85.04	95.20	98.07	109.45	119.46	128.28	135.97	142.53	147.95	47.03
X BAR	4.089	4.067	4.035	3.975	3.915	3.896	3.813	3.735	3.671	3.626	3.606	3.603	4.072
N	4.089	4.067	4.035	3.975	3.915	3.896	3.813	3.735	3.671	3.626	3.606	3.603	4.072
CP	.4639	.4058	.4677	.6042	.7070	.7308	.7726	.7156	.5789	.4153	.3035	.2698	.4072
INPUL OPT		135.75	184.29	217.10	236.59	241.81	261.48	277.64	291.12	302.40	311.69	319.16	118.61
INPUL VAC		213.55	232.60	252.13	265.39	269.11	283.63	296.02	306.52	315.22	322.12	327.45	211.61
EPSILON		1.024	1.416	2.286	3.475	3.968	7.169	13.249	24.714	45.827	82.992	146.961	1.000
COMPOSITION SHIFTING (MCL/100 GMS)													
28.92 CL	.7030	.7377	.7294	.6499	.5543	.5222	.3799	.2436	.1267	.0438	.0070	.0004	.7310
-13.50 CL*F	.0037	.0065	.0143	.0285	.0421	.0464	.0643	.0796	.0907	.0971	.0992	.0995	.0055
-38.87 CL*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-21.97 CL*F	.1473	.0948	.0502	.0240	.0132	.0110	.0049	.0020	.0007	.0002	.0000	.0000	.1083
.00 CL2	.0056	.0131	.0357	.0814	.1279	.1429	.2081	.2701	.3236	.3621	.3795	.3827	.0103
18.86 F	.2577	.1890	.1355	.0950	.0706	.0641	.0401	.0220	.0095	.0027	.0003	.0000	.2047
-64.50 F*H	2.3344	2.4002	2.4460	2.4723	2.4831	2.4853	2.4914	2.4943	2.4956	2.4961	2.4962	2.4963	2.3856
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0114	.0010	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020
79.20 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0016	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	.6240	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241	.6241

SYSTEM LIQUID NITROPROPellant										PC 300 PSIA		DENSITY		HEAT FORM		WT. 0/0	
COMPONENT										TREF FORMULA		GP/CC		(KCAL/FORM.WT.)		1.00	
CEG K										298 CL=63		1.00		44.35		80.	
298 N2=H4										1.00N		1.00N		+12.05		20.	
FROZEN EXPANSION										C STAR = 5337.4 FT/SEC		I SEA		I AT		I VAC	
CEG K										CAL/ I OPT DELVAC		LVL		10000		CF SEA CF VAC	
Epsilon										PC/P		P PSIA		TEMP		ENTHALPY	
1.000										300.000		5533.0		-30.85		.325	
1.000	1.052	161.945	3025.4	-47.25	.321	119.4	89.6	.553	200.4	203.3	208.0	209.0	1.211	1.260			
2.000	10.418	26.797	1947.2	-81.10	.305	209.3	32.6	1.131	225.2	230.3	239.9	241.9	1.358	1.458			
3.000	19.720	15.167	1626.5	-90.77	.298	226.3	25.2	1.660	229.1	236.4	250.7	253.5	1.381	1.528			
4.000	31.409	9.551	1433.2	-96.48	.293	258.9	21.2	2.219		256.4	260.1		1.568				
5.000	44.658	6.718	1299.9	-100.36	.289	245.9	18.7	2.780		259.8	264.6		1.595				
6.000	59.039	5.081	1200.2	-103.22	.286	250.9	16.9	3.327		262.1	267.8		1.616				
7.000	75.439	3.977	1121.7	-105.06	.280	254.8	15.6	3.932		263.7	270.5		1.630				
8.000	92.670	3.237	1057.8	-107.27	.282	257.8	14.5	4.478		264.7	272.3		1.642				
9.000	110.245	2.721	1004.5	-108.77	.280	260.3	13.6	5.011		265.4	274.0		1.652				
10.000	128.648	2.331	958.9	-110.04	.279	262.5	12.9	5.540		265.9	275.4		1.660				
11.000	149.441	2.007	919.4	-111.14	.278	264.5	12.3	6.124		266.1	276.6		1.667				
12.000	171.032	1.754	886.4	-112.11	.277	265.9	11.8	6.703		266.2	277.4		1.674				
13.000	193.235	1.553	853.8	-112.96	.276	267.3	11.3	7.271			278.6		1.679				
14.000	215.440	1.390	826.2	-113.72	.276	268.5	10.9	7.824			279.4		1.684				
15.000	238.681	1.257	801.3	-114.41	.275	269.6	10.5	8.357			280.1		1.689				
16.000	261.646	1.147	776.7	-115.24	.275	270.6	10.2	8.871			280.8		1.693				
17.000	286.301	1.048	758.0	-115.60	.274	271.5	9.9	9.417			281.4		1.696				
18.000	312.828	.959	739.0	-116.12	.274	272.3	9.6	10.001			281.9		1.700				
19.000	340.060	.882	721.5	-116.40	.274	273.1	9.3	10.583			282.5		1.705				
20.000	367.890	.815	705.2	-117.04	.273	273.8	9.1	11.162			282.9		1.709				
21.000	396.225	.757	690.1	-117.68	.273	274.5	8.9	11.736			283.4		1.710				
22.000	424.959	.704	676.0	-117.88	.273	275.1	8.7	12.302			283.8		1.711				
23.000	454.011	.661	662.8	-118.20	.273	275.7	8.5	12.860			284.2		1.713				
24.000	483.301	.621	650.4	-118.54	.272	276.2	8.3	13.407			284.5		1.715				
25.000	512.744	.585	638.7	-118.88	.272	276.7	8.2	13.947			284.8		1.717				
26.000	542.354	.553	627.7	-119.16	.272	277.2	8.0	14.470			285.2		1.719				
27.000	572.030	.524	617.2	-119.44	.272	277.6	7.9	14.985			285.5		1.721				
28.000	601.775	.499	607.3	-119.71	.272	278.0	7.7	15.489			285.7		1.722				
29.000	631.771	.473	597.9	-119.98	.272	278.4	7.6	15.984			286.0		1.724				
30.000	661.714	.449	589.0	-120.21	.272	278.8	7.5	16.464			286.3		1.726				
31.000	691.715	.427	580.4	-120.44	.271	279.2	7.3	17.227			286.5		1.727				
32.000	721.729	.406	572.3	-120.66	.271	279.5	7.2	17.808			286.7		1.729				
33.000	751.713	.388	564.5	-120.87	.271	279.8	7.1	18.389			287.0		1.730				
34.000	781.625	.371	557.1	-121.07	.271	280.2	7.0	18.967			287.2		1.731				
35.000	811.515	.355	549.9	-121.27	.271	280.5	6.9	19.542			287.4		1.732				
36.000	841.549	.340	543.1	-121.45	.271	280.7	6.8	20.113			287.6		1.734				
37.000	871.684	.326	536.5	-121.62	.271	281.0	6.7	20.681			287.8		1.735				
38.000	901.862	.314	530.2	-121.80	.271	281.3	6.7	21.244			287.9		1.736				
39.000	931.947	.302	524.1	-121.97	.271	281.5	6.6	21.802			288.1		1.737				
40.000	961.725	.291	518.2	-122.13	.271	281.8	6.5	22.355			288.3		1.738				
41.000	991.508	.281	512.6	-122.28	.271	282.0	6.4	22.901			288.4		1.739				
42.000	1021.287	.271	507.1	-122.43	.271	282.2	6.4	23.442			288.6		1.740				
43.000	1051.058	.262	501.8	-122.57	.271	282.5	6.3	23.977			288.7		1.741				
44.000	1080.833	.253	496.7	-122.71	.271	282.7	6.2	24.506			288.9		1.741				
45.000	1110.604	.244	491.8	-122.84	.270	282.9	6.1	25.028			289.0		1.742				
46.000	1140.379	.236	487.0	-122.97	.270	283.1	6.1	25.544			289.2		1.743				
47.000	1170.148	.228	482.4	-123.09	.270	283.3	6.0	26.055			289.3		1.744				
48.000	1200.000	.224	477.9	-123.21	.270	283.5	6.0	26.558			289.4		1.745				
49.000	1230.000	.219	473.4	-123.32	.269	283.7	5.9	27.055			289.5		1.746				
50.000	1260.000	.214	469.0	-123.42	.269	283.9	5.9	27.547			289.6		1.747				
51.000	1290.000	.210	464.6	-123.51	.269	284.1	5.8	28.034			289.7		1.748				
52.000	1320.000	.206	460.2	-123.60	.269	284.3	5.8	28.516			289.8		1.749				
53.000	1350.000	.202	455.8	-123.68	.269	284.5	5.7	29.000			289.9		1.750				
54.000	1380.000	.198	451.4	-123.76	.269	284.7	5.7	29.477			290.0		1.751				
55.000	1410.000	.194	447.0	-123.84	.269	284.9	5.6	29.950			290.1		1.752				
56.000	1440.000	.190	442.6	-123.91	.269	285.1	5.6	30.418			290.2		1.753				
57.000	1470.000	.186	438.2	-123.98	.269	285.3	5.5	30.882			290.3		1.754				
58.000	1500.000	.182	433.8	-124.05	.269	285.5	5.5	31.342			290.4		1.755				
59.000	1530.000	.178	429.4	-124.12	.269	285.7	5.4	31.800			290.5		1.756				
60.000	1560.000	.174	425.0	-124.18	.269	285.9	5.4	32.255			290.6		1.757				
61.000	1590.000	.170	420.6	-124.25	.269	286.1	5.3	32.707			290.7		1.758				
62.000	1620.000	.166	416.2	-124.31	.269	286.3	5.3	33.156			290.8		1.759				
63.000	1650.000	.162	411.8	-124.37	.269	286.5	5.2	33.602			290.9		1.760				
64.000	1680.000	.158	407.4	-124.43	.269	286.7	5.2	34.045			291.0		1.761				
65.000	1710.000	.154	403.0	-124.49	.269	286.9	5.1	34.485			291.1		1.762				
66.000	1740.000	.150	398.6	-124.55	.269	287.1	5.1	34.922			291.2		1.763				
67.000	1770.000	.146	394.2	-124.61	.269	287.3	5.0	35.356			291.3		1.764				
68.000	1800.000	.142	389.8	-124.67	.269	287.5	5.0	35.787			291.4		1.765				
69.000	1830.000	.138	385.4	-124.73	.269	287.7	4.9	36.215			291.5		1.766				
70.000	1860.000	.134	381.0	-124.79	.269	287.9	4.9	36.640			291.6		1.767				
71.000	1890.000	.130	376.6	-124.85	.269	288.1	4.8	37.062			291.7		1.768				
72.000	1920.000	.126	372.2	-124.91	.269	288.3	4.8	37.481			291.8		1.769				
73.000	1950.000	.122	367.8	-124.97	.269	288.5	4.7	37.897			291.9		1.770				
74.000	1980.000	.118	363.4	-125.03	.269	288.7	4.7	38.310			292.0		1.771				
75.000	2010.000	.114	359.0	-125.09	.269	288.9	4.6	38.720			292.1		1.772				
76.000	2040.000	.110	354.6	-125.15	.269	289.1	4.6	39.127			292.2		1.773				
77.000	2070.000	.106	350.2	-125.21	.269	289.3	4.5	39.531			292.3		1.774				
78.000	2100.000	.102	345.8	-125.27	.269	289.5	4.5	39.932			292.4		1.775				
79.000	2130.000	.098	341.4	-125.33	.269	289.7	4.4	40.331			292.5		1.776				
80.000	2160.000	.094	337.0	-125.39	.269	289.9	4.4	40.727			292.6		1.777				

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F₂-H₂ SYSTEM

PRESSURE PROFILE DATA			
SYSTEM LIQUID BIPROPELLANT PC-1000, PSIA			
COMPONENT	TREF FORMULA	DENSITY	HEAT FORM
	DEG K	GM/CC	(KCAL/FORM.WT.)
85.2 F2		1.51	-3.47
20.4 H2		0.071	-1.887
			25.

BULK DENSITY = .249 GM/CC
MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 603.37 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	540.2
TEMP, DEG K	2348.3	1881.2	1491.6	1169.3	908.2	781.7	701.3	540.0	415.5	319.6	242.9	179.1	2026.9
ENTHALPY (-)	30.25	85.74	129.99	164.87	192.08	205.01	213.16	229.42	241.93	251.52	259.12	265.41	68.69
CP	1.2131	1.1611	1.1078	1.0582	1.0276	1.0166	1.0111	1.0054	1.0030	.9963	.9882	.9796	1.1788
IMPUL OPT		219.71	294.55	342.21	375.21	389.90	398.90	416.24	429.12	438.73	446.21	452.29	182.87
IMPUL VAC		326.18	357.52	384.70	405.31	414.83	420.76	432.37	441.16	447.79	452.98	457.21	320.70
EPSILON		1.048	1.557	2.639	4.696	6.649	8.569	15.882	29.773	56.263	105.638	192.975	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	540.8
TEMP, DEG K	2348.3	1888.1	1498.1	1174.8	912.7	785.7	704.9	542.8	417.7	321.3	244.4	180.3	2033.6
ENTHALPY (-)	30.25	85.84	130.24	165.26	192.59	205.57	213.76	230.09	242.66	252.30	259.93	266.23	68.68
X BAR	14.384	14.375	14.375	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.377
N	14.384	14.375	14.375	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.377
CP	1.2627	1.1689	1.1092	1.0587	1.0278	1.0166	1.0109	1.0054	1.0028	.9964	.9868	.9798	1.1940
IMPUL OPT		219.91	294.93	342.70	375.80	390.53	399.55	416.95	429.86	439.50	446.99	453.08	182.84
IMPUL VAC		326.61	358.05	385.30	405.98	415.53	421.47	433.12	441.94	448.59	453.79	458.03	321.07
EPSILON		1.049	1.558	2.642	4.701	6.656	8.578	15.901	29.809	56.340	105.835	193.533	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-64.50 F+H	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0183	.0017	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 H2	10.4180	10.4263	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4251

SYSTEM LIQUID HYDROFLUORIC PC-1000, PSIA												
COMPONENT	TEMP	FORMULA	DENSITY	HEAT	FORM	WT. 4/5						
DEG. F			GM/CC	(KCAL/GRM-1)	(KCAL/GRM-1)							
85.7 F2			1.51	-3.47		75.						
20.4 F2			1.51	-3.47		25.						
PROTEIN EXPANSION												
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	OPT DELVAC	DELVAC I SEA	I AT	I AT	I VAC	CP SEA	CP VAC
			DEG. F	KCAL/100GM GR DEG	DEG	/P	LVL	10000	10000	LVL		
1.000	1.000	1000.000	234.0	-30.25	1.215							
2.000	10.076	91.045	1310.3	-109.00	1.001	322.3	49.7	.541	344.1	340.5	371.1	372.0
3.000	19.452	50.372	1108.3	-171.76	1.050	350.9	39.1	.777	378.0	382.0	390.5	390.0
4.000	31.640	31.579	973.4	-105.58	1.034	367.4	32.9	1.041	385.0	389.5	400.3	400.0
5.000	45.970	27.108	865.2	-128.58	1.025	370.1	29.1	1.278	388.5	392.0	407.2	407.0
6.000	58.526	17.146	817.0	-201.42	1.010	365.9	26.3	1.535	389.0	393.0	412.2	412.0
7.000	73.653	11.577	768.7	-268.75	1.015	371.8	24.3	1.787	397.7	413.1	416.1	416.0
8.000	90.257	11.080	722.2	-211.05	1.012	368.0	22.6	2.044	398.2	415.7	419.2	419.0
9.000	107.875	9.278	680.7	-138.48	1.018	369.5	21.2	2.300		417.9	421.8	421.0
10.000	126.952	7.877	656.4	-517.44	1.009	353.8	20.2	2.544		419.6	424.0	424.0
11.000	146.980	6.802	640.5	-220.31	1.008	358.6	19.3	2.833		421.1	425.9	425.9
12.000	167.739	5.962	607.7	-222.61	1.007	369.1	18.5	3.098		422.5	427.5	427.5
13.000	188.773	5.257	584.2	-224.68	1.006	371.4	17.8	3.358		423.9	429.1	429.1
14.000	210.581	4.701	549.5	-226.56	1.005	373.5	17.1	3.613		425.1	430.5	430.5
15.000	232.106	4.308	553.1	-228.10	1.004	375.9	16.6	3.877		426.9	431.5	431.5
16.000	254.096	3.930	538.3	-229.59	1.005	376.4	16.1	4.085		428.5	432.5	432.5
17.000	277.270	3.581	525.8	-230.75	1.002	377.8	15.6	4.261		429.8	433.5	433.5
18.000	305.212	3.274	517.5	-232.70	1.005	378.5	15.2	4.438		430.8	434.5	434.5
19.000	331.807	3.015	500.8	-233.56	1.002	379.3	14.8	4.615		431.8	435.2	435.2
20.000	358.036	2.786	480.2	-235.43	1.005	381.4	14.5	4.790		432.7	435.9	435.9
21.000	384.976	2.587	460.3	-237.32	1.004	382.2	14.1	4.962		433.5	436.6	436.6
22.000	411.616	2.416	441.1	-238.25	1.004	383.4	13.8	5.130		434.3	437.3	437.3
23.000	442.345	2.261	422.4	-237.22	1.004	385.3	13.5	5.292		435.0	437.9	437.9
24.000	470.464	2.120	404.3	-236.03	1.004	385.2	13.3	5.449		435.8	438.4	438.4
25.000	498.580	2.000	386.7	-234.80	1.003	385.9	13.0	5.600		436.7	439.0	439.0
26.000	526.631	1.898	369.4	-233.52	1.003	387.0	12.8	5.745		437.6	439.5	439.5
27.000	554.655	1.800	352.4	-232.20	1.003	387.4	12.6	5.885		438.4	440.0	440.0
28.000	582.282	1.717	336.2	-230.84	1.003	388.0	12.4	6.020		439.1	440.4	440.4
29.000	609.816	1.640	320.0	-229.47	1.003	388.7	12.2	6.150		439.8	440.8	440.8
30.000	636.350	1.567	304.2	-228.06	1.003	389.2	12.0	6.285		440.5	441.2	441.2
31.000	671.208	1.510	288.5	-226.61	1.003	389.8	11.8	6.415		441.2	441.6	441.6
32.000	704.623	1.459	273.1	-225.15	1.002	390.5	11.7	6.540		441.9	442.0	442.0
33.000	736.550	1.399	258.2	-223.68	1.002	390.9	11.5	6.661		442.5	442.5	442.5
34.000	772.668	1.294	243.3	-222.15	1.002	391.4	11.3	6.785		443.2	443.2	443.2
35.000	807.809	1.238	228.7	-220.58	1.002	391.8	11.2	6.903		443.8	443.8	443.8
36.000	843.041	1.180	214.2	-218.98	1.001	392.3	11.0	7.015		444.3	444.3	444.3
37.000	878.623	1.130	199.7	-217.37	1.001	392.7	10.9	7.120		444.8	444.8	444.8
38.000	914.516	1.093	185.7	-215.71	1.001	393.1	10.8	7.221		445.3	445.3	445.3
39.000	950.673	1.052	171.8	-214.01	1.001	393.5	10.7	7.318		445.8	445.8	445.8
40.000	987.061	1.015	158.4	-212.28	1.000	394.0	10.5	7.408		446.3	446.3	446.3
41.000	1023.639	.977	145.2	-210.54	1.000	394.3	10.4	7.491		446.7	446.7	446.7
42.000	1060.371	.943	132.6	-208.72	1.000	394.7	10.3	7.568		447.0	447.0	447.0
43.000	1097.222	.911	120.1	-206.77	1.000	395.0	10.2	7.641		447.3	447.3	447.3
44.000	1134.168	.880	107.8	-204.71	1.000	395.3	10.1	7.708		447.6	447.6	447.6
45.000	1171.198	.850	95.5	-202.53	1.000	395.7	10.0	7.771		447.9	447.9	447.9
46.000	1208.165	.820	83.7	-200.25	1.000	396.0	9.9	7.830		448.2	448.2	448.2
47.000	1245.180	.800	72.3	-197.95	1.000	396.3	9.8	7.885		448.5	448.5	448.5
48.000	1282.173	.780	61.3	-195.55	1.000	396.6	9.7	7.938		448.8	448.8	448.8
49.000	1319.120	.760	50.8	-193.05	1.000	396.9	9.6	7.988		449.1	449.1	449.1
50.000	1356.006	.737	39.5	-190.42	1.000	397.1	9.5	8.035		449.4	449.4	449.4
6.649	60.946	10.696	781.7	-205.01	1.017	389.9	24.9	1.696	399.9	397.4	411.9	412.0

SHIFTING EXPANSION												
C STAR = 4222.9 F/DEG												
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	OPT DELVAC	DELVAC I	SEA	I AT	I AT	I VAC	CP SEA CP VAC
			DEG F	KCAL/100GM GR DEG		/P	LVL	10000	10000	10000	LVL	
1.000	1.000	1000.000	234.0	-30.25	1.263							
2.000	10.050	92.116	1325.0	-109.27	1.002	322.0	49.9	.542	344.0	347.0	371.6	372.0
3.000	19.422	50.443	1110.0	-172.11	1.050	351.6	39.2	.777	379.1	382.0	389.2	389.5
4.000	31.622	31.624	978.5	-105.81	1.035	367.9	33.0	1.063	385.0	390.2	399.1	400.9
5.000	45.908	25.175	878.5	-125.85	1.025	378.6	29.2	1.280	388.5	392.7	405.8	407.0
6.000	58.233	17.172	821.5	-201.97	1.019	368.5	26.4	1.530	390.5	397.1	410.2	410.0
7.000	73.535	11.577	768.7	-267.28	1.015	372.8	24.3	1.770	398.0	413.7	418.8	418.0
8.000	90.112	11.087	726.2	-211.61	1.012	367.2	22.7	2.047	398.0	416.4	419.9	419.0
9.000	107.875	9.285	689.6	-132.62	1.018	369.1	21.5	2.300		418.8	422.5	422.0
10.000	126.952	7.890	660.5	-514.20	1.009	353.4	20.3	2.547		420.5	424.0	424.0
11.000	146.791	6.812	635.1	-220.91	1.008	367.3	19.3	2.836		421.8	425.9	425.9
12.000	167.460	5.972	611.2	-223.27	1.007	369.7	18.5	3.103		423.0	427.5	427.5
13.000	188.773	5.268	586.8	-225.27	1.006	371.2	17.8	3.360		424.0	429.1	429.1
14.000	210.112	4.734	571.7	-227.09	1.006	373.0	17.2	3.613		425.8	431.0	431.0
15.000	231.736	4.315	554.3	-228.78	1.006	375.3	16.6	3.855		426.9	432.2	432.2
16.000	253.640	3.943	541.4	-230.23	1.005	377.1	16.1	4.091		428.2	433.2	433.2
17.000	277.767	3.587	527.8	-231.60	1.005	378.5	15.7	4.268		429.7	434.2	434.2
18.000	306.642	3.282	515.3	-232.86	1.005	379.8	15.2	4.440		430.7	435.1	435.1
19.000	331.210	3.019	500.7	-233.82	1.005	381.0	14.8	4.613		431.5	435.9	435.9
20.000	358.293	2.791	493.0	-235.10	1.004	382.1	14.5	4.785		432.4	436.7	436.7
21.000	389.791	2.592	483.1	-236.10	1.004	383.2	14.2	4.951		433.0	437.4	437.4
22.000	415.598	2.416	473.8	-237.03	1.004	384.1	13.9	5.100		433.6	438.0	438.0
23.000	441.908	2.260	465.1	-237.99	1.004	385.0	13.6	5.245		434.2	438.6	438.6
24.000	469.643	2.120	456.9	-238.72	1.004	385.9	13.3	5.386		434.8	439.2	439.2
25.000	497.737	2.000	448.3	-239.30	1.003	386.8	13.1	5.521		435.4	439.7	439.7
26.000	525.764	1.902	442.0	-240.22	1.003	387.6	12.8	5.651		436.0	440.2	440.2
27.000	553.640	1.806	435.2	-241.21	1.003	388.1	12.6	5.777		436.6	440.7	440.7
28.000	581.357	1.720	428.6	-242.18	1.003	388.7	12.4	5.900		437.1	441.2	441.2
29.000	609.062	1.642	422.5	-243.18	1.003	389.4	12.2	6.019		437.6	441.6	441.6
30.000	637.150	1.569	416.6	-244.77	1.003	390.0	12.0	6.137		438.1	442.0	442.0
31.000	671.208	1.510	401.9	-246.37	1.002	390.5	11.9	6.251		438.6	442.5	442.5
32.000	704.623	1.459	387.1	-247.89	1.002	391.0	11.7	6.361		439.1	443.0	443.0
33.000	737.192	1.399	373.0	-249.38	1.002	391.6	11.5	6.469		439.6	443.5	443.5
34.000	771.540	1.296	359.7	-250.87	1.002	392.1	11.4	6.576		440.1	444.0	444.0
35.000	806.317	1.200	347.0	-252.36	1.001	392.6	11.2	6.683		440.6	444.5	444.5
36.000	841.436	1.108	336.5	-253.76	1.001	393.0	11.0	6.788		441.1	445.0	445.0
37.000	876.900	1.020	327.0	-255.08	1.001	393.5	10.8	6.893		441.6	445.5	445.5
38.000	912.812	0.935	317.0	-256.34	1.001	393.9	10.6	6.997		442.1	446.0	446.0
39.000	949.179	0.850	307.0	-257.50	1.000	394.3	10.7	7.102		442.6	446.5	446.5
40.000	986.235	0.765	297.0	-258.63	1.000	394.7	10.6	7.206		443.1	447.0	447.0
41.000	1023.173	0.680	287.0	-259.73	1.000	395.1	10.5	7.310		443.6	447.5	447.5
42.000	1059.994	0.613	282.7	-260.80	1.000	395.5	10.4	7.413		444.1	448.0	448.0
43.000	1097.223	0.553	280.3	-261.81	1.000	395.7	10.2	7.515		444.6	448.5	448.5
44.000	1135.112	0.488	285.0	-262.85	0.999	396.1	10.1	7.617		445.1	449.0	449.0
45.000	1173.164	0.433	281.5	-263.10	0.999	396.4	10.0	7.718		445.6	449.5	449.5
46.000	1211.400	0.380	278.0	-263.40	0.999	396.7	9.9	7.819		446.1	450.0	450.0
47.000	1249.961	0.329	268.3	-263.80	0.999	397.0	9.8	7.920		446.6	450.5	450.5
48.000	1279.961	0.281	263.1	-263.10	0.998	397.3	9.8	8.020		447.1	451.0	451.0
49.000	1319.736	0.235	253.0	-263.27	0.998	397.6	9.7	8.119		447.6	451.5	451.5
50.000	1361.173	0.190	243.0	-263.57	0.998	397.9	9.7	8.218		448.1	452.0	452.0
0.050	588.000	10.000	789.7	-203.27	1.017	390.5	25.0	1.781	390.5	398.1	412.0	412.5

PRESSURE PROFILE DATA												
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA												
COMPONENT	TREF FORMULA		DENSITY		HEAT FORM		WT. 0/0					
	DEG K		GM/CC		(KCAL/FORM.WT.)							
	85.2 F2		1.51		-3.47		80.					
	20.4 H2		.071		-1.687		20.					
BULK DENSITY = .299 GM/CC												
MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL												
PRESSURE PROFILE DATA												
CHAMBER ENTROPY 537.80 EU/100GMS												THROAT
CHAMBER												
FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 562.6
TEMP, DEG K	2855.4	2304.0	1842.5	1458.3	1141.2	985.2	885.1	682.7	525.3	403.9	310.3	235.2 2478.6
ENTHALPY (-)	26.03	82.90	128.61	164.98	193.61	207.27	215.91	235.16	246.45	256.67	264.50	270.75 65.12
CP	1.0497	1.0108	.9479	.9232	.8836	.8679	.8592	.8463	.8422	.8400	.8347	.8286 1.0252
IMPUL OPT	222.43	298.72	347.68	381.81	397.07	406.43	424.49	437.89	447.92	455.47	461.39	464.42
IMPUL VAC	330.64	363.16	391.49	413.04	422.99	429.18	441.29	450.42	457.34	462.59	466.72	468.83
EPSILON	1.051	1.571	2.684	4.804	6.817	8.793	16.311	30.357	57.695	109.502	205.841	1.000
SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 546.8
TEMP, DEG K	2855.4	2349.3	1892.0	1501.7	1177.7	1017.9	915.0	706.7	544.2	418.7	322.1	245.1 2519.6
ENTHALPY (-)	26.03	83.39	129.98	167.21	196.58	210.61	219.50	237.26	250.96	261.50	269.58	275.98 64.90
X BAR	12.084	12.037	12.027	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026 12.048
N	12.084	12.037	12.027	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026 12.048
CP	1.2658	1.0766	.9811	.9290	.8863	.8699	.8599	.8455	.8411	.8392	.8340	.8278 1.1297
IMPUL OPT	223.39	300.71	350.45	385.18	400.72	410.25	428.67	442.34	452.59	460.29	466.30	468.90
IMPUL VAC	332.84	366.13	395.00	416.97	427.12	433.44	445.81	455.13	462.21	467.57	471.76	473.60
EPSILON	1.053	1.582	2.706	4.849	6.886	8.886	16.498	30.925	58.413	110.999	209.417	1.000
COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-64.50 F+H	4.2102	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1158	.0231	.0022	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0433
.00 H2	7.7577	7.8039	7.8143	7.8153	7.8154	7.8154	7.8154	7.8154	7.8154	7.8154	7.8154	7.7937

SYSTEM LIQUID DIPROPELLANT PC 1000, PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. 0/0
	DEG K	GM/CC	(KCAL/FORM.WT.1	
85.2 F2		1.51	-5.47	85.
20.4 H2		0.071	-1.087	20.

FROZEN EXPANSION

C STAR = 8326.5 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA CF VAC
			DEG K	KCAL/1000GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL
1.000	1.000	1000.000	2855.4	-26.05	1.050								
1.000	1.043	542.642	2478.6	-65.12	1.025	184.4	140.4	259	321.0	322.2	324.4	324.8	1.255
2.000	1.007	94.281	1046.0	-147.49	.946	325.9	51.6	.548	369.5	371.9	374.6	377.4	1.459
3.000	10.234	51.900	1390.6	-171.20	.915	355.4	40.8	.785	388.7	388.2	394.9	396.2	1.531
4.000	30.441	32.614	1231.9	-185.55	.895	372.6	34.5	1.057	391.5	396.2	405.3	407.1	1.533
5.000	42.404	23.583	1122.2	-195.29	.882	383.7	30.5	1.295	395.2	401.0	412.1	414.3	1.601
6.000	56.213	17.790	1039.5	-202.55	.873	391.9	27.7	1.557	394.7	403.6	416.9	419.6	1.622
7.000	70.874	14.110	974.3	-208.22	.867	398.1	25.4	1.812	405.1	420.4	423.7	427.0	1.637
8.000	86.484	11.515	921.0	-212.82	.862	403.1	23.9	2.073	405.7	425.4	427.0	430.0	1.650
9.000	103.485	9.488	874.5	-216.05	.859	407.2	22.5	2.350		425.7	429.7	430.1	1.661
10.000	121.913	8.203	838.5	-219.92	.856	410.7	21.3	2.600		427.6	432.0	432.0	1.670
11.000	141.146	7.085	805.5	-222.73	.853	413.7	20.3	2.870		429.1	434.0	434.0	1.677
12.000	161.130	6.206	774.6	-225.20	.851	416.3	19.5	3.139		430.4	435.7	435.7	1.684
13.000	181.649	5.505	750.9	-227.39	.850	418.5	18.7	3.403		431.5	437.3	437.3	1.690
14.000	202.507	4.938	727.9	-229.34	.849	420.6	18.1	3.660		432.4	438.6	438.6	1.695
15.000	223.542	4.473	707.1	-231.10	.847	422.4	17.5	3.909		433.2	439.9	439.9	1.700
16.000	244.635	4.088	688.2	-232.70	.847	424.0	17.0	4.148		433.9	441.0	441.0	1.704
17.000	267.915	3.733	670.9	-234.16	.846	425.5	16.5	4.373		434.5	442.0	442.0	1.708
18.000	292.431	3.415	655.1	-235.50	.845	426.9	16.0	4.589		435.0	442.9	442.9	1.712
19.000	318.422	3.140	640.4	-236.74	.845	428.1	15.6	4.794		435.3	443.8	443.8	1.715
20.000	344.581	2.902	626.8	-237.89	.844	429.3	15.2	5.254		435.6	444.6	444.6	1.718
21.000	371.199	2.694	614.1	-238.96	.844	430.4	14.9	5.531		435.9	445.3	445.3	1.721
22.000	398.167	2.512	602.3	-239.94	.844	431.4	14.6	5.805		436.1	446.0	446.0	1.724
23.000	425.383	2.351	591.2	-240.90	.843	432.3	14.3	6.075		436.3	446.6	446.6	1.726
24.000	452.751	2.209	580.8	-241.77	.843	433.2	14.0	6.339		436.4	447.2	447.2	1.729
25.000	480.181	2.083	571.0	-242.60	.843	434.1	13.7	6.597		436.5	447.8	447.8	1.731
26.000	507.549	1.970	561.7	-243.38	.843	434.9	13.5	6.849		436.6	448.3	448.3	1.733
27.000	534.980	1.867	553.2	-244.12	.843	435.6	13.3	7.095		436.7	448.8	448.8	1.735
28.000	562.154	1.779	544.7	-244.81	.843	436.3	13.0	7.331		436.8	449.3	449.3	1.737
29.000	589.203	1.697	536.8	-245.44	.842	436.9	12.8	7.561		436.9	449.8	449.8	1.738
30.000	616.066	1.623	529.5	-246.11	.842	437.6	12.6	7.785		437.0	450.2	450.2	1.740
31.000	645.078	1.550	522.1	-246.71	.842	438.2	12.4	8.000		437.1	450.6	450.6	1.742
32.000	677.226	1.477	515.3	-247.29	.842	438.7	12.3	8.309		437.2	451.0	451.0	1.743
33.000	709.969	1.409	508.7	-247.84	.842	439.3	12.1	8.589		437.3	451.4	451.4	1.745
34.000	743.140	1.346	502.5	-248.37	.842	439.8	11.9	8.849		437.4	451.7	451.7	1.746
35.000	776.421	1.287	496.5	-248.88	.842	440.3	11.8	9.149		437.5	452.1	452.1	1.747
36.000	810.895	1.233	490.7	-249.34	.842	440.8	11.6	9.429		437.6	452.4	452.4	1.749
37.000	845.341	1.183	485.1	-249.83	.842	441.2	11.5	9.708		437.7	452.7	452.7	1.750
38.000	880.122	1.136	479.8	-250.28	.841	441.7	11.3	9.986		437.8	453.0	453.0	1.751
39.000	915.199	1.093	474.7	-250.71	.841	442.1	11.2	10.263		437.9	453.3	453.3	1.752
40.000	950.535	1.052	469.7	-251.11	.841	442.5	11.1	10.538		438.0	453.6	453.6	1.753
41.000	986.087	1.014	464.9	-251.53	.841	442.9	11.0	10.812		438.1	453.9	453.9	1.754
42.000	1021.824	.979	460.1	-251.92	.841	443.3	10.9	11.085		438.2	454.1	454.1	1.755
43.000	1057.710	.945	455.9	-252.29	.841	443.7	10.7	11.351		438.3	454.4	454.4	1.756
44.000	1093.709	.914	451.6	-252.63	.841	444.0	10.6	11.618		438.4	454.6	454.6	1.757
45.000	1129.791	.885	447.4	-252.95	.841	444.4	10.5	11.881		438.5	454.9	454.9	1.758
46.000	1165.924	.858	443.4	-253.35	.841	444.7	10.4	12.141		438.6	455.1	455.1	1.759
47.000	1202.081	.832	439.4	-253.68	.841	445.0	10.3	12.398		438.7	455.3	455.3	1.760
48.000	1238.235	.808	435.6	-253.99	.841	445.3	10.2	12.652		438.8	455.5	455.5	1.761
49.000	1274.342	.785	432.0	-254.31	.841	445.6	10.1	12.902		438.9	455.8	455.8	1.761
50.000	1310.441	.763	428.4	-254.61	.841	445.9	10.0	13.149		439.0	456.0	456.0	1.762
6.817	68.046	14.696	985.2	-207.27	.848	397.1	25.9	1.744	397.1	400.9	420.0	423.0	1.535

SHIFTING EXPANSION

C STAR = 8326.5 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA CF VAC
			DEG K	KCAL/1000GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL
1.000	1.000	1000.000	2855.4	-26.05	1.204								
1.000	1.829	546.824	2519.4	-64.90	1.130	183.9	142.7	261	322.8	325.9	326.2	326.4	1.237
2.000	10.434	95.842	1499.5	-144.71	.952	327.6	52.6	.551	372.3	374.7	379.5	380.4	1.427
3.000	18.962	52.738	1837.7	-175.12	.920	357.4	41.7	.807	387.9	391.4	398.7	399.5	1.486
4.000	30.249	35.059	1725.5	-187.88	.898	375.5	35.2	1.046	394.9	399.6	406.7	410.6	1.513
5.000	41.777	25.937	1162.9	-197.00	.885	386.7	31.3	1.306	398.7	404.5	415.7	417.9	1.602
6.000	55.381	18.057	1077.9	-205.37	.874	395.0	28.4	1.571	400.3	407.2	420.7	423.4	1.534
7.000	69.783	14.350	1010.9	-211.22	.869	401.4	26.2	1.827	408.8	424.4	427.6	430.0	1.638
8.000	85.408	11.494	954.1	-215.90	.864	406.9	24.5	2.084	409.5	427.4	429.8	432.0	1.651
9.000	101.977	9.408	910.2	-219.92	.860	410.7	23.0	2.350		429.7	433.7	434.0	1.662
10.000	119.914	8.339	871.0	-223.29	.856	414.2	21.9	2.621		431.6	436.1	436.1	1.671
11.000	138.813	7.204	837.0	-226.20	.854	417.3	20.8	2.894		433.2	438.1	438.1	1.679
12.000	158.448	6.310	807.1	-228.75	.851	419.9	20.0	3.165		434.5	439.9	439.9	1.686
13.000	178.472	5.597	780.5	-231.00	.850	422.3	19.2	3.432		435.6	441.5	441.5	1.692
14.000	199.233	5.019	756.8	-233.02	.848	424.3	18.5	3.693		436.6	442.9	442.9	1.697
15.000	219.989	4.544	735.3	-234.84	.847	426.2	17.9	3.945		437.4	444.1	444.1	1.702
16.000	240.818	4.153	715.6	-236.49	.846	427.9	17.4	4.188		438.1	445.3	445.3	1.706
17.000	263.185	3.800	697.9	-238.01	.845	429.4	16.9	4.447		438.7	446.3	446.3	1.710
18.000	287.641	3.477	681.5	-239.40	.844	430.8	16.4	4.729		439.2	447.3	447.3	1.714
19.000	312.774	3.197	666.1	-240.68	.844	432.1	16.0	5.013		439.6	448.2	448.2	1.717
20.000	338.487	2.954	652.2	-241.87	.843	433.3	15.6	5.295		439.9	449.0	449.0	1.720
21.000	364.839	2.742	639.0	-242.98	.843	434.4	15.3	5.575		440.2	449.7	449.7	1.723
22.000	391.220	2.556	626.8	-244.01	.843	435.4	15.0	5.852		440.4	450.4	450.4	1.726
23.000	418.058	2.392	615.3	-244.98	.842	436.4	14.7	6.125		440.6	451.1	451.1	1.729
24.000	445.028	2.247	604.5	-245.89	.842	437.3	14.4	6.393		440.8	451.7	451.7	1.731
25.000	472.106	2.118	594.4	-246.74	.842	438.2	14.1	6.655		440.9	452.3	452.3	1.733
26.000	499.192	2.003	584.8	-247.55	.842	439.0	13.8	6.911		441.0	452.8	452.8	1.735
27.000	526.223	1.900	575.7	-248.31	.842	439.7	13.6	7.180		441.1	453.3	453.3	

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. O/O
DEG K		GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	85.
20.4 H2		0.071	-1.887	15.

BULK DENSITY = .374 GM/CC
MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 466.63 EU/100GMS

	CHAMBER												THROAT	
	FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	543.5	
TEMP, DEG K	3439.7	2782.9	2234.9	1778.8	1401.0	1212.8	1091.3	842.9	647.9	497.0	381.1	291.6	2991.8	
ENTHALPY (-)	21.80	77.98	123.29	159.52	188.21	201.98	210.69	228.13	241.56	251.87	259.77	265.84	60.31	
CP	.8687	.8415	.8103	.7763	.7409	.7223	.7118	.6934	.6847	.6828	.6804	.6766	.8506	
IMPUL OPT		221.07	297.13	346.12	380.47	395.90	405.35	423.65	437.23	447.36	454.98	460.75	183.02	
IMPUL VAC		328.79	361.49	390.10	411.98	422.11	428.39	440.68	449.90	456.87	462.15	466.17	322.90	
EPSILON		1.051	1.578	2.708	4.874	6.931	8.951	16.617	31.085	58.541	110.877	210.434	1.000	
	SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	557.6	
TEMP, DEG K	3439.7	2941.1	2454.3	1992.4	1587.0	1381.9	1248.0	971.5	751.0	578.6	445.1	342.6	3121.9	
ENTHALPY (-)	21.80	79.17	127.20	166.55	198.15	213.44	223.17	242.74	257.92	269.63	278.66	285.57	59.28	
X BAR	9.898	9.767	9.699	9.680	9.677	9.677	9.677	9.677	9.677	9.677	9.677	9.677	9.807	
N	9.898	9.767	9.699	9.680	9.677	9.677	9.677	9.677	9.677	9.677	9.677	9.677	9.807	
CP	1.4434	1.1613	.9319	.8095	.7571	.7340	.7202	.6961	.6825	.6767	.6757	.6721	1.2635	
IMPUL OPT		223.39	302.79	354.85	391.67	408.30	418.53	438.40	453.21	464.31	472.69	479.01	180.55	
IMPUL VAC		334.55	370.76	401.84	425.57	436.61	443.48	456.94	467.07	474.74	480.57	484.99	327.15	
EPSILON		1.062	1.631	2.832	5.133	7.328	9.488	17.712	33.270	62.840	119.276	227.597	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0054	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0020	
-64.50 F+H	4.4683	4.4727	4.4736	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4717	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 H	.4357	.1775	.0440	.0053	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.2580	
.00 H2	4.9885	5.1154	5.1817	5.2010	5.2035	5.2036	5.2036	5.2036	5.2036	5.2036	5.2036	5.2036	5.0756	

SYSTEM LIQUID BIPROPELLANT										PC 1000, PSIA									
COMPONENT										DENSITY /									
REF. FORMULA										HEAT FORM									
DEG. K										BTU/LB.									
85.2 F2										1.51									
20.4 M2										0.071									
										-1.007									
										85.									
										15.									

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 85.2 F2 1.51 -3.47 89.
 20.4 H2 0.071 -1.887 11.

BULK DENSITY = .468 GM/CC
 MIXTURE RATIO = 8.091 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 405.19 EU/100GMS

	CHAMBER												THROAT
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	543.0
TEMP, DEG K	3973.1	3204.9	2568.5	2042.7	1609.1	1393.5	1253.8	967.2	740.9	565.7	431.5	329.3	3447.9
ENTHALPY (-)	18.42	72.44	115.88	150.57	178.03	191.21	199.56	216.25	229.08	238.89	246.38	252.07	55.52
CP	.7124	.6931	.6714	.6461	.6191	.6031	.5922	.5730	.5624	.5585	.5575	.5554	.6997
IMPUL OPT		216.76	291.17	339.05	372.61	387.70	396.96	414.84	428.08	437.93	445.31	450.83	179.63
IMPUL VAC		322.23	354.09	382.02	403.42	413.33	419.48	431.47	440.42	447.15	452.22	456.04	316.54
EPSILON		1.051	1.574	2.701	4.863	6.918	8.934	16.566	30.893	57.917	109.118	206.633	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	562.3
TEMP, DEG K	3973.1	3484.9	3025.5	2570.4	2115.3	1863.7	1694.9	1337.6	1044.0	808.3	623.0	479.4	3663.2
ENTHALPY (-)	18.42	74.05	121.65	162.01	195.52	212.04	222.66	244.22	261.14	274.30	284.46	292.29	54.20
X BAR	8.251	8.067	7.926	7.839	7.805	7.800	7.799	7.798	7.798	7.798	7.798	7.798	8.131
N	8.251	8.067	7.926	7.839	7.805	7.800	7.799	7.798	7.798	7.798	7.798	7.798	8.131
CP	1.62C1	1.3822	1.1082	.8497	.6860	.6402	.6198	.5880	.5658	.5517	.5462	.5449	1.4771
IMPUL OPT		219.98	299.66	353.42	392.50	410.40	421.50	443.19	459.50	471.79	481.07	488.09	176.41
IMPUL VAC		330.46	368.84	402.71	428.86	441.02	448.61	463.54	474.82	483.34	489.80	494.72	322.38
EPSILON		1.069	1.681	3.009	5.576	8.026	10.442	19.687	37.226	70.513	133.892	255.042	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0385	.0126	.0029	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0197
-64.50 F+H	4.6457	4.6716	4.6813	4.6839	4.6842	4.6842	4.6842	4.6842	4.6842	4.6842	4.6842	4.6842	4.6645
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.8660	.5239	.2518	.0802	.0128	.0029	.0008	.0000	.0000	.0000	.0000	.0000	.6457
.00 H2	2.7005	2.8586	2.9898	3.0743	3.1078	3.1128	3.1138	3.1142	3.1142	3.1142	3.1142	3.1142	2.8013

SYSTEM LIQUID R1PROPPELLANT										PC 1000, PSIA										HEAT FORM										WT. O/O									
COMPONENT										DENSITY										(KCAL/POUN. WT.)																			
TREF FORMULA										GR/CC																													
DEG K										0.071										-1.007										11.									
85.2 F2										1.51										-3.47										89.									
20.4 H2										0.071										-1.007										11.									
FROZEN EXPANSION																																							
C STAR = 8112.4 FT/SEC																																							
DEG K										/P										LVL										10000									
PC/P										I SEA										I AT										I VAC									
P PSIA										I SEA										I AT										I VAC									
TEMP										I SEA										I AT										I VAC									
ENTHALPY										I SEA										I AT										I VAC									
CP CAL / I OPT										I SEA										I AT										I VAC									
DEL VAC										I SEA										I AT										I VAC									
DEL VAC										I SEA										I AT										I VAC									
I SEA										I SEA										I AT										I VAC									
I AT										I AT										I AT										I VAC									
I AT										I AT										I AT										I VAC									
I VAC										I VAC										I VAC										I VAC									
CF SEA										CF SEA										CF SEA										CF SEA									
CF VAC										CF VAC										CF VAC										CF VAC									
LVL										LVL										LVL										LVL									
1.000										1.000										1.000										1.000									
1.000	1.042	542.971	3447.9	-155.62	1.700	179.6	136.9	.252	312.8	314.0	316.1	316.1	1.241	1.255																									
2.000	10.541	94.863	2302.7	-113.63	.640	317.4	50.6	.534	360.2	362.6	367.2	368.1	1.429	1.440																									
3.000	18.993	52.650	1956.4	-156.13	.641	346.2	40.2	.764	375.2	378.0	385.1	386.4	1.488	1.515																									
4.000	33.101	30.148	1511.7	-204.07	.592	393.1	23.0	1.020	382.0	382.0	392.4	397.1	1.515	1.575																									
5.000	41.261	26.049	1351.0	-229.15	.618	373.9	13.1	1.262	385.7	381.3	402.1	403.0	1.530	1.621																									
6.000	55.041	18.168	1149.7	-186.14	.609	382.0	27.6	1.518	387.2	394.0	407.0	409.5	1.536	1.624																									
7.000	69.296	14.435	1386.8	-141.62	.603	388.2	25.5	1.765	395.5	410.8	413.6		1.640																										
8.000	84.827	11.199	1312.5	-104.07	.599	393.1	23.0	2.020		396.2	413.5	416.9	1.636																										
9.000	101.120	9.887	1300.0	-76.92	.592	422.2	22.2	2.270			415.8	422.0	1.678																										
10.000	118.876	8.412	1196.3	-52.06	.588	400.7	21.3	2.531			417.6	426.0	1.673																										
11.000	137.664	7.267	1149.6	-205.70	.585	403.6	20.3	2.795			419.2	423.9	1.681																										
12.000	157.114	6.365	1108.3	-128.11	.582	406.2	19.5	3.057			420.5	425.7	1.688																										
13.000	177.210	5.643	1071.6	-110.24	.578	410.8	18.7	3.315			421.5	427.1	1.694																										
14.000	197.710	5.059	1038.6	-112.14	.577	410.5	18.0	3.567			422.5	428.6	1.700																										
15.000	218.459	4.578	1008.8	-123.86	.575	412.3	17.4	3.812			423.3	429.8	1.705																										
16.000	239.336	4.178	981.6	-125.43	.574	414.0	16.9	4.048			424.0	431.9	1.709																										
17.000	261.526	3.824	956.6	-116.86	.577	415.5	16.4	4.284			424.8	431.9	1.713																										
18.000	285.930	3.514	931.4	-118.11	.571	416.8	16.0	4.518			425.0	432.8	1.717																										
19.000	311.041	3.215	912.4	-119.39	.570	418.1	15.6	4.840			425.4	433.7	1.720																										
20.000	336.757	2.969	892.6	-120.51	.569	419.3	15.2	5.117			425.7	434.5	1.723																										
21.000	362.979	2.755	874.2	-121.56	.568	420.4	14.8	5.383			426.0	435.2	1.726																										
22.000	389.405	2.567	857.0	-122.53	.564	421.6	14.5	5.639			426.2	435.9	1.728																										
23.000	416.538	2.401	840.9	-123.45	.566	422.3	14.2	5.914			426.4	436.5	1.731																										
24.000	443.681	2.254	825.7	-124.31	.566	423.2	13.9	6.172			426.6	437.1	1.734																										
25.000	470.956	2.123	811.7	-125.12	.565	424.0	13.6	6.426			426.7	437.7	1.736																										
26.000	498.278	2.008	797.8	-125.88	.564	424.8	13.4	6.675			426.8	438.2	1.738																										
27.000	525.592	1.903	785.0	-126.60	.564	425.6	13.2	6.914			426.9	438.7	1.742																										
28.000	552.835	1.809	772.9	-127.29	.564	426.3	12.9	7.149			427.0	439.2	1.746																										
29.000	579.972	1.724	761.3	-127.94	.563	426.9	12.7	7.377			427.1	439.6	1.749																										
30.000	606.910	1.648	750.3	-128.55	.563	427.5	12.5	7.598			427.2	440.1	1.753																										
31.000	634.346	1.580	739.8	-129.14	.562	428.1	12.3	7.813			427.3	440.6	1.757																										
32.000	660.285	1.501	729.8	-129.71	.562	428.7	12.1	8.030			427.4	441.0	1.760																										
33.000	686.772	1.431	720.2	-130.25	.562	429.3	12.0	8.362			427.5	441.5	1.764																										
34.000	713.779	1.367	711.1	-130.76	.561	429.8	11.8	8.635			427.6	441.6	1.765																										
35.000	745.953	1.305	702.3	-131.25	.561	430.3	11.6	8.908			427.7	441.7	1.766																										
36.000	799.170	1.251	693.8	-131.73	.561	430.8	11.5	9.180			427.8	441.8	1.768																										
37.000	833.450	1.200	685.7	-132.19	.561	431.3	11.3	9.452			427.9	441.9	1.769																										
38.000	868.175	1.152	677.9	-132.62	.561	431.7	11.2	9.721			428.0	442.0	1.770																										
39.000	903.185	1.107	670.4	-133.04	.560	432.1	11.1	9.987			428.1	442.1	1.771																										
40.000	938.484	1.066	663.1	-133.45	.560	432.5	10.9	10.262			428.2	442.2	1.772																										
41.000	974.034	1.027	656.1	-133.84	.560	432.9	10.8	10.528			428.3	442.3	1.773																										
42.000	1009.749	.990	649.4	-134.22	.560	433.3	10.7	10.793			428.4	442.4	1.774																										
43.000	1045.674	.956	642.8	-134.59	.560	433.6	10.6	11.055			428.5	442.5	1.775																										
44.000	1081.832	.924	636.5	-134.95	.560	434.0	10.5	11.313			428.6	442.6	1.776																										
45.000	1118.033	.894	630.4	-135.28	.560	434.3	10.4	11.573			428.7	442.7	1.777																										
46.000	1154.317	.866	624.5	-135.61	.559	434.6	10.3	11.827			428.8	442.8	1.778																										
47.000	1190.653	.840	618.8	-135.93	.559	435.0	10.1	12.078			428.9	442.9	1.779																										
48.000	1227.042	.815	613.3	-136.24	.558	435.3	10.0	12.321			429.0	443.0	1.780																										
49.000	1263.379	.792	607.8	-136.55	.559	435.6	10.0	12.572			429.1	443.1	1.781																										
50.000	1299.772	.769	602.5	-136.84	.559	435.9	9.9	12.813			429.2	443.2	1.782																										
6.918	68.046	14.696	1391.5	-191.21	.603	387.7	25.6	1.765	387.7	395.4	410.4	413.3	1.538	1.639																									

SHIFTING EXPANSION										C STAR = 8352.5 FT/SEC																													
DEG K										/P										LVL										10000									
PC/P										I SEA										I AT										I VAC									
P PSIA										I SEA										I AT										I VAC									
TEMP										I SEA										I AT										I VAC									
ENTHALPY										I SEA										I AT										I VAC									
CP CAL / I OPT										I SEA										I AT										I VAC									
DEL VAC										I SEA										I AT										I VAC									
DEL VAC										I SEA										I AT										I VAC									
I SEA										I SEA										I AT										I VAC									
I AT										I AT										I AT										I VAC									
I AT										I AT										I AT										I VAC									
I VAC										I VAC										I VAC										I VAC									
CF SEA										CF SEA										CF SEA										CF SEA									
CF VAC										CF VAC										CF VAC										CF VAC									
LVL										LVL										LVL										LVL									
1.000										1.000										1.000										1.000									
1.000	1.779	562.253	3663.2	-54.20	1.477	176.4	146.0	.260	318.6	319.7	321.9	322.4	1.242	1.227																									
2.000	8.511	112.219	2878.9	-115.54	1.020	319.9	60.5	.539	372.5	374.9	379.5	380.4	1.435	1.465																									
3.000	15.408	69.260	2278.5	-134.69	.640	318.5	40.6	.764	380.3	384.9	414.0	415.8	1.492	1.602																									
4.000	24.871	40.208	2356.3	-178.48	.760	373.2	42.6	1.059	400.3	404.9	414.0	415.8	1.435	1.602																									
5.000	34.252	29.105	2193.3	-150.16	.707	388.6	38.3	1.315	405.5	411.3	422.8	424.8	1.562	1.636																									
6.000	44.549	22.501	2063.3	-119.02	.675	396.4	35.1	1.561	408.5	415.5	428.8	431.5	1.574	1.662																									
7.000	55.423	17.371	2012.1	-111.17	.640	410.3	30.6	1.807	410.9	418.0	433.6	436.7	1.578	1.692																									
8.000	67.730	14.765	1985.9	-211.79	.640	410.3	30.6	2.077	410.4	418.6	437.4	440.9	1.581	1.698																									
9.000	80.576	12.411	1788.8	-216.99	.630	415.4	29.0	2.339		420.4	440.5	444.4	1.712																										
10.000	93.953	10.644	1771.9	-220.98	.623	416.8	27.7	2.578		420.7	443.0	447.4	1.723																										
11.000	108.037	9.255	1689.2	-124.82	.618	423.2	26.2	2.880		425.1	445.0	450.0	1.733																										
12.000	123.075	8.125	1610.7	-127.81	.610	425.4	25.4	3.130		425.2	445.1	450.1	1.737																										
13.000	138.666	7.212	1563.7	-130.71	.607	429.7	24.5	3.401		428.5	454.3		1.750																										
14.000	154.777	6.461	1521.2	-133.29	.603	432.3	23.7	3.671		428.5	454.3		1.757																										
15.000	171.282	5.838	1482.5	-135.62	.599	434.7	23.0	3.937		428.9	457.7		1.763																										
16.000	188.076	5.188	1447.0	-137.74	.594	437.0	22.3	4.199		429.0	457.7		1.769																										
17.000	205.069	4.676	1414.3	-139.69	.594	438.7	21.7	4.566		429.2	460.5		1.774																										
18.000	222.184	4.201	1384.0	-141.49	.591	440.5	21.2	4.706		429.7	461.7		1.778																										
19.000	239.165	3.778	1355.9	-143.15	.589	442.1	20.7	4.948		429.8	462.8		1.783																										
20.000	257.287	3.417	1329.1	-144.69	.587	443.7	20.2	5.198		429.9	463.9		1.787																										
21.000	277.120	3.109	1305.0	-146.13	.585	445.1	19.8	5.478		430.0	464.8		1.791																										
22.000	297.431	3.362	1281.9	-147.48	.583	446.4	19.4	5.758		430.1	465.7		1.																										

SYSTEM LIQUID BI-PROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. O/O
DEG K		GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	95.
20.4 H2		0.071	-1.887	5.

BULK DENSITY = .750 GM/CC
MIXTURE RATIO = 19.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 300.44 EU/100GMS

	CHAMBER											THROAT
	FROZEN EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 540.5
TEMP, DEG K	4893.7	3883.9	3067.8	2408.2	1875.8	1615.0	1447.2	1105.3	837.3	631.6	475.9	359.1 4195.8
ENTHALPY (-)	13.36	59.60	96.21	125.05	147.61	158.33	165.10	178.53	188.75	196.47	202.30	206.67 45.41
CP	.4619	.4533	.4431	.4305	.4160	.4066	.3997	.3859	.3770	.3740	.3742	.3745 .4561
IMPUL OPT		200.56	268.46	311.70	341.74	355.13	363.33	379.06	390.61	399.12	405.42	410.08 166.99
IMPUL VAC		297.32	325.56	350.31	369.17	377.85	383.23	393.63	401.32	407.03	411.28	414.46 292.54
EPSILON		1.046	1.551	2.634	4.701	6.657	8.569	15.756	29.095	53.955	100.526	188.366 1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 570.1
TEMP, DEG K	4893.7	4447.3	4051.8	3689.6	3342.1	3137.0	2983.7	2570.4	2086.0	1659.5	1306.7	1018.5 4614.3
ENTHALPY (-)	13.36	61.91	104.71	142.62	176.18	193.87	205.76	231.41	252.72	269.80	283.32	293.91 43.71
X BAR	5.780	5.592	5.425	5.279	5.156	5.097	5.062	5.008	5.000	5.000	5.000	5.000 5.663
N	5.780	5.592	5.425	5.279	5.156	5.097	5.062	5.008	5.000	5.000	5.000	5.000 5.663
CP	2.1157	2.0123	1.8175	1.5508	1.2218	1.0131	.8606	.5293	.4089	.3915	.3746	.3620 2.0612
IMPUL OPT		205.51	281.90	335.33	376.35	396.27	409.11	435.53	456.31	472.31	484.61	494.02 162.49
IMPUL VAC		310.13	349.32	385.55	415.93	431.16	441.03	461.08	476.07	487.50	496.26	502.93 301.52
EPSILON		1.078	1.744	3.264	6.462	9.734	13.087	26.320	51.129	98.707	190.280	365.450 1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
18.86 F	.9662	.7422	.5443	.3722	.2275	.1575	.1152	.0494	.0397	.0397	.0397	.0394 .8265
-64.50 F+H	4.0335	4.2577	4.4556	4.6278	4.7725	4.8425	4.8848	4.9507	4.9603	4.9603	4.9603	4.9603 4.1734
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001 .0001
52.10 H	.6331	.4823	.3462	.2261	.1247	.0764	.0479	.0061	.0000	.0000	.0000	.0000 .5394
.00 H2	.1468	.1102	.0792	.0532	.0316	.0207	.0138	.0018	.0000	.0000	.0000	.0000 .1238

SYSTEM LIQUID BIPROPELLANT PC 300. PSIA

COMPONENT	TREE FORMULA	DENSITY	HEAT FORM	WT. O/O
DEG K		GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	75.
20.4 H2		0.071	-1.887	25.

BULK DENSITY = .249 GM/CC

MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 637.79 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	162.5
TEMP, DEG K	2341.9	1932.1	1581.8	1283.9	1088.0	1033.9	827.8	660.5	526.1	418.9	333.5	263.8	2022.6
ENTHALPY (-)	30.25	79.06	119.17	151.89	172.68	178.33	199.57	216.55	230.07	240.85	249.39	256.33	68.44
CP	1.2126	1.1677	1.1225	1.0752	1.0485	1.0421	1.0208	1.0091	1.0054	1.0033	.9977	.9909	1.1784
IMPUL OPT		206.06	278.12	325.29	352.00	358.91	383.79	402.57	416.93	428.03	436.62	443.47	182.26
IMPUL VAC		322.71	348.87	374.39	390.45	394.75	410.62	422.98	432.63	440.20	446.12	450.87	320.32
EPSILON		1.019	1.377	2.128	3.081	3.459	5.768	9.771	16.736	28.901	50.242	87.115	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	162.8
TEMP, DEG K	2341.9	1943.8	1593.8	1294.4	1097.2	1042.8	835.2	666.5	531.1	422.8	336.8	266.5	2034.1
ENTHALPY (-)	30.25	79.20	119.54	152.49	173.43	179.12	200.53	217.64	231.27	242.15	250.76	257.74	68.43
X BAR	14.391	14.377	14.375	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.378
N	14.391	14.377	14.375	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.374	14.378
CP	1.3007	1.1861	1.1256	1.0766	1.0491	1.0426	1.0208	1.0090	1.0051	1.0032	.9972	.9908	1.2063
IMPUL OPT		206.36	278.71	326.09	352.92	359.87	384.87	403.74	418.18	429.34	437.97	444.86	182.26
IMPUL VAC		323.43	349.77	375.42	391.56	395.88	411.84	424.26	433.96	441.58	447.53	452.30	320.98
EPSILON		1.020	1.379	2.131	3.085	3.465	5.779	9.790	16.770	28.963	50.358	87.372	1.000
COMPOSITION SHIFTING (MOLE/100 GM)													
18.86 F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-64.50 F+H	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474	3.9474
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0323	.0044	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0075
.00 H2	10.4110	10.4249	10.4270	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4271	10.4234

SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
COMPONENT REF. FORMULA DENSITY HEAT FORM. WT. O/B
DEG. F. GM/CC. (KCAL/FORM.WT.)
85.2 F2 1.51 -3.47 75.
20.4 M2 0.071 -1.887 75.

FROZEN EXPANSION													
C STAR 812.2 U F1/VEL													
EPSILON	P/P	P PSIA	TEMP	ENTHALPY	CP CAL	I OPT	DELTA C	DELTA VAC	I SEA	I AT	I AT	I VAC	CF SEA CF VAC
			DEG. F	KCAL/100GM	GM DEG.		/P	/P	LVL	10000	50000	LVL	LVL
1.000	1.000	100.000	2341.9	-30.25	1.213								
1.000	1.846	162.542	2022.6	-68.44	1.179	182.3	138.1	.849	307.8	311.6	316.9	320.3	1.208 1.257
2.000	10.318	29.075	1317.9	-148.26	1.081	320.8	50.6	1.739	345.8	353.5	366.4	371.4	1.357 1.457
3.000	19.579	15.323	1100.8	-171.94	1.050	350.3	39.1	2.551	351.9	363.2	385.1	389.4	1.381 1.528
4.000	31.085	9.451	970.2	-184.94	1.035	366.8	32.9	3.408					1.569
5.000	44.154	6.788	840.5	-194.18	1.026	377.6	29.0	4.272					1.596
6.000	56.140	5.142	711.9	-200.99	1.020	385.4	26.3	5.104					1.616
7.000	74.495	4.027	581.6	-206.32	1.015	391.4	24.2	6.006					1.631
8.000	91.437	3.281	474.2	-210.61	1.012	396.1	22.6	6.881					1.643
9.000	108.678	2.760	384.0	-214.18	1.010	400.0	21.3	7.735					1.653
10.000	126.471	2.372	304.0	-217.20	1.009	403.3	20.2	8.565					1.662
11.000	146.044	2.045	234.0	-219.62	1.008	406.1	19.2	9.294					1.669
12.000	167.050	1.784	169.3	-222.11	1.007	408.5	18.4	10.297					1.676
13.000	189.137	1.586	109.1	-224.14	1.007	410.7	17.7	11.174					1.681
14.000	211.057	1.421	567.1	-225.95	1.006	412.6	17.1	12.024					1.686
15.000	233.180	1.287	555.9	-227.59	1.006	414.3	16.5	12.854					1.691
16.000	255.330	1.175	536.1	-229.07	1.006	415.9	16.0	13.649					1.695
17.000	276.223	1.078	522.7	-230.42	1.005	417.3	15.6	14.432					1.699
18.000	295.614	.988	510.3	-231.67	1.005	418.6	15.2	15.140					1.702
19.000	324.673	.910	499.8	-232.82	1.005	419.8	14.8	15.784					1.705
20.000	356.287	.842	489.2	-233.89	1.005	420.9	14.4	16.369					1.708
21.000	384.467	.781	478.6	-234.88	1.005	421.9	14.1	16.927					1.711
22.000	415.822	.730	469.2	-235.80	1.004	422.9	13.8	17.499					1.714
23.000	445.568	.688	460.5	-236.67	1.004	423.8	13.5	18.067					1.716
24.000	466.529	.643	452.4	-237.49	1.004	424.6	13.3	18.613					1.718
25.000	485.481	.607	444.8	-238.25	1.004	425.4	13.1	19.148					1.720
26.000	502.849	.574	437.6	-238.97	1.004	426.1	12.8	19.664					1.722
27.000	518.113	.544	431.4	-239.65	1.004	426.8	12.6	20.168					1.724
28.000	534.637	.516	424.4	-240.32	1.003	427.5	12.4	20.654					1.726
29.000	548.242	.493	418.1	-240.93	1.003	428.1	12.2	21.121					1.728
30.000	561.114	.469	412.6	-241.50	1.003	428.7	12.0	21.573					1.729
31.000	572.235	.446	406.9	-242.05	1.003	429.2	11.8	22.024					1.731
32.000	581.145	.425	401.6	-242.55	1.003	429.8	11.6	22.474					1.732
33.000	588.626	.406	396.6	-243.02	1.002	430.3	11.5	22.921					1.734
34.000	594.234	.388	391.7	-243.51	1.002	430.8	11.3	23.361					1.735
35.000	600.127	.372	387.1	-243.98	1.002	431.3	11.2	23.794					1.736
36.000	604.471	.357	382.6	-244.49	1.001	431.7	11.0	24.226					1.738
37.000	608.357	.343	378.3	-244.92	1.001	432.1	10.9	24.658					1.739
38.000	611.949	.331	374.2	-245.33	1.001	432.6	10.8	25.084					1.740
39.000	615.357	.317	370.2	-245.73	1.001	433.0	10.6	25.509					1.741
40.000	618.329	.306	366.4	-246.13	1.000	433.5	10.5	25.936					1.742
41.000	621.757	.295	362.7	-246.54	1.000	433.7	10.4	26.372					1.743
42.000	625.117	.285	359.1	-246.94	1.000	434.1	10.3	26.804					1.744
43.000	627.743	.276	355.6	-247.34	1.000	434.4	10.2	27.234					1.745
44.000	630.274	.267	352.3	-247.75	.999	434.7	10.1	27.672					1.746
45.000	632.688	.259	349.1	-248.14	.999	435.1	10.0	28.104					1.747
46.000	634.983	.251	346.1	-248.54	.999	435.4	9.9	28.535					1.748
47.000	637.148	.244	343.2	-248.94	.999	435.7	9.8	28.967					1.749
48.000	639.274	.237	340.3	-249.36	.998	436.0	9.7	29.394					1.749
49.000	641.363	.230	337.3	-249.75	.998	436.3	9.6	29.818					1.750
50.000	643.425	.224	334.2	-249.93	.998	436.6	9.5	30.244					1.751
50.041	643.418	14.676	1.0863	-172.68	1.749	352.0	38.5	2.617	352.0	363.6	386.0	392.4	1.381 1.532

SHIFTING EXPANSION													
C STAR 812.2 U F1/VEL													
EPSILON	P/P	P PSIA	TEMP	ENTHALPY	CP CAL	I OPT	DELTA C	DELTA VAC	I SEA	I AT	I AT	I VAC	CF SEA CF VAC
			DEG. F	KCAL/100GM	GM DEG.		/P	/P	LVL	10000	50000	LVL	LVL
1.000	1.000	100.000	2341.9	-30.25	1.213								
1.000	1.843	162.514	2034.1	-67.44	1.176	182.3	138.7	.852	308.5	312.2	319.5	323.0	1.256 1.237
2.000	12.074	29.112	1329.4	-148.76	1.082	321.5	50.8	1.742	346.7	354.4	369.3	372.5	1.356 1.457
3.000	19.531	15.360	1117.3	-172.20	1.051	351.2	39.3	2.550	352.9	364.2	386.1	390.5	1.380 1.524
4.000	31.033	9.477	979.4	-185.72	1.035	367.8	33.1	3.417					1.568
5.000	44.137	6.777	849.0	-195.03	1.026	378.6	29.2	4.285					1.595
6.000	56.132	5.137	719.1	-201.84	1.020	386.4	26.4	5.124					1.615
7.000	74.477	4.022	589.2	-207.26	1.015	392.4	24.3	6.027					1.630
8.000	91.417	3.279	479.4	-211.55	1.012	397.2	22.7	6.903					1.643
9.000	108.654	2.758	389.6	-215.19	1.010	401.1	21.4	7.724					1.653
10.000	126.446	2.370	309.6	-218.20	1.009	404.8	20.3	8.531					1.662
11.000	146.019	2.043	239.6	-220.62	1.008	408.2	19.2	9.284					1.669
12.000	167.025	1.782	169.7	-223.20	1.007	409.7	18.5	10.329					1.675
13.000	189.112	1.584	109.7	-225.24	1.006	411.9	17.8	11.209					1.681
14.000	211.032	1.419	569.7	-227.07	1.006	413.8	17.2	12.067					1.686
15.000	233.152	1.282	559.9	-228.72	1.006	415.5	16.6	12.896					1.691
16.000	255.302	1.170	540.1	-230.21	1.005	417.1	16.1	13.695					1.695
17.000	276.295	1.072	520.3	-231.58	1.005	418.5	15.7	14.494					1.699
18.000	295.606	.981	510.5	-232.86	1.005	419.8	15.3	15.195					1.702
19.000	324.626	.903	500.8	-234.00	1.005	421.0	14.9	15.894					1.705
20.000	356.246	.835	491.3	-235.08	1.005	422.1	14.5	16.589					1.708
21.000	384.466	.780	481.3	-236.08	1.004	423.1	14.2	17.278					1.711
22.000	409.559	.732	471.3	-237.01	1.004	424.1	13.9	17.957					1.714
23.000	432.231	.686	461.3	-237.88	1.004	425.0	13.6	18.625					1.716
24.000	454.120	.645	451.3	-238.70	1.004	425.8	13.3	19.289					1.718
25.000	475.162	.604	441.4	-239.48	1.004	426.6	13.1	19.951					1.720
26.000	495.363	.575	431.4	-240.21	1.004	427.4	12.9	20.613					1.722
27.000	514.561	.546	421.4	-240.90	1.003	428.1	12.6	21.265					1.724
28.000	532.729	.519	411.4	-241.55	1.003	428.7	12.4	21.914					1.726
29.000	550.054	.495	401.4	-242.17	1.003	429.4	12.2	22.572					1.728
30.000	567.461	.470	391.4	-242.76	1.003	430.0	12.0	23.209					1.729
31.000	584.816	.448	381.4	-243.32	1.003	430.5	11.9	23.850					1.731
32.000	602.179	.427	371.4	-243.85	1.002	431.1	11.7	24.497					1.732
33.000	619.593	.408	361.4	-244.36	1.002	431.6	11.5	25.139					1.734
34.000	636.919	.390	351.4	-244.85	1.002	432.1	11.4	25.780					1.735
35.000	653.540	.373	341.4	-245.32	1.001	432.5	11.2	26.409					1.736
36.000	670.178	.358	331.4	-245.77	1.001	433.0	11.1	27.042					1.737
37.000	686.729	.344	321.4	-246.21	1.001	433.4	11.0	27.669					1.7

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA

COMPONENT	REF FORMULA	DENSITY	HEAT FORM	WT. G/G
DEG K		GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	80.
20.4 H2		0.071	-1.887	20.

BULK DENSITY = .299 GM/CC
MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 566.75 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	162.9
TEMP, DEG K	2818.5	2337.9	1926.3	1575.1	1342.0	1277.0	1027.3	821.6	654.8	521.1	414.5	329.8	2445.4
ENTHALPY (-)	26.03	75.63	116.64	150.30	171.84	177.72	199.86	217.62	231.80	243.09	252.08	259.20	64.67
CP	1.0479	1.0143	.9773	.9399	.9088	.9007	.8733	.8555	.8462	.8432	.8415	.8371	1.0234
IMPUL OPT		207.73	280.76	328.79	356.16	363.26	388.87	408.25	423.09	434.54	443.45	450.37	183.36
IMPUL VAC		325.64	352.64	378.98	395.64	400.10	416.55	429.34	439.31	447.11	453.24	458.04	323.09
EPSILON		1.021	1.386	2.155	3.133	3.521	5.893	9.997	17.122	29.546	51.282	89.456	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.4
TEMP, DEG K	2818.5	2404.4	2006.4	1649.4	1409.0	1341.8	1082.3	867.6	692.7	551.9	439.4	350.1	2509.8
ENTHALPY (-)	26.03	76.23	118.42	153.33	175.75	181.87	204.99	223.58	238.45	250.31	259.76	267.25	64.14
X BAR	12.119	12.052	12.030	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.064
N	12.119	12.052	12.030	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.026	12.064
CP	1.4037	1.1537	1.0135	.9484	.9157	.9068	.8763	.8560	.8452	.8406	.8397	.8358	1.2069
IMPUL OPT		208.98	283.51	332.78	360.89	368.20	394.56	414.55	429.87	441.70	450.92	458.08	182.09
IMPUL VAC		328.86	357.13	384.31	401.48	406.09	423.08	436.31	446.62	454.70	461.05	466.03	325.84
EPSILON		1.024	1.400	2.183	3.178	3.574	5.990	10.178	17.452	30.136	52.341	91.405	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-64.50 F+H	4.2100	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2105	4.2104
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1861	.0518	.0081	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0755
.00 H2	7.7226	7.7895	7.8113	7.8151	7.8153	7.8154	7.8154	7.8154	7.8154	7.8154	7.8154	7.8154	7.7777

SYSTEM LIQUID BIPROPELLANT PC 300 PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. O/O
	DEG K	GM/CC	(KCAL/FORM.WT.)	
85.2 F2		1.51	-3.47	85.
20.4 H2		0.071	-1.887	15.

BULK DENSITY = .374 GM/CC
MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 490.41 EU/100GMS

CHAMBER

THROAT

FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100
TEMP, DEG K	3329.7	2764.2	2281.9	1871.1	1598.5	1522.4	1278.3	983.6	783.5	622.2	493.5	391.3
ENTHALPY (-)	21.80	70.08	110.06	142.96	164.06	169.84	191.62	209.12	223.10	234.22	243.05	250.04
CP	.8646	.8417	.8146	.7857	.7628	.7561	.7260	.7053	.6927	.6866	.6853	.6832
IMPUL OPT	204.93	277.08	324.64	351.78	358.85	384.35	403.67	418.46	429.86	438.70	445.58	450.52
IMPUL VAC	321.35	348.16	374.39	391.00	395.47	411.93	424.70	434.62	442.36	448.41	453.16	458.81
EPSILON	1.021	1.388	2.164	3.153	3.547	5.950	10.103	17.286	29.760	51.506	89.552	1.000

SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100
TEMP, DEG K	3329.7	2947.5	2564.8	2176.4	1887.6	1804.2	1474.5	1193.7	959.3	767.0	611.6	487.0
ENTHALPY (-)	21.80	71.26	114.17	150.79	174.79	181.40	206.59	227.07	243.59	256.83	267.40	275.82
X BAR	9.984	9.833	9.735	9.690	9.680	9.679	9.677	9.677	9.677	9.677	9.677	9.677
N	9.984	9.833	9.735	9.690	9.680	9.679	9.677	9.677	9.677	9.677	9.677	9.677
P	1.7114	1.3937	1.0924	.8844	.8025	.7874	.7442	.7146	.6947	.6831	.6774	.6763
IMPUL OPT	207.42	283.46	334.97	364.81	372.61	400.93	422.56	439.24	452.16	462.21	470.08	477.72
IMPUL VAC	328.22	359.61	389.40	408.11	411.12	431.70	446.20	457.51	466.35	473.28	478.74	484.35
EPSILON	1.031	1.447	2.303	3.386	3.817	6.456	11.043	19.015	32.890	57.130	99.618	1.000

COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0066	.0018	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026
-64.50 F+H	4.4671	4.4719	4.4736	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4737	4.4711
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.6068	.3105	.1153	.0256	.0051	.0029	.0001	.0000	.0000	.0000	.0000	.3840
.00 H2	4.9035	5.0493	5.1461	5.1909	5.2011	5.2022	5.2036	5.2036	5.2036	5.2036	5.2036	5.0129

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 85.2 F2 1.51 -3.47 89.
 20.4 H2 0.071 -1.887 11.
 BULK DENSITY = .468 GM/CC
 MIXTURE RATIO = 8.091 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA													
CHAMBER ENTROPY 425.07 EU/100GMS													
CHAMBER												THROAT	
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.0
TEMP, DEG K	3785.8	3130.4	2575.6	2106.8	1797.3	1711.1	1378.8	1101.9	874.9	691.8	545.9	430.6	3276.5
ENTHALPY (-)	18.42	64.35	102.25	132.33	153.25	159.69	179.19	195.65	208.76	219.15	227.36	233.84	54.21
CP	.7091	.6921	.6733	.6521	.6340	.6283	.6049	.5847	.5712	.5642	.5618	.5610	.6960
IMPUL OPT		199.88	270.04	316.16	342.46	349.30	373.97	392.64	406.91	417.87	426.32	432.88	176.44
IMPUL VAC		313.21	339.05	364.38	380.44	384.75	400.65	412.95	422.47	429.85	435.59	440.08	310.82
EPSILON		1.020	1.384	2.153	3.134	3.524	5.907	10.013	17.084	29.296	50.464	87.287	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	169.4
TEMP, DEG K	3785.8	3414.8	3065.2	2720.8	2449.0	2364.5	1995.3	1644.3	1337.8	1079.1	864.9	690.4	3518.2
ENTHALPY (-)	18.42	65.80	107.56	144.24	169.10	176.09	203.20	225.75	244.20	259.15	271.17	280.78	52.85
X BAR	8.370	8.185	8.028	7.909	7.847	7.835	7.805	7.799	7.798	7.798	7.798	7.798	8.235
N	8.370	8.185	8.028	7.909	7.847	7.835	7.805	7.799	7.798	7.798	7.798	7.798	8.235
CP	1.9398	1.7063	1.4273	1.1225	.9063	.8498	.6830	.6177	.5884	.5680	.5544	.5471	1.7781
IMPUL OPT		203.00	278.46	330.83	362.04	370.34	400.92	424.68	443.18	457.61	468.89	477.73	173.04
IMPUL VAC		322.03	354.86	387.06	407.94	413.59	434.50	450.79	463.53	473.51	481.33	487.47	317.79
EPSILON		1.034	1.478	2.423	3.656	4.150	7.177	12.425	21.572	37.526	65.366	114.047	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0418	.0171	.0058	.0014	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0225
-64.50 F=H	4.6424	4.6671	4.6785	4.6828	4.6839	4.6840	4.6842	4.6842	4.6842	4.6842	4.6842	4.6842	4.6617
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	1.1015	.7552	.4540	.2193	.0977	.0719	.0126	.0010	.0000	.0000	.0000	.0000	.8504
.00 H2	2.5844	2.7452	2.8901	3.0053	3.0655	3.0784	3.1079	3.1137	3.1142	3.1142	3.1142	3.1142	2.7003

SYSTEM LIQUID BI-PROPELLANT		PC 300 - SEA		HEAT FORM		WT. 0/0	
COMPONENT	REF. FORMULA	DENSITY	LM/CC	LM/CC	LM/CC	LM/CC	LM/CC
85.2 E2	1.51	-3.87	87.2				
20.4 M2	0.071	-1.887	11.2				
FROZEN EXPANSION							
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC
			DEG. K	KCAL/100GM	GM DEG.		
1.000	1.000	300.000	178.2	-18.42	1.709		
2.000	1.001	162.969	576.5	-58.21	1.696	136.4	18.2
3.000	10.193	29.451	1169.2	-129.28	1.655	111.0	40.9
4.000	19.076	15.727	1830.4	-151.15	1.616	159.8	59.0
5.000	30.092	9.970	1622.9	-164.20	1.622	356.1	53.0
6.000	42.688	7.028	1478.4	-175.15	1.612	566.9	29.1
7.000	56.148	5.185	1369.7	-179.74	1.594	774.0	26.2
8.000	71.682	4.187	1268.5	-174.95	1.568	100.8	24.4
9.000	86.016	3.408	1212.6	-169.14	1.593	185.4	22.8
10.000	104.817	2.862	1153.2	-162.64	1.588	289.5	21.4
11.000	121.755	2.468	1102.5	-155.61	1.585	392.6	20.5
12.000	141.235	2.124	1059.5	-149.70	1.582	495.5	19.4
13.000	161.599	1.856	1019.5	-140.46	1.579	592.2	18.3
14.000	182.611	1.643	984.7	-129.46	1.577	680.1	17.4
15.000	204.078	1.470	953.7	-118.25	1.575	762.1	17.2
16.000	225.835	1.328	925.6	-107.96	1.574	838.4	16.6
17.000	247.740	1.211	900.1	-97.72	1.572	909.4	16.1
18.000	269.779	1.112	876.7	-87.66	1.571	968.8	15.6
19.000	294.432	1.019	855.5	-77.89	1.570	1008.1	15.2
20.000	319.996	.938	835.4	-68.32	1.569	1039.5	14.8
21.000	347.879	.865	817.0	-58.94	1.569	11.4	14.4
22.000	372.879	.805	799.4	-49.74	1.568	11.5	14.1
23.000	400.021	.750	783.4	-40.75	1.567	12.4	13.7
24.000	427.520	.702	768.7	-31.81	1.567	13.5	13.3
25.000	455.300	.659	754.6	-23.06	1.566	14.7	13.2
26.000	483.296	.621	741.5	-14.54	1.566	15.0	12.9
27.000	511.450	.587	729.4	-6.07	1.565	15.7	12.7
28.000	539.718	.556	718.9	2.17	1.565	16.4	12.5
29.000	568.070	.528	705.6	10.37	1.565	17.1	12.2
30.000	596.485	.503	698.9	18.94	1.564	17.7	12.0
31.000	624.965	.478	688.7	27.95	1.564	18.5	11.4
32.000	653.536	.455	675.0	37.30	1.564	19.2	11.7
33.000	682.296	.433	665.7	46.91	1.564	19.9	11.5
34.000	711.252	.413	656.4	56.78	1.563	20.7	11.3
35.000	740.405	.393	648.5	66.92	1.563	20.8	11.2
36.000	769.753	.374	642.0	77.36	1.563	20.9	11.0
37.000	799.299	.356	636.9	88.10	1.563	21.2	10.9
38.000	829.049	.340	632.4	99.15	1.563	21.5	10.9
39.000	858.999	.324	628.7	110.50	1.563	21.8	10.7
40.000	889.149	.310	624.9	122.14	1.563	22.1	10.6
41.000	919.499	.297	621.7	134.07	1.563	22.4	10.6
42.000	949.949	.285	618.7	146.30	1.562	22.7	10.5
43.000	980.499	.274	615.4	158.83	1.562	23.0	10.5
44.000	1011.149	.263	612.4	171.66	1.562	23.3	10.4
45.000	1041.899	.253	609.4	184.79	1.562	23.6	10.4
46.000	1072.749	.243	606.4	198.22	1.562	23.9	10.3
47.000	1103.599	.234	603.4	211.95	1.562	24.2	10.3
48.000	1134.449	.225	600.4	225.98	1.562	24.5	10.2
49.000	1165.299	.216	597.4	240.31	1.562	24.8	10.2
50.000	1196.149	.208	594.4	254.94	1.562	25.1	10.1
51.000	1226.999	.200	591.4	269.87	1.562	25.4	10.1
52.000	1257.849	.192	588.4	285.10	1.562	25.7	10.0
53.000	1288.699	.185	585.4	300.63	1.562	26.0	10.0
54.000	1319.549	.178	582.4	316.46	1.562	26.3	9.9
55.000	1350.399	.171	579.4	332.59	1.562	26.6	9.9
56.000	1381.249	.164	576.4	349.02	1.562	26.9	9.8
57.000	1412.099	.158	573.4	365.75	1.562	27.2	9.8
58.000	1442.949	.152	570.4	382.78	1.562	27.5	9.7
59.000	1473.799	.146	567.4	400.11	1.562	27.8	9.7
60.000	1504.649	.140	564.4	417.74	1.562	28.1	9.6
61.000	1535.499	.135	561.4	435.67	1.562	28.4	9.6
62.000	1566.349	.130	558.4	453.90	1.562	28.7	9.5
63.000	1597.199	.125	555.4	472.43	1.562	29.0	9.5
64.000	1628.049	.120	552.4	491.26	1.562	29.3	9.4
65.000	1658.899	.115	549.4	510.39	1.562	29.6	9.4
66.000	1689.749	.110	546.4	529.82	1.562	29.9	9.3
67.000	1720.599	.105	543.4	549.55	1.562	30.2	9.3
68.000	1751.449	.100	540.4	569.58	1.562	30.5	9.2
69.000	1782.299	.095	537.4	589.91	1.562	30.8	9.2
70.000	1813.149	.090	534.4	610.54	1.562	31.1	9.1
71.000	1843.999	.085	531.4	631.47	1.562	31.4	9.1
72.000	1874.849	.080	528.4	652.70	1.562	31.7	9.0
73.000	1905.699	.075	525.4	674.23	1.562	32.0	9.0
74.000	1936.549	.070	522.4	696.06	1.562	32.3	8.9
75.000	1967.399	.065	519.4	718.19	1.562	32.6	8.9
76.000	1998.249	.060	516.4	740.62	1.562	32.9	8.8
77.000	2029.099	.055	513.4	763.35	1.562	33.2	8.8
78.000	2059.949	.050	510.4	786.38	1.562	33.5	8.7
79.000	2090.799	.045	507.4	809.71	1.562	33.8	8.7
80.000	2121.649	.040	504.4	833.34	1.562	34.1	8.6
81.000	2152.499	.035	501.4	857.27	1.562	34.4	8.6
82.000	2183.349	.030	498.4	881.50	1.562	34.7	8.5
83.000	2214.199	.025	495.4	906.03	1.562	35.0	8.5
84.000	2245.049	.020	492.4	930.86	1.562	35.3	8.4
85.000	2275.899	.015	489.4	956.09	1.562	35.6	8.4
86.000	2306.749	.010	486.4	981.72	1.562	35.9	8.3
87.000	2337.599	.005	483.4	1007.65	1.562	36.2	8.3
88.000	2368.449	.000	480.4	1033.98	1.562	36.5	8.2
89.000	2399.299	.000	477.4	1060.71	1.562	36.8	8.2
90.000	2430.149	.000	474.4	1087.84	1.562	37.1	8.1
91.000	2460.999	.000	471.4	1115.27	1.562	37.4	8.1
92.000	2491.849	.000	468.4	1143.00	1.562	37.7	8.0
93.000	2522.699	.000	465.4	1171.13	1.562	38.0	8.0
94.000	2553.549	.000	462.4	1200.06	1.562	38.3	7.9
95.000	2584.399	.000	459.4	1229.79	1.562	38.6	7.9
96.000	2615.249	.000	456.4	1260.42	1.562	38.9	7.8
97.000	2646.099	.000	453.4	1291.95	1.562	39.2	7.8
98.000	2676.949	.000	450.4	1323.38	1.562	39.5	7.7
99.000	2707.799	.000	447.4	1355.71	1.562	39.8	7.7
100.000	2738.649	.000	444.4	1388.94	1.562	40.1	7.6

SHIFTING EXPANSION													
C STAR = 0.245, 0 FT/SEC													
PSILEN	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I VAC	CF SEA	CF VAC
			DEG. K	KCAL/100GM	GM DEG.								
	1.000	100.000	378.0	-18.42	1.709								
1.000	1.771	169.459	576.5	-58.21	1.696	175.0	18.2	18.2	18.2	18.2	18.2	1.240	1.101
2.000	8.746	34.403	1169.2	-129.28	1.655	111.0	40.9	40.9	40.9	40.9	40.9	1.365	1.049
3.000	15.427	19.471	1830.4	-151.15	1.616	159.8	59.0	59.0	59.0	59.0	59.0	1.407	1.055
4.000	23.168	12.481	1622.9	-164.20	1.622	356.1	53.0	53.0	53.0	53.0	53.0	1.406	1.111
5.000	32.416	8.255	1478.4	-175.15	1.612	566.9	29.1	29.1	29.1	29.1	29.1	1.421	1.154
6.000	42.567	7.074	1369.7	-179.74	1.594	774.0	26.2	26.2	26.2	26.2	26.2	1.424	1.171
7.000	52.890	5.474	1268.5	-174.95	1.568	100.8	24.4	24.4	24.4	24.4	24.4	1.424	1.192
8.000	63.519	4.457	1212.6	-169.14	1.593	185.4	22.8	22.8	22.8	22.8	22.8	1.431	1.199
9.000	74.990	3.690	1153.2	-162.64	1.588	289.5	21.4	21.4	21.4	21.4	21.4	1.431	1.208
10.000	87.235	3.142	1102.5	-155.61	1.585	392.6	20.5	20.5	20.5	20.5	20.5	1.431	1.210
11.000	100.235	2.711	1059.5	-149.70	1.582	495.5	19.4	19.4	19.4	19.4	19.4	1.431	1.216
12.000	113.999	2.386	1019.5	-140.46	1.579	592.2	18.3	18.3	18.3	18.3	18.3	1.431	1.220
13.000	128.611	2.143	984.7	-129.46	1.577	680.1	17.4	17.4	17.4	17.4	17.4	1.431	1.224
14.000	144.078	1.947	953.7	-118.25	1.575	762.1	17.2	17.2	17.2	17.2	17.2	1.431	1.228
15.000	160.235	1.771	925.6	-107.96	1.574	838.4	16.6	16.6	16.6	16.6	16.6	1.431	1.232
16.000	177.740	1.612	900.1	-97.72	1.572	909.4	16.1	16.1	16.1	16.1	16.1	1.431	1.236
17.000	196.779	1.468	876.7	-87.66	1.571	968.8	15.6	15.6	15.6	15.6	15.6	1.431	1.240
18.000	217.432	1.338	855.5	-77.89	1.570	1008.1	15.2	15.2	15.2	15.2	15.2	1.431	1.244
19.000	239.996	1.224	835.4	-68.32	1.569	1039.5	14.8	14.8	14.8	14.8	14.8	1.431	1.248
20.000	264.003	1.135	815.1	-58.91	1.569	1068.4	14.4	14.4	14.4	14.4	14.4	1.431	1.252
21.000	289.996	1.065	795.7	-49.49	1.569	1094.8	14.0	14.0	14.0	14.0	14.0	1.431	1.256
22.000	317.449	1.012	777.4	-40.06	1.569	1118.4	13.6	13.6	13.6	13.6	13.6	1.431	1.260
23.000	346.997	0.953	760.5	-30.61	1.568	1139.5	13.2	13.2	13.2	13.2	13.2	1.431	1.264
24.000	378.035	0.902	744.3	-21.14	1.568	1158.2	12.8	12.8	12.8	12.8	12.8	1.431	1.268
25.000	410.622	0.854	728.3	-11.63	1.567	1174.4	12.4	12.4	12.4	12.4	12.4	1.431	1.272
26.000	444.921	0.816	712.3	-2.09	1.567	1188.1	12.0	12.0	12.0	12.0	12.0	1.431	1.276
27.000	481.997	0.779	696.3	7.46	1.566	1200.4	11.6	11.6	11.6	11.6	11.6	1.431	1.280
28.000	521.996	0.742	680.3	17.91	1.565	1211.4	11.2	11.2	11.2	11.2	11.2	1.431	1.284
29.000	564.003	0.707	664.3	28.36	1.564	1221.4	10.8	10.8	10.8	10.8	10.8	1.431	1.288
30.000	607.996	0.673	648.3	38.81	1.563	1230.4	10.4	10.4	10.4	10.4	10.4	1.431	1.292
31.000	653.996	0.640	632.3	49.26	1.562	1238.4	10.0	10.0	10.0	10.0	10.0	1.431	1.296
32.000	701.996	0.607	616.3	59.71	1.561	1245.4	9.6	9.6	9.6	9.6	9.6	1.431	1.300
33.000	751.996	0.574	600.3	70.16	1.560	1251.4	9.2	9.2	9.2	9.2	9.2	1.431	1.304
34.000	803.996	0.541	584.3	80.61	1.559	1256.4	8.8	8.8	8.8	8.8	8.8	1.431	1.308
35.000	857.996	0.508	568.3	91.06	1.558	1261.4	8.4	8.4	8.4	8.4	8.4	1.431	1.312
36.000	913.996	0.475	552.3	101.51	1.557	1266.4	8.0	8.0	8.0	8.0	8.0	1.431	1.316
37.000	971.996	0.442	536.3	111.96	1.556	1271.4	7.6	7.6	7.6	7.6	7.6	1.431	1.320
38.000	1031.996	0.409	520.3	122.41	1.555	1276.4	7.2	7.2	7.2	7.2	7.2	1.431	1.324
39.000	1093.996	0.376	504.3	132.86	1.554	1281.4	6.8	6.8	6.8	6.8	6.8	1.431	1.328
40.000	1157.996	0.343	488.3	143.31	1.553	1286.4	6.4	6.4	6.4	6.4	6.4	1.431	1.332
41.000	1223.996	0.310	472.3	153.76	1.552	1291.4	6.0	6.0	6.0	6.0	6.0	1.431	1.336
42.000	1291.996	0.277	456.3	164.21	1.551	1296.4	5.6	5.6	5.6	5.6	5.6	1.431	1.340
43.000	1361.996	0.244	440.3	174.66	1.550	1301.4	5.2	5.2	5.2	5.2	5.2	1.431	1.344
44.000	1433.996	0.211	424.3	185.11	1.549	1306.4	4.8	4.8	4.8	4.8	4.8	1.431	1.348
45.000	1507.996	0.178	408.3	195.56	1.548	1311.4	4.4	4.4	4.4	4.4	4.4	1.431	1.352
46.000	1583.996	0.145	392.3	206.01	1.547	1316.4	4.0	4.0	4.0	4.0	4.0	1.431	1.356
47.000	1661.996	0.112	376.3	216.46	1.546	1321.4	3.6	3.6	3.6	3.6	3.6	1.431	1.360
48.000	1741.996	0.079	360.3	226.91	1.545	1326.4	3.2	3.2	3.2	3.2	3.2	1.431	1.364
49.000	1823.996	0.046	344.3	237.36	1.544	1331.4	2.8	2.8	2.8	2.8	2.8	1.431	1.368
50.000	1907.996	0.013	328.3	247.81	1.543	1336.4	2.4	2.4	2.4	2.4	2.4	1.431	1.372
51.000	1993.996	0.000	312.3	258.26	1.542	1341.4	2.0	2.0	2.0	2.0	2.0	1.431	1.376
52.000	2081.996	0.000	296.3	268.71	1.541	1346.4	1.6	1.6	1.6	1.6	1.6	1.431	1.380
53.000	2171.996	0.000	280.3	279.16	1.540	1351.4	1.2	1.2	1.2	1.2	1.2	1.431	1.384
54.000	2263.996	0.000	264.3	289.61	1.539	1356.4	0.8	0.8	0.8	0.8	0.8	1.431	1.388
55.000	2357.996	0.000	248.3	300.06	1.538	1361.4	0.4	0.4	0.4	0.4	0.4	1.431	1.392
56.000	2453.996	0.000	232.3	310.51	1.537	1366.4	0.0	0.0	0.0	0.0	0.0	1.431	1.396
57.000	2551.996	0.000	216.3	320.96	1.536	1371.4	0.0	0.0	0.0	0.0	0.0	1.431	1.400
58.000	2651.996	0.000	200.3	331.41	1.535	1376.4	0.0	0.0	0.0	0.0	0.0	1.431	1.404
59.000	2753.996	0.000	184.3	341.86	1.534	1381.4	0.0	0.0	0.0	0.0	0.0	1.431	1.408
60.000	2857.996	0.000	168.3	352.31	1.533	1386.4	0.0	0.0	0.0	0.0	0.0	1.431	1.412
61.000	2963.996	0.000	152.3	362.76	1.532	1391.4	0.0	0.0	0.0	0.0	0.0	1.431	1.416
62.000	3071.996	0.000	136.3	373.21	1.531	1396.4	0.0	0.0	0.0	0.0	0.0	1.431	1.420
63.000	3181.996	0.000	120.3	383.66	1.530	1401.4	0.0	0.0	0.0	0.0	0.0	1.431	1.424
64.000	3293.996	0.000	104.3	394.11	1.529	1406.4	0.0	0.0	0.0	0.0	0.0	1.431	1.428
65.000	3407.996	0.000	88.3	404.56	1.528	1411.4	0.0	0.0	0.0	0.0	0.0	1.431	1.432
66.000	3523.996	0.000	72.3	415.01	1.527	1416.4	0.0	0.0	0.0	0.0	0.0	1.431	1.436
67.000	3641.996	0.000	56.3	425.46	1.526	1421.4	0.0	0.0	0.0	0.0	0.0	1.431	1.440
68.000	3761.996	0.000	40.3	435.91	1.525	1426.4	0.0	0.0	0.0	0.0	0.0	1.431	1.444
69.000	3883.996	0.000	24.3	446.36	1.524	1431.4	0.0	0.0	0.0	0.0	0.0	1.431	1.448
70.000	4007.996	0.000	8.3	456.81	1.523	1436.4	0.0	0.0	0.0	0.0	0.0	1.431	1.452
71.000	4133.996	0.000	-7.7	467.26	1.522	1441.4	0.0	0.0	0.0	0.0	0.0	1.431	1.456
72.000	4261.996	0.000	-23.7	477.71	1.521	1446.4	0.0	0.0	0.0	0.0	0.0	1.431	1.460
73.000	4391.996	0.000	-39.7	488.16	1.520	1451.4	0.0	0.0	0.0	0.0	0.0	1.431	1.464
74.000	4523.996	0.000	-55.7	498.61	1.519	1456.4	0.0	0.0	0.0	0.0	0.0	1.431	1.468
75.000	4657.996	0.000	-71.7	509.06	1.518	1461.4	0.0	0.0	0.0	0.0	0.0	1.431	1.472
76.000	4793.996	0.000	-87.7	519.51	1.517	1466.4	0.0	0.0	0.0	0.0	0.0	1.431	1.476
77.000	4931.996	0.000	-103.7	529.96	1.516	1471.4	0.0	0.0	0.0	0.0	0.0	1.431	1.480
78.000	5071.996	0.000	-119.7	540.41	1.515	1476.4	0.0	0.0	0.0	0.0	0.0	1.431	1.484
79.000	5213.996	0.000	-135.7	550.86	1.514	1481.4	0.0	0.0	0.0	0.0	0.0	1.431	1.488
80.000	5357.996	0.000	-151.7	561.31	1.513	1486.4	0.0	0.0	0.0	0.0	0.0	1.431	1.492
81.000	5503.996	0.000	-167.7	571.76	1.512	1491.4	0.0	0.0	0.0	0.0	0.0	1.431	1.496
82.000	5651.996	0.000	-183.7	582.21	1.511	1496.4	0.0	0.0	0.0	0.0	0.0	1.431	1.500
83.000	5801.996	0.000	-199.7	592.66	1.510	1501.4	0.0	0.0	0.0	0.0	0.0	1.431	1.504
84.000	5953.996	0.000	-215.7	603.11	1.509	1506.4	0.0	0.0	0.0	0.0	0.0	1.431	1.508
85.000	6107.996	0.000	-231.7	613.56	1.508	1511.4	0.0	0.0	0.0	0.0	0.0	1.431	1.512
86.000	6263.996	0.000	-247.7	624.01	1.507	1516.4	0.0	0.0	0.0	0.			

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 85.2 F2 1.51 -3.47 95.
 20.4 H2 0.071 -1.887 5.

BULK DENSITY = .750 GM/CC
 MIXTURE RATIO = 19.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 314.39 EU/100GMS

CHAMBER													THROAT	
	FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	161.2	
TEMP, DEG K	4597.6	3746.1	3040.9	2456.9	2078.2	1913.7	1574.6	1246.6	980.0	766.6	598.5	466.8	3923.1	
ENTHALPY (-)	13.35	52.26	83.90	109.53	125.77	130.18	146.71	159.86	170.23	178.37	184.72	189.68	44.22	
CP	.4604	.4531	.4439	.4331	.4236	.4211	.4076	.3939	.3843	.3788	.3771	.3775	.4543	
IMPUL OPT	183.97	247.72	289.25	312.71	318.79	340.60	357.00	369.42	378.87	386.10	391.65	397.87	163.87	
IMPUL VAC	287.47	310.12	332.42	346.49	350.26	364.10	374.75	382.90	389.16	393.97	397.71	402.56	285.56	
EPSILON	1.018	1.366	2.106	3.045	3.418	5.683	9.560	16.175	27.473	46.868	80.261	1.000		
	SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.9	
TEMP, DEG K	4597.6	4259.6	3955.2	3675.5	3472.2	3411.8	3154.1	2888.1	2587.6	2209.0	1817.8	1483.0	4358.7	
ENTHALPY (-)	13.35	54.16	90.94	124.20	147.59	154.34	181.67	206.33	228.39	247.56	263.54	276.64	42.18	
X BAR	5.880	5.709	5.553	5.412	5.314	5.286	5.177	5.087	5.024	5.001	5.000	5.000	5.759	
N	5.880	5.709	5.553	5.412	5.314	5.286	5.177	5.087	5.024	5.001	5.000	5.000	5.759	
CP	2.5558	2.4568	2.2891	2.0547	1.8326	1.7602	1.4194	1.0458	.6799	.4282	.3985	.3830	2.4923	
IMPUL OPT	188.40	259.79	310.53	341.72	350.21	382.65	409.72	432.51	451.38	466.52	478.57	485.35	158.35	
IMPUL VAC	299.98	332.87	365.91	388.40	394.73	419.54	440.72	458.49	472.53	483.36	491.97	495.39		
EPSILON	1.039	1.516	2.558	3.985	4.579	8.450	15.812	29.517	53.526	94.892	168.055	1.000		
	COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	1.0467	.8491	.6704	.5098	.3987	.3671	.2430	.1406	.0675	.0405	.0397	.0397	.9072	
-64.50 F+H	3.9532	4.1508	4.3296	4.4902	4.6013	4.6329	4.7570	4.8594	4.9325	4.9595	4.9603	4.9603	4.0927	
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 H	.7522	.6078	.4751	.3540	.2693	.2451	.1500	.0724	.0194	.0007	.0000	.0000	.6505	
.00 H2	.1275	.1008	.0778	.0581	.0448	.0411	.0266	.0143	.0042	.0001	.0000	.0000	.1085	

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Ford Motor Company
AERONUTRONIC DIVISION

H_2O_2 - B_5H_9 SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 1000 PSIA PE 101 PSIA
 COMPONENT I-EE FORMULA DENSITY PLAT FORM WT. G/G
 DEG K G/CC (KCAL/FORM.WT.)
 29H H2O2 1.448 -44.84 69.
 29H H5F9 0.620 +7.74 35.

BULK DENSITY = .778 GM/CC
 MIXTURE RATIO = 1.77H LH OXIDIZER / LH OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 529.15 FU/100GMS

CHAMBER	THREAT														
	FROZEN EXPANSION														
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	5.921	1.583	.631	.251	.100	.043	.016	.006
TEMP, DEG K	2674.7	2504.6	2357.0	2212.6	2085.0	2010.4	1958.8	1894.6	1740.1	1660.7	1545.4	1372.6	1257.6	1161.6	1090.0
ENTHALPY (-)	79.98	107.10	132.00	154.67	175.61	187.03	194.70	212.67	229.07	244.35	258.64	272.02	285.29	298.61	311.91
CP	.7237	.7066	.6956	.6791	.6608	.6496	.6421	.6235	.6055	.5967	.5865	.5747	.5610	.5457	.5291
IMPUL OPT	151.53	206.72	244.36	272.45	295.78	315.27	328.34	338.26	347.60	354.80	360.49	364.99	368.14	370.00	370.80
IMPUL VAC	227.84	254.82	279.23	299.15	308.94	315.27	328.34	338.26	347.60	354.80	360.49	364.99	368.14	370.00	370.80
EPSILON	1.071	1.695	5.088	5.259	8.807	11.735	23.541	47.631	96.788	192.148	403.656	1.000			
	SHIFTING EXPANSION														
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	5.921	1.583	.631	.251	.100	.043	.016	.006
TEMP, DEG K	2674.7	2504.6	2357.0	2212.6	2085.0	2010.4	1958.8	1894.6	1740.1	1660.7	1545.4	1372.6	1257.6	1161.6	1090.0
ENTHALPY (-)	79.98	107.10	132.00	154.67	175.61	187.03	194.70	212.67	229.07	244.35	258.64	272.02	285.29	298.61	311.91
X BAK	5.799	5.652	5.510	5.388	5.270	5.163	5.072	4.987	4.907	4.832	4.764	4.705	4.655	4.611	4.571
N	5.895	5.889	5.885	5.881	5.878	5.876	5.875	5.873	5.870	5.865	5.852	5.837	5.819	5.791	5.751
CP	5.0418	5.0711	4.2275	4.2602	5.5961	5.1777	2.8582	2.0677	6.1440	5.4490	4.6675	4.8104	4.9495	5.0895	5.2295
IMPUL OPT	153.54	212.72	254.89	288.43	305.16	316.19	339.75	366.14	378.14	374.24	408.74	419.09	425.69	429.71	433.71
IMPUL VAC	233.27	265.51	295.42	321.33	344.81	364.84	383.42	390.89	396.60	410.90	423.69	429.71	433.71	437.71	441.71
EPSILON	1.070	1.613	3.489	7.132	10.786	15.058	22.363	31.284	42.301	55.909	71.455	1.000			
	COMPOSITION SHIFTING (MOL/100 GMS)														
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H+H+O	1.0528	.9423	.8443	.7556	.6778	.6080	.5453	.4851	.4285	.3755	.3257	.2788	.2346	.1928	.1531
-135.32 H+H+O2	.5142	.4052	.3031	.2156	.1395	.1023	.0790	.0555	.0219	.0156	.0107	.0070	.0040	.0020	.0000
66.00 H+H2	.0006	.0003	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 H+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H+H3	.0012	.0007	.0005	.0003	.0002	.0002	.0002	.0003	.0002	.0001	.0001	.0000	.0000	.0000	.0000
-236.60 H+H3+O2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 H+O	.0204	.0146	.0106	.0072	.0048	.0037	.0030	.0021	.0010	.0006	.0004	.0002	.0001	.0000	.0000
-84.00 H+O2	.0030	.0018	.0011	.0006	.0003	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2+O2	.2818	.2668	.2539	.2415	.2293	.2175	.2060	.1946	.1833	.1721	.1609	.1497	.1385	.1273	.1161
-210.10 H2+O3	.2504	.2366	.2235	.2103	.1971	.1839	.1707	.1575	.1443	.1311	.1179	.1047	.0915	.0783	.0651
-541.69 H3+H3+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0244	.0225	.0200	.0174	.0148	.0122	.0096	.0070	.0044	.0028	.0012	.0006	.0003	.0001	.0000
9.33 H+O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 H2	3.5944	3.7273	3.8432	3.9427	4.0269	4.0962	4.1534	4.2063	4.2549	4.2982	4.3369	4.3709	4.4000	4.4249	4.4459
-57.80 H2+O	.0512	.0321	.0191	.0103	.0050	.0031	.0020	.0013	.0008	.0005	.0003	.0001	.0001	.0001	.0001
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 H2+O3/C	.0983	.2367	.3744	.4932	.6081	.6701	.7121	.8016	.8815	.9570	1.0272	1.0912	1.1498	1.1998	1.2448
.00 H/L	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. %
 DEG K GM/CC (KCAL/100MM.KT.)
 298 H2+P2 1.044 -44.84 6%
 298 O5+P2 0.620 +7.74 52%

BULK DENSITY = 1.014 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 327.55 EU/100GMS

CHAMBER

TEMP

	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
TEMP, DEG K	2885.1	2489.2	2142.5	1837.5	1569.6	1429.1	1334.6	1126.6	945.9	772.2	657.7	541.4	2635.2
ENTHALPY (-)	25.72	113.18	136.46	137.20	174.61	183.54	187.45	202.04	212.65	221.55	223.50	225.08	103.14
CP	.7005	.6662	.6744	.6544	.6412	.6275	.6208	.6007	.5901	.5791	.5672	.5555	.6935
IMPUL OPT	154.57	210.93	249.37	278.04	291.72	300.41	311.11	322.31	334.15	343.01	350.47	356.47	123.11
IMPUL VAC	232.47	260.05	285.00	305.54	315.41	321.49	325.27	326.11	324.91	322.62	319.47	315.00	226.62
EPSILON	1.071	1.676	3.091	5.947	8.822	11.757	13.574	14.574	14.742	14.642	14.361	13.977	1.000

	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
TEMP, DEG K	2885.1	2489.2	2142.5	1837.5	1569.6	1429.1	1334.6	1126.6	945.9	772.2	657.7	541.4	2635.2
ENTHALPY (-)	25.72	113.18	136.46	137.20	174.61	183.54	187.45	202.04	212.65	221.55	223.50	225.08	103.14
X HAR	5.594	5.569	5.426	5.299	5.172	5.102	5.053	4.940	4.833	4.733	4.640	4.555	5.578
N	5.594	5.569	5.426	5.299	5.172	5.102	5.053	4.940	4.833	4.733	4.640	4.555	5.578
CP	1.0110	.9507	.72565	.6104	.65911	.64404	.62979	.61479	.60341	.59460	.58605	.57747	.9734
IMPUL OPT	155.78	214.94	257.45	291.24	308.20	319.37	325.43	326.34	322.40	319.22	315.72	312.02	226.62
IMPUL VAC	235.57	267.99	298.17	324.53	338.25	347.49	352.69	353.62	350.66	346.07	340.84	335.71	226.62
EPSILON	1.081	1.806	3.481	6.141	11.031	15.156	18.572	22.439	26.130	29.126	31.542	33.400	1.000

	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
COMPOSITION SHIFTING (MOL/100 GM)	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.971	1.565	.631	.251	.100	566.2
142.60 B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B+H+O	.7256	.6064	.5000	.4043	.3200	.2757	.2460	.1818	.1271	.0818	.0466	.0271	.6552
-135.32 B+H+O2	.9971	.9771	.8756	.7829	.6941	.6460	.6132	.5412	.4743	.4247	.3795	.3393	.9899
66.00 B+H2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 B+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B+H3	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-238.60 B+H3+O3	.0005	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
5.74 B+O	.0294	.0134	.0092	.0059	.0034	.0029	.0023	.0014	.0008	.0004	.0001	.0000	.0147
-84.00 B+O2	.0126	.0064	.0046	.0032	.0023	.0019	.0016	.0011	.0007	.0005	.0003	.0002	.0086
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2+O2	.1211	.1120	.0888	.0689	.0511	.0420	.0361	.0237	.0141	.0072	.0029	.0009	.1162
-210.10 B2+O3	.2624	.2525	.2448	.2391	.2315	.2248	.2193	.2086	.2027	.1905	.1831	.1738	.5137
-541.69 B3+H3+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0558	.0294	.0242	.0191	.0154	.0136	.0123	.0097	.0074	.0055	.0037	.0025	.0387
9.33 F+O	.0011	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 F2	5.1760	5.3428	5.4764	5.5955	5.7000	5.7545	5.7910	5.8091	5.8247	5.8378	5.8482	5.8554	5.8584
-57.80 F2+O	.1915	.1286	.1019	.0797	.0638	.0564	.0518	.0431	.0375	.0347	.0334	.0312	.1522
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 B2+O3/C	.0000	.0000	.1380	.2602	.3856	.4523	.5005	.6113	.7162	.8150	.9071	.9910	.0000

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.1 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298	H2*O2	1.448	-44.84	70.
298	B5*H9	0.620	+7.74	30.

PULK DENSITY = 1.034 GM/CC
MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 325.59 EU/100GMS

	CHAMBER												THROAT	
	FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	564.6	
TEMP, DEG K	3010.0	2603.1	2245.2	1930.3	1653.2	1507.6	1409.6	1195.5	1008.2	844.9	703.2	580.8	2751.4	
ENTHALPY (-)	88.60	116.56	140.70	161.49	179.34	188.51	194.59	207.56	218.53	227.75	235.46	241.85	106.42	
CP	.6924	.6810	.6674	.6522	.6351	.6246	.6159	.5956	.5752	.5544	.5325	.5110	.6857	
IMPUL OPT		155.96	212.90	251.82	280.96	294.82	303.66	321.70	336.21	347.94	357.44	365.13	124.53	
IMPUL VAC		234.60	262.59	287.94	308.68	318.91	325.53	339.21	350.34	359.38	366.71	372.63	228.63	
EPSILON		1.071	1.700	3.104	5.986	8.891	11.862	23.853	48.348	98.346	200.137	406.454	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	574.3
TEMP, DEG K	3010.0	2704.1	2434.4	2286.7	2158.6	2088.4	2039.8	1928.6	1823.1	1722.2	1625.6	1533.5	2822.8
ENTHALPY (-)	88.60	117.00	142.34	165.29	186.44	197.97	205.92	223.91	240.54	255.91	270.14	283.31	106.08
X BAR	5.450	5.419	5.386	5.259	5.131	5.061	5.011	4.898	4.791	4.691	4.599	4.513	5.430
N	5.450	5.419	5.400	5.395	5.392	5.390	5.389	5.387	5.385	5.384	5.383	5.383	5.430
CP	1.0558	.9804	4.9577	5.8221	5.4946	5.1790	4.9312	4.3046	3.6988	3.1885	2.8019	2.5147	1.0094
IMPUL OPT		157.17	216.22	258.30	291.74	308.46	319.47	343.09	363.56	381.52	397.41	411.57	123.31
IMPUL VAC		237.78	268.65	298.55	324.57	338.08	347.13	366.89	384.33	399.83	413.67	426.11	230.78
EPSILON		1.082	1.768	3.409	6.983	10.771	14.783	31.950	70.030	155.051	345.975	776.960	1.000

COMPOSITION SHIFTING (MOL/100 GM)													
132.60	B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76	B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13	B*H*O	.5695	.4622	.3517	.2603	.1833	.1451	.1208	.0732	.0401	.0196	.0086	.0035
-132.32	B*H*O2	1.1708	1.1968	1.1851	1.1049	1.0275	.9858	.9573	.8917	.8254	.7513	.6630	.5586
60.00	B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00	B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00	B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60	B*H3*O3	.0000	.0005	.0003	.0002	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0006
5.74	B*O	.0341	.0164	.0068	.0039	.0021	.0015	.0011	.0005	.0002	.0001	.0000	.0224
-84.00	B*O2	.0222	.0129	.0066	.0047	.0033	.0027	.0024	.0016	.0010	.0006	.0003	.0002
199.30	B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60	B2*O2	.0720	.0611	.0471	.0308	.0183	.0128	.0097	.0044	.0017	.0005	.0001	.0000
-210.10	B2*O3	.2164	.2817	.3507	.3329	.3002	.2772	.2588	.2100	.1576	.1077	.0663	.0367
-541.69	B3*H3*O6	.0000	.0000	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10	H	.0788	.0452	.0236	.0182	.0142	.0121	.0107	.0078	.0055	.0036	.0022	.0013
9.33	H*O	.0030	.0010	.0003	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0016
.00	H2	2.9550	3.0936	3.2302	3.3411	3.4328	3.4775	3.5057	3.5600	3.5969	3.6192	3.6312	3.6368
-57.80	H2*O	.3273	.2479	.1837	.1617	.1494	.1457	.1446	.1485	.1625	.1884	.2267	.2763
59.56	O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00	O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34	B2*O3/C	.0000	.0000	.0141	.1366	.2605	.3296	.3779	.4894	.5946	.6932	.7848	.8694

PMESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.1 PSIA
 COMPONENT TRLE FORMULA DENSITY HEAT FURN RT. C/O
 LEG K GM/CC (KCAL/PPM.WT.)
 29H H2O2 1.444 -44.84 72.
 29H H5OH9 0.620 17.74 27.

FLCK DENSITY = 1.054 GM/CC
 MIXTURE RATIO = 2.571 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 425.32 EU/1000PS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	564.9
TEMP, DEG K	3118.2	2702.2	2455.7	2012.6	1727.9	1578.1	1477.1	1256.2	1062.2	892.6	745.0	617.2	2854.0
ENTHALPY (-)	91.48	119.71	144.15	165.24	184.38	192.72	198.93	212.18	223.42	232.70	240.84	247.44	109.46
CP	.6240	.6730	.6579	.6453	.6284	.6183	.6101	.5895	.5693	.5484	.5269	.5052	.6771
IMPUL OPT	156.72	214.05	253.31	282.75	305.73	324.64	338.77	350.75	360.46	368.34	375.07	380.34	125.07
IMPUL VAC	235.84	264.13	289.77	310.20	321.17	327.90	331.83	335.14	338.43	340.95	342.63	343.79	227.79
EPSILON	1.072	1.754	3.117	6.022	8.757	11.959	14.114	16.964	19.443	20.665	21.475	21.800	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	574.7
TEMP, DEG K	3118.2	2809.6	2520.8	2269.3	2134.4	2060.4	2009.1	1892.5	1784.2	1683.6	1590.2	1503.1	2929.6
ENTHALPY (-)	91.48	120.15	145.78	168.64	189.35	200.61	208.37	225.86	241.96	256.81	270.53	283.24	109.11
X BAK	5.308	5.271	5.245	5.208	5.078	5.007	4.956	4.841	4.732	4.630	4.535	4.448	5.284
N	5.308	5.271	5.245	5.231	5.227	5.226	5.225	5.223	5.221	5.221	5.220	5.220	5.284
CP	1.0024	1.0026	.9103	4.7192	4.5084	4.2497	4.0732	3.7053	3.4136	3.1802	2.9748	2.7529	1.0392
IMPUL OPT	157.93	217.35	259.08	291.79	308.12	318.67	324.71	328.81	332.24	334.67	336.44	337.84	123.84
IMPUL VAC	238.99	267.94	298.52	323.91	337.06	345.87	350.07	351.28	352.01	352.47	352.59	352.92	231.92
EPSILON	1.083	1.764	3.323	6.798	10.472	14.353	18.438	22.677	26.748	30.415	33.240	35.200	1.000
	COMPOSITION, SHIFTING (MOLE/100 GR)												
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H2O2	.4310	.3365	.2416	.1554	.0971	.0712	.0561	.0300	.0147	.0070	.0031	.0013	.3744
-135.32 H2O2	1.2695	1.3507	1.3934	1.4006	1.3187	1.2697	1.2329	1.1387	1.0266	.9026	.7681	.6282	1.3285
66.00 H2O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 H2O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 H2O2	.0011	.0007	.0005	.0004	.0003	.0002	.0002	.0002	.0001	.0001	.0001	.0001	.0000
5.74 H2O	.0358	.0176	.0069	.0022	.0010	.0006	.0004	.0002	.0001	.0000	.0000	.0000	.0249
-84.00 H2O	.0345	.0218	.0117	.0056	.0049	.0031	.0026	.0017	.0010	.0006	.0003	.0001	.0266
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2O2	.0414	.0320	.0219	.0124	.0059	.0036	.0025	.0019	.0013	.0008	.0004	.0002	.0358
-210.10 H2O2	.1796	.2124	.2591	.2906	.2427	.2128	.1909	.1405	.0767	.0376	.0171	.0076	.1950
-541.09 H2O2	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1020	.0623	.0327	.0157	.0076	.0036	.0017	.0006	.0003	.0001	.0000	.0000	.0770
9.33 H2O	.0074	.0028	.0009	.0002	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0042
.00 H2	2.6818	2.8060	2.9252	3.0283	3.0944	3.1238	3.1406	3.1694	3.1856	3.1942	3.1985	3.2005	2.7566
-57.80 H2O	.5128	.4279	.3509	.2962	.2621	.2317	.2015	.1555	.0827	.0409	.0203	.0094	.4610
59.56 O	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 H2O2/L	.0000	.0000	.0000	.0228	.1488	.2191	.2685	.3823	.4897	.5905	.6846	.7721	.0000

[illegible]

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.1 PSIA
 COMPONENT REF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 298 H2O2 1.440 -44.84 16.
 298 H5OH 0.620 47.74 24.

FULK DENSITY = 1.097 GM/CC
 MIXTURE RATIO = 5.167 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 517.45 Btu/1000GM

CHAMBER	TIMEOUT											
EXPAN. EXPANSION												
PRESSURE, PSIA	1000	392.1	152.5	63.10	25.12	14.70	10.00	5.921	1.585	.631	.251	.100
TEMP, DEG K	5290.5	2976.5	2444.5	2150.0	1854.2	1697.9	1592.4	1361.0	1156.5	976.6	819.2	682.0
ENTHALPY (-)	97.24	125.49	150.04	171.32	199.70	179.21	205.55	219.09	240.64	240.43	247.67	255.56
CP	.7555	.6549	.6435	.6290	.6151	.6027	.5955	.5752	.5546	.5335	.5126	.4911
IMPUL OPT	156.77	214.51	253.86	293.61	277.83	306.72	325.57	340.06	352.94	362.96	371.12	374.79
IMPUL VAC	246.04	264.67	270.64	312.61	322.57	327.46	345.73	355.41	364.96	372.75	379.10	389.91
EPSILON	1.073	1.712	3.141	6.091	9.079	12.145	24.374	56.129	102.637	210.272	430.363	1.000
SHIFTING EXPANSION												
PRESSURE, PSIA	1000	392.1	152.5	63.10	25.12	14.70	10.00	5.921	1.585	.631	.251	.100
TEMP, DEG K	5290.5	2976.5	2444.5	2150.0	1854.2	1697.9	1592.4	1361.0	1156.5	976.6	819.2	682.0
ENTHALPY (-)	97.24	125.49	150.04	171.32	199.70	179.21	205.55	219.09	240.64	240.43	247.67	255.56
X BAK	5.024	4.976	4.938	4.915	4.899	4.857	4.800	4.677	4.577	4.474	4.370	4.290
N	5.024	4.976	4.938	4.915	4.899	4.857	4.800	4.677	4.577	4.474	4.370	4.290
CP	1.1555	1.0364	.9129	.7965	.7078	.5861	.5721	.5606	.5455	.5263	.5064	1.000
IMPUL OPT	157.91	217.36	259.02	291.65	306.56	316.74	338.54	357.43	374.01	388.73	401.91	423.72
IMPUL VAC	249.00	269.99	278.30	321.80	333.95	342.50	369.50	376.60	390.94	403.73	419.46	431.88
EPSILON	1.073	1.765	3.504	6.567	9.910	13.567	29.373	64.279	142.613	319.414	720.769	1.000
COMPOSITION SHIFTING (MOL/100 GM)												
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H+H+O	.2240	.1628	.1675	.0618	.0297	.0192	.0146	.0075	.0037	.0018	.0004	.0000
-135.32 H+H+O2	1.3570	1.4575	1.5062	1.5612	1.5023	1.5632	1.4972	1.5334	1.1647	.9958	.8259	1.4000
66.00 H+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 H+H+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 H+H+O3	.0018	.0013	.0010	.0009	.0010	.0010	.0009	.0007	.0005	.0004	.0003	.0002
5.74 H+O	.0317	.0352	.0063	.0018	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0214
-24.00 H+O2	.0634	.0442	.0265	.0130	.0048	.0030	.0024	.0014	.0008	.0005	.0002	.0001
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2+O2	.0124	.0084	.0048	.0022	.0008	.0004	.0003	.0001	.0000	.0000	.0000	.0000
-210.10 H2+O3	.0240	.0116	.0113	.0122	.0127	.0115	.0112	.0104	.0072	.0034	.0018	.0009
-541.69 H3+H+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0330	.0915	.0575	.0245	.0086	.0054	.0046	.0039	.0037	.0032	.0026	.0024
9.35 H+O	.0791	.0140	.0056	.0018	.0004	.0002	.0001	.0001	.0000	.0000	.0000	.0191
.00 H2	2.0509	2.1294	2.1994	2.2549	2.2924	2.3039	2.3088	2.3164	2.3205	2.3226	2.3236	2.3242
-57.80 H2+O	1.0162	.9596	.9071	.8629	.8291	.8439	.8750	.9541	1.0372	1.1211	1.2039	1.2838
59.56 O	.0011	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 H2+O3/7	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/D
298 H2O2		1.448	-44.84	64.
298 H5OH9		0.620	+7.74	36.

BULK DENSITY = .978 GM/CC
MIXTURE RATIO = 1.778 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 343.20 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	2566.3	2221.6	1917.6	1649.6	1535.7	1413.7	1205.9	1023.8	864.6	725.9	605.7	502.0
ENTHALPY (-)	79.95	104.34	125.42	143.59	151.18	159.19	172.53	183.88	193.49	201.59	208.37	214.01
CP	.7133	.7003	.6858	.6696	.6619	.6514	.6375	.6135	.5941	.5736	.5531	.5330
IMPUL OPT		145.65	198.88	235.28	248.92	262.55	283.79	300.69	314.29	325.30	334.24	341.50
IMPUL VAC		223.46	248.07	271.05	280.39	290.02	305.47	318.06	328.32	336.69	343.48	349.00
EPSILON		1.052	1.588	2.756	3.640	5.051	9.514	18.194	35.087	67.934	131.677	254.917

	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	2566.3	2383.9	2247.8	2130.8	2079.0	2021.7	1918.7	1819.2	1719.6	1633.0	1568.1	1506.3
ENTHALPY (-)	79.95	104.87	127.74	148.92	158.27	168.55	186.77	203.71	219.45	234.05	247.77	260.67
X BAR	5.901	5.793	5.662	5.531	5.473	5.408	5.295	5.191	5.098	5.006	4.905	4.811
N	5.901	5.891	5.885	5.882	5.880	5.879	5.877	5.875	5.873	5.866	5.914	5.940
CP	.9799	5.9780	6.1292	5.7030	5.4316	5.0825	4.3207	3.4522	2.5384	1.7681	1.1080	0.7221
IMPUL OPT		147.23	203.89	244.95	261.03	277.62	304.84	328.12	348.36	366.14	382.09	396.50
IMPUL VAC		228.32	257.86	286.54	298.71	311.67	333.65	353.00	370.12	385.44	399.49	412.30
EPSILON		1.074	1.706	3.138	4.268	6.131	12.382	25.521	53.267	112.794	242.723	525.933

	COMPOSITION SHIFTING (MOL/100 GM)											
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 O*H*O	1.0268	.9169	.8238	.7428	.7080	.6705	.6060	.5475	.4926	.4251	.3487	.2796
-135.32 F*H*O2	.5463	.4495	.3503	.2602	.2225	.1829	.1190	.0690	.0333	.0175	.0129	.0092
66.00 F*H2	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 H*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H*H3	.0004	.0003	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0000	.0003
-732.60 F*H3*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 H*H	.0244	.0153	.0107	.0077	.0066	.0055	.0037	.0024	.0015	.0008	.0005	.0003
-84.00 F*H2	.0039	.0021	.0013	.0007	.0006	.0004	.0002	.0001	.0000	.0000	.0000	.0002
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2*O2	.3039	.2974	.2859	.2759	.2726	.2700	.2683	.2717	.2810	.2654	.2169	.1708
-210.10 H2*O3	.3197	.3378	.3221	.2919	.2754	.2546	.2100	.1592	.1049	.0713	.0598	.0484
-541.69 H3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0339	.0233	.0180	.0142	.0127	.0110	.0082	.0058	.0038	.0025	.0019	.0015
9.33 H*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 H2	3.5972	3.7234	3.8329	3.9273	3.9667	4.0082	4.0766	4.1335	4.1806	4.2231	4.2640	4.3007
-57.80 H2*O	.0442	.0271	.0166	.0098	.0074	.0053	.0026	.0011	.0004	.0001	.0001	.0001
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 H2*O3/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 B/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		PE 0.05 PSIA			
COMPONENT										DENSITY		HEAT FORM		WT. 8/8	
REF FORMULA										GM/CC		[KCAL/FORM.WT.]			
DEG K															
298 H2O2										1.448		-44.84		64.	
298 H5OH9										0.620		+7.74		36.	
FROZEN EXPANSION															
C STAR = 5478.8 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
DEG K				DEG K		/P	/P	LVL	10000	50000		LVL			
1.000	1.000	300.000	2568.3	-79.95	713										
1.000	1.741	168.472	2332.8	-96.53	705	170.1	99.1	.588	210.5	213.1	218.2	219.2	1.193	1.262	
2.000	8.849	33.980	1792.4	-133.97	679	217.3	41.5	1.221	240.8	246.2	256.7	258.7	1.364	1.466	
3.000	15.456	19.409	1613.6	-146.00	667	239.7	34.3	1.789	248.0	255.4	271.0	274.0	1.405	1.553	
4.000	23.397	12.822	1499.1	-153.57	659	253.1	30.2	2.357		259.1	279.3	283.3		1.605	
5.000	32.009	9.132	1417.1	-158.95	652	262.2	27.6	2.943			284.7	289.7		1.642	
6.000	41.541	7.222	1353.7	-163.08	646	268.9	25.7	3.555			288.5	294.6		1.669	
7.000	51.622	5.811	1302.3	-166.39	642	274.2	24.2	4.167			291.3	298.4		1.691	
8.000	61.923	4.845	1259.5	-169.13	638	278.5	23.1	4.759			293.5	301.6		1.709	
9.000	72.215	4.154	1222.8	-171.46	634	282.1	22.1	5.321			295.2	304.3		1.724	
10.000	83.144	3.608	1190.9	-173.48	631	285.2	21.3	5.862			296.5	306.5		1.737	
11.000	95.159	3.153	1162.7	-175.25	628	287.9	20.6	6.392			297.4	308.5		1.748	
12.000	107.494	2.791	1137.4	-176.84	626	290.3	20.0	6.919			298.1	310.3		1.758	
13.000	120.028	2.499	1114.7	-178.26	623	292.4	19.4	7.437			298.6	311.9		1.767	
14.000	132.692	2.262	1094.0	-179.54	621	294.4	19.0	7.944			299.0	313.3		1.775	
15.000	145.571	2.065	1075.1	-180.71	619	296.1	18.5	8.467			299.3	314.6		1.782	
16.000	157.816	1.901	1057.7	-181.79	617	297.7	18.1	8.934			299.5	315.8		1.789	
17.000	170.237	1.762	1041.6	-182.79	615	299.1	17.8	9.400			299.7	316.9		1.795	
18.000	182.511	1.644	1026.6	-183.71	614	300.4	17.4	9.855			299.8	317.9		1.801	
19.000	196.377	1.528	1012.5	-184.57	612	301.7	17.1	10.307			299.9	318.8		1.806	
20.000	210.401	1.422	999.3	-185.37	611	302.8	16.8	10.754			299.9	319.7		1.811	
21.000	225.569	1.329	987.0	-186.13	609	303.9	16.6	12.465			299.9	320.5		1.816	
22.000	240.647	1.247	975.1	-186.84	608	304.9	16.3	13.085			299.9	321.3		1.820	
23.000	255.742	1.173	964.2	-187.51	607	305.9	16.1	13.708			299.9	322.0		1.824	
24.000	271.254	1.107	953.8	-188.15	605	306.8	15.9	14.326			299.9	322.7		1.828	
25.000	286.443	1.047	943.8	-188.75	604	307.7	15.6	14.939			299.9	323.3		1.832	
26.000	301.857	.994	934.3	-189.32	603	308.5	15.4	15.545			299.9	323.9		1.835	
27.000	317.318	.945	925.1	-189.86	602	309.2	15.3	16.143			299.9	324.5		1.838	
28.000	332.858	.901	916.6	-190.38	601	310.0	15.1	16.734			299.9	325.0		1.842	
29.000	348.475	.861	908.4	-190.88	600	310.7	14.9	17.315			299.9	325.6		1.845	
30.000	363.709	.825	900.4	-191.36	599	311.3	14.8	17.888			299.9	326.1		1.847	
31.000	379.055	.791	892.8	-191.81	598	312.0	14.6	18.448			299.9	326.6		1.850	
32.000	394.405	.761	885.5	-192.25	597	312.7	14.5	19.000			299.9	327.0		1.853	
33.000	409.963	.733	878.5	-192.67	596	313.1	14.3	19.542			299.9	327.5		1.855	
34.000	424.857	.706	871.7	-193.07	595	313.7	14.2	20.075			299.9	327.9		1.858	
35.000	439.963	.682	865.1	-193.46	594	314.2	14.0	20.598			299.9	328.3		1.860	
36.000	454.167	.658	858.8	-193.84	593	314.8	13.9	21.111			299.9	328.7		1.862	
37.000	468.749	.632	852.7	-194.20	592	315.1	13.8	21.616			299.9	329.1		1.864	
38.000	482.504	.609	846.7	-194.55	592	315.7	13.7	22.115			299.9	329.4		1.866	
39.000	496.119	.588	841.0	-194.89	591	316.2	13.6	22.608			299.9	329.8		1.868	
40.000	509.682	.568	835.4	-195.22	590	316.7	13.5	23.098			299.9	330.1		1.870	
41.000	523.681	.544	830.0	-195.54	589	317.1	13.4	23.583			299.9	330.5		1.872	
42.000	537.655	.521	824.8	-195.85	589	317.5	13.3	24.065			299.9	330.8		1.874	
43.000	551.442	.504	819.7	-196.14	588	317.9	13.2	24.544			299.9	331.1		1.876	
44.000	565.147	.488	814.8	-196.43	587	318.3	13.1	25.019			299.9	331.4		1.878	
45.000	578.664	.473	810.0	-196.72	586	318.7	13.0	25.487			299.9	331.7		1.879	
46.000	592.117	.459	805.1	-197.00	586	319.1	12.9	25.949			299.9	332.0		1.881	
47.000	605.495	.446	800.7	-197.26	585	319.5	12.8	26.405			299.9	332.2		1.882	
48.000	618.911	.433	796.3	-197.52	584	319.8	12.7	26.859			299.9	332.5		1.884	
49.000	632.265	.421	792.0	-197.77	584	320.2	12.6	27.307			299.9	332.8		1.885	
50.000	645.742	.409	787.7	-198.02	583	320.5	12.5	27.751			299.9	333.0		1.887	
51.000	659.244	.397	783.4	-198.27	582	320.9	12.4	28.191			299.9	333.2		1.888	
52.000	672.771	.385	779.1	-198.52	581	321.2	12.3	28.627			299.9	333.4		1.889	
53.000	686.324	.373	774.8	-198.77	580	321.5	12.2	29.060			299.9	333.6		1.890	
54.000	699.901	.361	770.5	-199.02	579	321.8	12.1	29.490			299.9	333.8		1.891	
55.000	713.502	.349	766.2	-199.27	578	322.1	12.0	29.917			299.9	334.0		1.892	
56.000	727.127	.337	761.9	-199.52	577	322.4	11.9	30.341			299.9	334.2		1.893	
57.000	740.776	.325	757.6	-199.77	576	322.7	11.8	30.762			299.9	334.4		1.894	
58.000	754.449	.313	753.3	-199.99	575	323.0	11.7	31.180			299.9	334.6		1.895	
59.000	768.146	.301	749.0	-200.22	574	323.3	11.6	31.595			299.9	334.8		1.896	
60.000	781.867	.289	744.7	-200.45	573	323.6	11.5	32.008			299.9	335.0		1.897	

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2O2		1.448	-44.84	68.
298 H5OH9		0.620	+7.74	32.

BULK DENSITY = 1.014 GM/CC
MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 340.76 EU/100GMS

	CHAMBER										THROAT									
	FROZEN EXPANSION																			
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	170.1							
TEMP, DEG K	2845.2	2473.3	2144.4	1853.6	1729.6	1596.7	1369.7	1169.3	993.3	839.1	704.5	587.5	2597.4							
ENTHALPY (-)	85.72	111.53	133.94	153.35	161.48	170.09	184.49	196.81	207.30	216.19	223.68	229.95	102.96							
CP	.6994	.6883	.6746	.6595	.6520	.6433	.6243	.6053	.5860	.5664	.5458	.5253	.6920							
IMPUL OPT	149.85	204.83	242.56	256.73	270.93	293.13	310.88	325.23	336.91	346.44	354.22	362.29	122.49							
IMPUL VAC	230.09	255.72	279.71	289.49	299.58	315.85	329.17	340.08	349.02	356.33	362.29	362.29	225.58							
EPSILON	1.053	1.595	2.779	3.674	5.114	9.678	18.595	36.038	70.141	136.688	266.106	1.000								
	SHIFTING EXPANSION																			
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.5							
TEMP, DEG K	2845.2	2576.3	2324.9	2188.2	2137.9	2083.0	1986.5	1897.3	1814.2	1735.9	1661.3	1588.9	2673.8							
ENTHALPY (-)	85.72	111.97	135.58	157.00	166.48	176.89	195.41	212.68	228.83	243.36	258.14	271.44	102.57							
X BAR	5.623	5.588	5.565	5.452	5.392	5.325	5.204	5.090	4.982	4.878	4.781	4.689	5.599							
N	5.623	5.588	5.565	5.559	5.558	5.556	5.553	5.552	5.550	5.549	5.548	5.547	5.599							
CP	1.1310	1.0382	.9596	8.6485	8.6006	8.5092	8.2216	7.7774	7.1664	6.3947	5.4850	4.4904	1.0720							
IMPUL OPT	151.13	208.27	249.03	265.07	281.63	308.91	332.34	352.85	371.03	387.29	401.96	412.08								
IMPUL VAC	233.48	261.97	290.44	302.66	315.68	337.95	357.48	375.00	390.77	405.02	417.98	227.98								
EPSILON	1.063	1.655	3.046	4.152	5.978	12.124	25.127	52.859	112.431	241.115	520.156	1.000								
	COMPOSITION SHIFTING (MOL/100 GM)																			
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H*H*O	.7023	.5999	.4887	.3984	.3615	.3218	.2543	.1953	.1444	.1013	.0662	.0391	.6390							
-135.32 H*H*O2	.9914	.9740	.9215	.8287	.7856	.7389	.6579	.5858	.5231	.4696	.4254	.3892	.9844							
56.00 H*H2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-45.00 H*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
18.00 H*H3	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-238.60 H*H3*O3	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001							
5.74 H*O	.0459	.0231	.0097	.0059	.0049	.0040	.0026	.0016	.0010	.0005	.0003	.0001	.0304							
-84.00 H*O2	.0261	.0112	.0052	.0034	.0030	.0025	.0018	.0013	.0009	.0006	.0004	.0003	.0141							
149.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-111.60 H2*O2	.1177	.1105	.0985	.0787	.0697	.0601	.0443	.0310	.0202	.0120	.0062	.0027	.1136							
-210.10 H2*O3	.2667	.3517	.4553	.4624	.4534	.4417	.4148	.3821	.3431	.2981	.2472	.1915	.3187							
-541.69 H3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
52.10 H	.0895	.0512	.0254	.0189	.0173	.0156	.0127	.0103	.0082	.0064	.0049	.0036	.0639							
9.33 H*O	.0016	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007							
.00 H2	3.2023	3.3377	3.4774	3.5918	3.6388	3.6891	3.7743	3.8480	3.9109	3.9631	4.0048	4.0361	3.2870							
-57.80 H2*O	.1834	.1279	.0831	.0636	.0575	.0513	.0418	.0348	.0298	.0268	.0255	.0265	.1473							
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-305.34 H2*O3/C	.0000	.0000	.0000	.1071	.1658	.2310	.3490	.4613	.5684	.6703	.7668	.8578	.0000							

SYSTEM LIQUID BIPHORELLANT										PC 300. PSIA		PE 0.05 PSIA			
COMPONENT		REF. FORMULA		DEG. K		DENSITY GM/CM ³		HEAT FORM. [KCAL/FORM.WT.]		WT. 0/0					
298 H2O2						1.448		-44.84		68.					
298 B5MH9						0.620		+7.74		32.					
FROZEN EXPANSION															
						C STAIR. 2 BT/SEC									
EPSILON		PC/P		P PSIA		TEMP		ENTHALPY		CP CAL/ I		OPT DELVAC		DELVAC	
						DEG. K		KCAL/100GM		GM DEG		/P		/P	
1.000	1.000	100.000	2845.2	-85.72	699	170.107	2547.4	-102.96	672	122.5	103.1	606	216.7	219.4	224.5
2.000	1.764	170.107	2547.4	-102.96	672	122.5	103.1	606	216.7	219.4	224.5	225.4	1.192	1.241	1.241
3.000	8.736	34.342	2012.0	-142.84	688	170.107	2547.4	-102.96	672	122.5	103.1	606	216.7	219.4	224.5
4.000	15.295	19.006	1816.5	-155.07	657	266.7	15.8	1.822	255.7	261.8	279.4	282.5	1.407	1.554	1.554
5.000	23.038	13.022	1694.5	-163.77	650	260.6	31.6	2.427	267.3	288.1	292.2	1.607	1.607	1.607	1.607
6.000	31.474	9.532	1605.4	-169.53	644	270.0	28.9	3.032	293.8	298.9	1.644	1.644	1.644	1.644	1.644
7.000	40.741	7.364	1536.3	-173.96	639	277.1	26.9	3.659	297.8	304.0	1.672	1.672	1.672	1.672	1.672
8.000	50.576	5.932	1480.4	-177.52	634	282.6	25.5	4.291	300.7	308.1	1.695	1.695	1.695	1.695	1.695
9.000	60.616	4.940	1433.7	-180.47	630	287.1	24.3	4.904	303.0	311.4	1.713	1.713	1.713	1.713	1.713
10.000	70.701	4.243	1393.8	-182.98	626	290.9	23.3	5.488	304.8	314.2	1.728	1.728	1.728	1.728	1.728
11.000	81.121	3.698	1358.9	-185.16	623	294.1	22.5	6.073	306.2	316.6	1.741	1.741	1.741	1.741	1.741
12.000	92.764	3.234	1328.0	-187.08	621	297.0	21.7	6.721	307.2	318.7	1.753	1.753	1.753	1.753	1.753
13.000	104.757	2.888	1300.4	-188.79	618	299.5	21.1	7.367	308.0	320.4	1.763	1.763	1.763	1.763	1.763
14.000	116.913	2.566	1275.5	-190.33	616	301.7	20.5	8.006	308.6	322.2	1.772	1.772	1.772	1.772	1.772
15.000	129.141	2.322	1252.8	-191.72	614	303.7	20.0	8.633	309.0	323.7	1.781	1.781	1.781	1.781	1.781
16.000	141.441	2.120	1232.0	-193.00	612	305.5	19.6	9.262	309.3	325.1	1.788	1.788	1.788	1.788	1.788
17.000	153.711	1.952	1212.9	-194.17	610	307.2	19.2	9.893	309.6	326.4	1.795	1.795	1.795	1.795	1.795
18.000	165.834	1.804	1195.1	-195.24	608	308.7	18.8	10.520	309.8	327.5	1.801	1.801	1.801	1.801	1.801
19.000	177.817	1.687	1178.6	-196.25	606	310.1	18.5	10.951	328.6	1.807	1.807	1.807	1.807	1.807	1.807
20.000	189.666	1.595	1163.2	-197.18	605	311.4	18.2	11.529	329.6	1.813	1.813	1.813	1.813	1.813	1.813
21.000	201.457	1.467	1148.7	-198.06	603	312.6	17.9	12.173	330.5	1.818	1.818	1.818	1.818	1.818	1.818
22.000	213.694	1.372	1135.1	-198.88	602	313.8	17.6	12.818	331.3	1.823	1.823	1.823	1.823	1.823	1.823
23.000	225.124	1.281	1122.2	-199.65	600	314.8	17.3	13.463	332.2	1.827	1.827	1.827	1.827	1.827	1.827
24.000	237.130	1.211	1110.0	-200.38	599	315.8	17.1	14.105	332.9	1.831	1.831	1.831	1.831	1.831	1.831
25.000	249.472	1.143	1098.5	-201.07	598	316.8	16.9	14.745	333.6	1.835	1.835	1.835	1.835	1.835	1.835
26.000	262.472	1.082	1087.5	-201.73	597	317.7	16.6	15.379	334.3	1.839	1.839	1.839	1.839	1.839	1.839
27.000	275.218	1.027	1077.0	-202.35	596	318.5	16.4	16.008	334.9	1.843	1.843	1.843	1.843	1.843	1.843
28.000	287.854	971	1067.0	-202.95	594	319.4	16.2	16.629	335.6	1.846	1.846	1.846	1.846	1.846	1.846
29.000	300.347	931	1057.5	-203.52	593	320.1	16.1	17.243	336.2	1.849	1.849	1.849	1.849	1.849	1.849
30.000	312.714	890	1048.4	-204.06	592	320.9	15.9	17.866	336.7	1.852	1.852	1.852	1.852	1.852	1.852
31.000	324.957	852	1039.6	-204.58	591	321.6	15.7	18.486	337.3	1.855	1.855	1.855	1.855	1.855	1.855
32.000	337.077	817	1031.2	-205.07	590	322.2	15.6	19.103	337.8	1.858	1.858	1.858	1.858	1.858	1.858
33.000	349.077	785	1023.1	-205.55	590	322.9	15.4	19.688	338.3	1.861	1.861	1.861	1.861	1.861	1.861
34.000	360.954	756	1015.3	-206.01	589	323.5	15.3	20.275	338.8	1.863	1.863	1.863	1.863	1.863	1.863
35.000	372.710	729	1007.4	-206.45	588	324.1	15.1	20.872	339.2	1.866	1.866	1.866	1.866	1.866	1.866
36.000	384.347	704	1000.0	-206.88	587	324.7	15.0	21.468	339.6	1.868	1.868	1.868	1.868	1.868	1.868
37.000	395.867	681	993.5	-207.29	586	325.2	14.9	22.061	340.1	1.871	1.871	1.871	1.871	1.871	1.871
38.000	407.267	656	986.8	-207.68	585	325.7	14.7	22.655	340.5	1.873	1.873	1.873	1.873	1.873	1.873
39.000	418.549	632	980.2	-208.07	584	326.3	14.6	23.247	340.9	1.875	1.875	1.875	1.875	1.875	1.875
40.000	429.714	610	973.8	-208.44	584	326.7	14.5	23.837	341.2	1.877	1.877	1.877	1.877	1.877	1.877
41.000	440.764	589	967.7	-208.80	583	327.2	14.4	24.424	341.6	1.879	1.879	1.879	1.879	1.879	1.879
42.000	451.699	570	961.7	-209.15	582	327.7	14.3	25.007	342.0	1.881	1.881	1.881	1.881	1.881	1.881
43.000	462.519	554	956.3	-209.48	581	328.5	14.2	25.587	342.6	1.883	1.883	1.883	1.883	1.883	1.883
44.000	473.224	538	950.3	-209.81	581	328.5	14.1	26.161	342.6	1.885	1.885	1.885	1.885	1.885	1.885
45.000	483.814	524	944.8	-210.11	580	329.0	14.0	26.731	343.0	1.886	1.886	1.886	1.886	1.886	1.886
46.000	494.289	510	939.4	-210.44	579	329.8	13.9	27.293	343.6	1.889	1.889	1.889	1.889	1.889	1.889
47.000	504.649	497	934.2	-211.01	578	330.2	13.8	27.846	343.9	1.891	1.891	1.891	1.891	1.891	1.891
48.000	514.894	485	929.3	-211.32	578	330.6	13.7	28.390	344.2	1.893	1.893	1.893	1.893	1.893	1.893
49.000	525.024	474	924.5	-211.60	577	330.9	13.6	28.925	344.4	1.895	1.895	1.895	1.895	1.895	1.895
50.000	535.039	463	919.8	-211.87	576	331.3	13.5	29.457	344.7	1.896	1.896	1.896	1.896	1.896	1.896
51.000	544.939	453	915.4	-212.14	575	331.7	13.4	29.982	345.0	1.897	1.897	1.897	1.897	1.897	1.897
52.000	554.724	443	911.0	-212.40	574	332.1	13.3	30.503	345.3	1.898	1.898	1.898	1.898	1.898	1.898
53.000	564.494	434	906.8	-212.65	573	332.5	13.2	31.019	345.6	1.899	1.899	1.899	1.899	1.899	1.899
54.000	574.249	425	902.6	-212.89	572	332.9	13.1	31.530	345.9	1.900	1.900	1.900	1.900	1.900	1.900
55.000	583.989	417	898.4	-213.12	571	333.3	13.0	32.036	346.2	1.901	1.901	1.901	1.901	1.901	1.901
56.000	593.714	409	894.2	-213.35	570	333.7	12.9	32.537	346.5	1.902	1.902	1.902	1.902	1.902	1.902
57.000	603.424	402	890.0	-213.57	569	334.1	12.8	33.033	346.8	1.903	1.903	1.903	1.903	1.903	1.903
58.000	613.119	395	885.8	-213.78	568	334.5	12.7	33.524	347.1	1.904	1.904	1.904	1.904	1.904	1.904
59.000	622.809	388	881.6	-213.98	567	334.9	12.6	34.010	347.4	1.905	1.905	1.905	1.905	1.905	1.905
60.000	632.494	381	877.4	-214.18	566	335.3	12.5	34.491	347.7	1.906	1.906	1.906	1.906	1.906	1.906
61.000	642.174	375	873.2	-214.37	565	335.7	12.4	34.967	348.0	1.907	1.907	1.907	1.907	1.907	1.907
62.000	651.849	369	869.0	-214.55	564	336.1	12.3	35.438	348.3	1.908	1.908	1.908	1.908	1.908	1.908
63.000	661.519	363	864.8	-214.73	563	336.5	12.2	35.904	348.6	1.909	1.909	1.909	1.909	1.909	1.909
64.000	671.184	357	860.6	-214.90	562	336.9	12.1	36.365	348.9	1.910	1.910	1.910	1.910	1.910	1.910
65.000	680.844	351	856.4	-215.07	561	337.3	12.0	36.821	349.2	1.911	1.911	1.911	1.911	1.911	1.911
66.000	690.519	345	852.2	-215.24	560	337.7	11.9	37.272	349.5	1.912	1.912	1.912	1.912	1.912	1.912
67.000	700.184	339	848.0	-215.41	559	338.1	11.8	37.723	349.8	1.913	1.913	1.913	1.913	1.913	1.913
68.000	709.849	333	843.8	-215.58	558	338.5	11.7	38.174	350.1	1.914	1.914	1.914	1.914	1.914	1.914
69.000	719.519	327	839.6	-215.75	557	338.9	11.6	38.625	350.4	1.915	1.915	1.915	1.915	1.915	1.915
70.000	729.184	321	835.4	-215.92	556	339.3	11.5	39.076	350.7	1.916	1.916	1.916	1.916	1.916	1.916
71.000	738.849	315	831.2	-216.09	555	339.7	11.4	39.527	351.0	1.917	1.917	1.917	1.917	1.917	1.917
72.000	748.519	309	827.0	-216.26	554	34									

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2*O2		1.448	-44.84	70.
298 B5*H9		0.620	+7.74	30.

BULK DENSITY = 1.034 GM/CC
MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 338.67 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	169.9
TEMP, DEG K	2957.5	2575.4	2237.2	1937.7	1809.9	1672.6	1438.1	1230.7	1047.8	887.3	746.8	624.5	2702.7
ENTHALPY (-)	88.60	114.81	137.61	157.39	165.69	174.49	189.23	201.87	212.66	221.82	229.56	236.05	106.13
CP	.6915	.6799	.6672	.6528	.6455	.6367	.6189	.5997	.5805	.5609	.5405	.5198	.6844
IMPUL OPT	151.01	206.49	244.63	258.97	273.36	295.88	313.91	328.52	340.44	350.19	358.16	366.44	123.50
IMPUL VAC	231.93	257.90	282.22	292.13	302.39	318.94	332.51	343.66	352.81	360.31	366.44	372.34	227.34
EPSILON		1.054	1.598	2.788	3.693	5.140	9.745	18.762	36.432	71.056	138.775	270.786	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	172.8
TEMP, DEG K	2957.5	2689.6	2436.9	2196.3	2133.2	2075.9	1974.2	1878.7	1788.3	1701.9	1618.9	1539.1	2785.6
ENTHALPY (-)	88.60	115.27	139.32	160.95	170.33	180.61	198.89	215.87	231.67	246.38	260.09	272.88	105.83
X BAR	5.488	5.445	5.415	5.396	5.346	5.279	5.157	5.041	4.931	4.827	4.730	4.639	5.460
N	5.488	5.445	5.415	5.396	5.346	5.279	5.157	5.041	4.931	4.827	4.730	4.639	5.460
CP	1.2015	1.0946	.9924	.9014	7.3294	7.0479	6.4111	5.6898	4.9533	4.2742	3.7041	3.2635	1.1347
IMPUL OPT	152.32	210.05	250.89	266.65	282.93	309.75	332.74	352.79	370.50	386.25	400.40	422.42	
IMPUL VAC	235.44	264.36	291.73	303.63	316.41	338.16	357.35	374.40	389.66	403.39	415.82	429.82	
EPSILON		1.064	1.659	2.978	4.047	5.827	11.801	24.392	51.128	108.260	231.026	496.047	1.000
COMPOSITION SHIFTING (MOLE/100 GM)													
132.60 B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*H*O	.5428	.4519	.3547	.2556	.2196	.1841	.1268	.0820	.0492	.0271	.0137	.0063	.4859
-135.32 B*H*O2	1.1660	1.1911	1.1907	1.1648	1.1319	1.0928	1.0264	.9673	.9124	.8561	.7920	.7140	1.1847
66.00 B*H2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*H3*O3	.0002	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
5.74 B*O	.0512	.0272	.0120	.0041	.0030	.0022	.0012	.0006	.0003	.0001	.0000	.0000	.0349
-44.00 B*O2	.0346	.0217	.0117	.0052	.0043	.0036	.0027	.0019	.0013	.0009	.0006	.0003	.0261
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2*O2	.0684	.0594	.0479	.0343	.0279	.0214	.0122	.0062	.0027	.0010	.0003	.0001	.0630
-210.10 B2*O3	.2214	.2818	.3547	.4380	.4323	.4109	.3634	.3080	.2474	.1861	.1296	.0830	.2583
-541.69 B3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1229	.0763	.0415	.0190	.0162	.0143	.0112	.0086	.0063	.0045	.0030	.0020	.0921
9.33 H*O	.0044	.0016	.0005	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0024
.00 H2	2.9621	3.0895	3.2175	3.3420	3.3860	3.4289	3.4970	3.5491	3.5864	3.6109	3.6256	3.6337	3.0426
-57.80 H2*O	.3143	.2447	.1834	.1330	.1249	.1203	.1156	.1168	.1245	.1401	.1649	.2001	.2694
59.56 O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 B2*O3/C	.0000	.0000	.0000	.0000	.0477	.1135	.2330	.3471	.4555	.5580	.6541	.7438	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		PE 0.05 PSIA			
COMPONENT		TREF	FORMULA	DENSITY		HEAT FORM		WT. G/G							
		DEG K		GM/CC		(KCAL/FORM.WT.)									
298 H2+O2				1.448		-44.84		70.							
298 O5+H9				0.620		+7.74		30.							
FROZEN EXPANSION															
C STAR = 5897.7 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000		LVL		
1.000	1.000	300.000	2957.5	-88.60	1.202										
2.000	1.765	169.944	2702.7	-106.13	1.135	122.4	107.4	622	220.7	223.4	228.8	229.8	1.232	1.183	
3.000	8.697	34.493	2102.3	-146.58	1.061	225.1	43.7	1.267	250.2	255.8	266.6	268.8	1.365	1.466	
4.000	15.174	19.770	1903.1	-159.64	1.051	248.6	36.3	1.837	257.9	266.1	281.8	284.9	1.407	1.556	
5.000	22.893	13.104	1775.5	-167.91	1.043	282.7	32.1	2.447	269.6	290.6	294.7			1.408	
6.000	31.262	9.596	1683.6	-173.79	1.037	322.2	29.3	3.058		296.4	301.4			1.645	
7.000	40.428	7.421	1612.4	-178.31	1.033	379.4	27.4	3.689		300.5	306.8			1.673	
8.000	50.166	5.980	1554.7	-181.95	1.028	405.0	25.9	4.326		303.5	310.9			1.696	
9.000	60.131	4.989	1506.5	-184.97	1.025	489.6	24.7	4.946		305.8	314.2			1.716	
10.000	70.112	4.279	1465.3	-187.54	1.021	593.4	23.7	5.536		307.4	317.1			1.730	
11.000	80.324	3.735	1429.3	-189.77	1.018	696.7	22.9	6.120		309.1	319.5			1.743	
12.000	91.826	3.267	1397.4	-191.74	1.015	799.6	22.1	6.774		310.1	321.7			1.755	
13.000	103.648	2.894	1368.9	-193.49	1.013	902.1	21.5	7.426		310.9	323.6			1.765	
14.000	115.680	2.593	1343.1	-195.06	1.010	1004.3	20.9	8.071		311.5	325.3			1.775	
15.000	127.818	2.347	1319.7	-196.49	1.008	1106.4	20.4	8.704		312.0	326.8			1.783	
16.000	139.975	2.143	1298.2	-197.80	1.006	1208.2	20.0	9.321		312.3	328.2			1.790	
17.000	152.078	1.973	1278.4	-199.00	1.004	1309.9	19.6	9.919		312.6	329.5			1.797	
18.000	164.077	1.828	1260.0	-200.10	1.003	1411.5	19.2	10.496		312.7	330.7			1.804	
19.000	175.941	1.705	1242.9	-201.13	1.001	1512.9	18.8	11.053						1.810	
20.000	188.125	1.595	1226.9	-202.09	1.000	1614.2	18.5	11.618						1.815	
21.000	201.903	1.486	1211.9	-202.99	1.000	1715.5	18.2	12.267						1.820	
22.000	215.920	1.389	1197.8	-203.83	1.000	1816.6	17.9	12.918						1.825	
23.000	230.141	1.304	1184.4	-204.63	1.000	1917.7	17.7	13.568						1.830	
24.000	244.516	1.227	1171.8	-205.38	1.000	2018.8	17.4	14.216						1.834	
25.000	259.064	1.158	1159.8	-206.09	1.000	2119.7	17.2	14.862						1.839	
26.000	273.701	1.096	1148.5	-206.76	1.000	2220.6	17.0	15.502						1.842	
27.000	288.416	1.040	1137.6	-207.41	1.000	2321.5	16.8	16.138						1.845	
28.000	303.181	0.990	1127.2	-208.02	1.000	2422.3	16.6	16.766						1.849	
29.000	317.970	0.943	1117.3	-208.60	1.000	2523.1	16.4	17.388						1.852	
30.000	332.761	0.902	1107.9	-209.16	1.000	2623.9	16.2	18.000						1.855	
31.000	347.534	0.863	1098.8	-209.69	1.000	2724.6	16.1	18.604						1.858	
32.000	362.277	0.828	1090.0	-210.20	1.000	2825.3	15.9	19.199						1.861	
33.000	376.962	0.796	1081.6	-210.69	1.000	2925.9	15.7	19.784						1.864	
34.000	391.592	0.766	1073.5	-211.17	1.000	3026.5	15.6	20.359						1.866	
35.000	406.155	0.739	1065.7	-211.62	1.000	3127.1	15.5	20.925						1.869	
36.000	420.646	0.713	1058.2	-212.06	1.000	3227.7	15.3	21.481						1.871	
37.000	435.063	0.689	1050.9	-212.48	1.000	3328.3	15.2	22.027						1.874	
38.000	449.404	0.666	1043.9	-212.89	1.000	3428.8	15.1	22.562						1.876	
39.000	463.751	0.642	1037.1	-213.29	1.000	3529.4	14.9	23.074						1.878	
40.000	478.144	0.620	1030.5	-213.67	1.000	3629.9	14.8	23.577						1.880	
41.000	492.511	0.599	1024.2	-214.04	1.000	3730.3	14.7	24.071						1.882	
42.000	506.844	0.579	1017.8	-214.40	1.000	3830.7	14.6	24.559						1.884	
43.000	521.146	0.560	1011.8	-214.74	1.000	3931.1	14.5	25.048						1.886	
44.000	535.426	0.543	1005.9	-215.06	1.000	4031.7	14.4	25.536						1.888	
45.000	549.686	0.526	1000.2	-215.41	1.000	4132.1	14.3	26.018						1.890	
46.000	563.927	0.510	994.7	-215.73	1.000	4232.6	14.2	26.498						1.892	
47.000	578.141	0.495	989.3	-216.04	1.000	4333.0	14.1	26.972						1.893	
48.000	592.336	0.481	984.0	-216.34	1.000	4433.4	14.0	27.444						1.895	
49.000	606.517	0.468	978.9	-216.63	1.000	4533.7	13.9	27.914						1.897	
50.000	620.675	0.455	973.9	-216.92	1.000	4634.1	13.8	28.372						1.898	
51.000	634.811	0.443	969.0	-217.20	1.000	4734.5	13.7	28.828						1.900	
52.000	648.924	0.432	964.2	-217.49	1.000	4834.9	13.6	29.282						1.901	
53.000	663.014	0.421	959.5	-217.77	1.000	4935.3	13.5	29.734						1.902	
54.000	677.081	0.410	954.8	-218.05	1.000	5035.7	13.4	30.184						1.903	
55.000	691.124	0.400	950.1	-218.33	1.000	5136.1	13.3	30.632						1.904	
56.000	705.141	0.390	945.4	-218.61	1.000	5236.5	13.2	31.078						1.905	
57.000	719.134	0.380	940.7	-218.89	1.000	5336.9	13.1	31.522						1.906	
58.000	733.101	0.370	936.0	-219.17	1.000	5437.3	13.0	31.964						1.907	
59.000	747.041	0.360	931.3	-219.45	1.000	5537.7	12.9	32.404						1.908	
60.000	760.954	0.350	926.6	-219.73	1.000	5638.1	12.8	32.842						1.909	
61.000	774.841	0.340	921.9	-220.01	1.000	5738.5	12.7	33.278						1.910	
62.000	788.701	0.330	917.2	-220.29	1.000	5838.9	12.6	33.712						1.911	
63.000	802.534	0.320	912.5	-220.57	1.000	5939.3	12.5	34.144						1.912	
64.000	816.341	0.310	907.8	-220.85	1.000	6039.7	12.4	34.574						1.913	
65.000	830.124	0.300	903.1	-221.13	1.000	6140.1	12.3	35.002						1.914	
66.000	843.881	0.290	898.4	-221.41	1.000	6240.5	12.2	35.428						1.915	
67.000	857.614	0.280	893.7	-221.69	1.000	6340.9	12.1	35.852						1.916	
68.000	871.324	0.270	889.0	-221.97	1.000	6441.3	12.0	36.274						1.917	
69.000	885.014	0.260	884.3	-222.25	1.000	6541.7	11.9	36.694						1.918	
70.000	898.681	0.250	879.6	-222.53	1.000	6642.1	11.8	37.112						1.919	
71.000	912.324	0.240	874.9	-222.81	1.000	6742.5	11.7	37.528						1.920	
72.000	925.941	0.230	870.2	-223.09	1.000	6842.9	11.6	37.942						1.921	
73.000	939.534	0.220	865.5	-223.37	1.000	6943.3	11.5	38.354						1.922	
74.000	953.101	0.210	860.8	-223.65	1.000	7043.7	11.4	38.764						1.923	
75.000	966.641	0.200	856.1	-223.93	1.000	7144.1	11.3	39.172						1.924	
76.000	980.154	0.190	851.4	-224.21	1.000	7244.5	11.2	39.578						1.925	
77.000	993.641	0.180	846.7	-224.49	1.000	7344.9	11.1	39.982						1.926	
78.000	1007.101	0.170	842.0	-224.77	1.000	7445.3	11.0	40.384						1.927	
79.000	1020.534	0.160	837.3	-225.05	1.000	7545.7	10.9	40.784						1.928	
80.000	1033.941	0.150	832.6	-225.33	1.000	7646.1	10.8	41.184						1.929	
81.000	1047.354	0.140	827.9	-225.61	1.000	7746.5	10.7	41.584						1.930	
82.000	1060.767	0.130	823.2	-225.89	1.000	7846.9	10.6</								

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2O2		1.448	-44.84	72.
298 H5OH9		0.620	+7.74	28.

BULK DENSITY = 1.054 GM/CC
MIXTURE RATIO = 2.571 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
CHAMBER ENTROPY 336.07 EU/100GMS

	CHAMBER										THROAT									
	FROZEN EXPANSION																			
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.660	.285	.119	.050	169.9							
TEMP, DEG K	3053.2	2663.2	2317.5	2011.0	1860.0	1739.3	1498.5	1285.2	1096.6	930.6	785.0	657.9	2793.1							
ENTHALPY (-)	91.48	117.90	140.92	160.92	169.33	178.25	193.22	206.08	217.08	226.45	234.37	241.04	109.15							
CP	.6822	.6719	.6593	.6455	.6382	.6296	.6124	.5930	.5739	.5540	.5342	.5136	.6757							
IMPUL OPT		151.61	207.39	245.79	260.25	274.75	297.50	315.75	330.56	342.66	352.58	360.71	123.98							
IMPUL VAC		232.92	259.11	283.66	293.68	304.06	320.82	334.59	345.91	355.23	362.88	369.15	228.26							
EPSILON		1.054	1.600	2.797	3.707	5.165	9.809	18.918	36.802	71.909	140.716	275.103	1.000							
	SHIFTING EXPANSION																			
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.5							
TEMP, DEG K	3053.2	2785.2	2530.6	2284.3	2171.2	2053.3	1945.9	1845.5	1751.5	1663.4	1581.1	1504.1	2882.6							
ENTHALPY (-)	91.48	118.36	142.63	164.49	173.91	184.07	201.88	218.38	233.68	247.88	261.09	273.40	108.71							
X BAR	5.354	5.304	5.266	5.241	5.233	5.218	5.094	4.976	4.865	4.761	4.663	4.572	5.321							
N	5.354	5.304	5.266	5.241	5.233	5.228	5.225	5.223	5.222	5.221	5.220	5.220	5.321							
CP	1.2620	1.1416	1.0143	.8950	.8431	.79482	.750863	.716133	.681233	.649128	.626647	.613996	1.1871							
IMPUL OPT		152.91	210.95	252.03	267.79	283.81	309.91	332.26	351.72	368.86	384.12	397.82	122.43							
IMPUL VAC		236.43	265.57	293.10	304.47	316.45	337.56	356.16	372.66	387.42	400.72	412.77	230.75							
EPSILON		1.065	1.662	2.982	3.999	5.657	11.439	23.593	49.360	104.401	222.777	478.825	1.000							
	COMPOSITION SHIFTING (MOL/100 GM)																			
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B#H#C	.4033	.3241	.2429	.1638	.1296	.0957	.0582	.0332	.0178	.0091	.0044	.0021	.3538							
-135.32 B#H#C2	1.2847	1.3430	1.3857	1.4128	1.4210	1.4213	1.3470	1.2668	1.1760	1.0721	.9555	.8285	1.3231							
66.00 H#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-45.00 B#H2#O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
18.00 B#H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-738.60 B#H3#O3	.0004	.0002	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0000	.0000	.0003							
5.74 B#C	.0516	.0280	.0126	.0043	.0023	.0011	.0005	.0002	.0001	.0000	.0000	.0000	.0358							
-34.00 B#O2	.0525	.0356	.0211	.0105	.0070	.0043	.0030	.0020	.0013	.0008	.0005	.0003	.0417							
119.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-111.60 B2#O2	.0382	.0304	.0220	.0136	.0101	.0067	.0030	.0012	.0004	.0001	.0000	.0000	.0334							
-210.10 B2#O3	.1736	.2122	.2549	.2988	.3180	.3303	.2690	.2082	.1528	.1064	.0703	.0442	.1973							
-541.69 B3#H3#O36	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
52.10 H	.1550	.1019	.0592	.0288	.0190	.0117	.0086	.0062	.0043	.0029	.0019	.0012	.1205							
9.33 H#B	.0103	.0044	.0016	.0005	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0062							
.00 H2	2.6891	2.8027	2.9128	3.0137	3.0555	3.0956	3.1379	3.1656	3.1824	3.1970	3.1970	3.1996	2.7608							
-57.80 H2#O	.4949	.4214	.3535	.2944	.2706	.2510	.2661	.2924	.3296	.3772	.4332	.4956	.4481							
59.56 O	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002							
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-305.34 B2#O3/C	.0000	.0000	.0000	.0000	.0000	.0098	.1316	.2475	.3572	.4605	.5575	.6484	.0000							

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA				PF 0.05 PSIA			
COMPONENT										REF FORMULA		DENSITY		HEAT FORM		WT. G/O	
										DEG K		GN/CC		(KCAL/POUN.WT.)			
										298 H2+O2		1.448		-94.84		72.	
										298 O2+H2		0.620		+7.74		28.	
										FROZEN EXPANSION							
										C STAR = 5923.7 FT/SEC							
										C STAR = 6024.2 FT/SEC							
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP	CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
			DEG K	KCAL/100GM	GM DEG			/P	/P	LVL	10000	50000	LVL	LVL			
1.000	1.000	300.000	303.2	-91.48	.682												
1.000	1.766	169.911	279.1	-104.15	.676	124.0	104.3	.614	219.2	222.0	227.2	228.3	1.191	1.240			
2.000	8.662	36.635	218.0	-149.90	.654	225.9	44.1	1.272	251.3	256.9	267.8	270.0	1.165	1.406			
3.000	15.059	19.865	197.2	-163.10	.644	249.6	36.7	1.484	259.2	267.3	281.1	286.3	1.408	1.555			
4.000	22.759	13.181	184.6	-171.46	.636	263.8	32.4	2.458	270.9				1.609	1.609			
5.000	31.263	9.658	175.2	-177.42	.630	273.4	29.7	3.071					1.644	1.644			
6.000	40.132	7.475	167.9	-182.01	.626	280.6	27.7	3.704					1.675	1.675			
7.000	49.780	6.026	162.0	-185.69	.622	286.3	26.2	4.345					1.697	1.697			
8.000	59.658	5.029	157.0	-188.76	.618	290.9	25.0	4.988					1.716	1.716			
9.000	69.547	4.314	152.7	-191.37	.615	294.8	24.0	5.563					1.731	1.731			
10.000	79.591	3.769	149.1	-193.63	.612	298.1	23.2	6.145					1.745	1.745			
11.000	89.760	3.298	145.9	-195.63	.609	301.0	22.4	6.801					1.757	1.757			
12.000	100.000	2.903	142.9	-197.41	.607	303.4	21.8	7.456					1.767	1.767			
13.000	110.548	2.614	140.3	-199.01	.604	305.9	21.2	8.105					1.777	1.777			
14.000	120.558	2.370	137.9	-200.46	.602	307.9	20.7	8.742					1.785	1.785			
15.000	130.551	2.165	135.7	-201.79	.600	309.8	20.3	9.364					1.793	1.793			
16.000	140.517	1.992	133.6	-202.91	.598	311.5	19.9	9.987					1.800	1.800			
17.000	150.443	1.847	131.7	-203.83	.596	313.1	19.5	10.549					1.806	1.806			
18.000	160.327	1.722	130.3	-205.18	.594	314.5	19.1	11.112					1.812	1.812			
19.000	170.167	1.613	128.8	-206.16	.593	315.9	18.8	11.663					1.818	1.818			
20.000	180.000	1.503	127.4	-207.07	.591	317.1	18.5	12.215					1.823	1.823			
21.000	190.000	1.402	126.3	-207.99	.590	318.1	18.2	12.768					1.828	1.828			
22.000	200.000	1.313	124.0	-208.74	.589	319.4	18.0	13.321					1.832	1.832			
23.000	210.000	1.242	122.7	-209.51	.587	320.4	17.7	13.874					1.837	1.837			
24.000	220.000	1.172	121.4	-210.23	.586	321.4	17.5	14.427					1.841	1.841			
25.000	230.000	1.109	120.3	-210.92	.585	322.3	17.3	14.980					1.845	1.845			
26.000	240.000	1.053	119.1	-211.57	.584	323.2	17.1	15.533					1.849	1.849			
27.000	250.000	1.002	118.1	-212.19	.583	324.1	16.9	16.086					1.852	1.852			
28.000	260.000	.955	117.1	-212.79	.582	324.9	16.7	16.639					1.855	1.855			
29.000	270.000	.913	116.2	-213.36	.581	325.6	16.5	17.192					1.858	1.858			
30.000	280.000	.874	115.4	-213.90	.580	326.3	16.3	17.745					1.861	1.861			
31.000	290.000	.838	114.2	-214.42	.579	327.0	16.2	18.298					1.864	1.864			
32.000	300.000	.806	113.4	-214.92	.578	327.7	16.0	18.851					1.867	1.867			
33.000	310.000	.775	112.5	-215.41	.577	328.3	15.9	19.404					1.870	1.870			
34.000	320.000	.746	111.7	-215.87	.576	328.9	15.7	19.957					1.872	1.872			
35.000	330.000	.712	110.9	-216.32	.575	329.6	15.6	20.510					1.875	1.875			
36.000	340.000	.680	110.2	-216.75	.575	330.1	15.5	21.063					1.877	1.877			
37.000	350.000	.649	109.5	-217.17	.574	330.7	15.3	21.616					1.879	1.879			
38.000	360.000	.621	108.8	-217.57	.573	331.2	15.2	22.169					1.881	1.881			
39.000	370.000	.596	108.1	-217.96	.572	331.7	15.1	22.722					1.884	1.884			
40.000	380.000	.573	107.4	-218.34	.571	332.2	15.0	23.275					1.886	1.886			
41.000	390.000	.551	106.8	-218.75	.571	332.7	14.9	23.828					1.889	1.889			
42.000	400.000	.530	106.2	-219.06	.570	333.2	14.8	24.381					1.890	1.890			
43.000	410.000	.510	105.6	-219.40	.569	333.6	14.7	24.934					1.891	1.891			
44.000	420.000	.492	105.1	-219.74	.568	334.0	14.6	25.487					1.893	1.893			
45.000	430.000	.474	104.4	-220.05	.568	334.5	14.5	26.040					1.895	1.895			
46.000	440.000	.458	103.8	-220.38	.567	334.9	14.4	26.593					1.897	1.897			
47.000	450.000	.443	103.3	-220.69	.567	335.3	14.3	27.146					1.898	1.898			
48.000	460.000	.429	102.8	-221.00	.566	335.7	14.2	27.699					1.900	1.900			
49.000	470.000	.416	102.3	-221.28	.565	336.0	14.1	28.252					1.901	1.901			
50.000	480.000	.403	101.7	-221.57	.565	336.4	14.0	28.805					1.902	1.902			
51.000	490.000	.390	101.2	-221.85	.564	336.7	13.9	29.358					1.903	1.903			
52.000	500.000	.377	100.6	-222.13	.563	337.0	13.8	29.911					1.904	1.904			

SHIFTING EXPANSION																
C STAR = 6024.2 FT/SEC																
PSI/TON	PC/P	P PSIA	TEMP	ENTHALPY	CP	CAL/100GM	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM DEG			/P	/P	LVL	10000	50000	LVL	LVL		
1.000	1.779	173.545	286.2	-106.71	1.187	122.4	108.3	.624	221.6	224.3	229.7	230.7	1.232	1.183		
2.000	7.954	37.670	244.5	-150.41	.972	226.9	46.4	1.285	256.4	262.1	273.1	275.3	1.369	1.470		
3.000	13.713	21.877	222.0	-164.69	.952	242.4	41.0	1.473	265.8	274.1	290.1	294.1	1.420	1.567		
4.000	20.418	14.693	211.1	-173.92	.927	267.8	36.7	2.497	278.8	300.2	304.5		1.626	1.626		
5.000	27.619	11.855	202.1	-180.57	.907	278.4	33.9	3.127	280.2	307.0	312.3		1.668	1.668		
6.000	35.125	8.941	201.0	-185.69	.883	286.3	32.1	3.756					1.700	1.700		
7.000	43.124	6.962	197.7	-189.79	.859	292.5	30.8	4.420					1.726	1.726		
8.000	51.115	5.865	196.3	-193.21	.837	297.5	29.8	5.079					1.748	1.748		
9.000	59.114	5.075	197.1	-196.14	.814	301.8	29.0	5.717					1.767	1.767		
10.000	66.890	4.468	197.8	-198.69	.793	305.4	28.4	6.326					1.783	1.783		
11.000	74.242	3.978	194.7	-200.96	.768	308.6	27.9	6.899					1.797	1.797		
12.000	81.344	3.583	193.0	-203.03	.743	311.5	27.4	7.511					1.810	1.810		
13.000	88.149	3.261	190.5	-204.92	.718	314.3	26.9	8.163					1.823	1.823		
14.000	100.149	2.996	191.7	-206.66	.693	316.8	26.5	8.861					1.832	1.832		
15.000	109.195	2.746	190.7	-208.26	.668	319.7	26.1	9.502					1.842	1.842		
16.000	116.250	2.512	189.4	-209.74	.643	322.8	25.8	10.197					1.851	1.851		
17.000	122.363	2.297	188.2	-211.12	.618	325.6	25.5	10.862					1.859	1.859		
18.000	127.561	2.106	187.1	-212.41	.593	328.2	25.2	11.507					1.867	1.867		
19.000	142.245	2.045	187.6	-213.62	.568	330.6	24.9	12.057					1.874	1.874		
20.000	154.583	1.947	186.7	-214.76	.543	332.7	24.7	12.604					1.881	1.881		
21.000	162.811	1.843	186.1	-215.84	.518	334.9	24.4	13.256					1.887	1.887		
22.000	171.420	1.750	185.6	-216.86	.493	336.8	24.2	13.834					1.893	1.893		
23.000	179.959	1.668	184.8	-217.83	.468	338.5	24.0	14.397					1.899	1.899		
24.000	188.861	1.588	184.3	-218.75	.443	340.3	23.8	14.993					1.904	1.904		
25.000	198.767	1.510	183.7	-219.64	.418	342.3	23.6	15.654					1.910	1.910		
26.000	208.761	1.438	183.2	-220.48	.393	344.5	23.5	16.316					1.914	1.914		
27.000	218.659	1.371	182.6	-221.29	.368	346.7	23.3	16.955					1.919	1.919		
28.000	228.761	1.312	182.0	-222.06	.343	348.9	23.1	17.641					1.924	1.924		
29.000	238.810	1.256	181.84	-222.80	.318	350.9	23.0	18.303					1.928	1.928		
30.000	248.956	1.205	181.4	-223.52	.293	352.9	22.9	18.962					1.932	1.932		
31.000	259.127	1.158	180.9	-224.21	.268	354.9	22.7	19.625					1.936	1.936		
32.000	269.314	1.115	180.5	-224.87	.243	356.7	22.6	20.275					1.940	1.940		
33.000	279.505	1.073	180.1	-225.51	.218	358.5	22.5	20.926					1.943	1.943		
34.000	289.693	1.036	179.90	-226.13	.193	360.3	22.3	21.573					1.946	1.946		
35.000	299.888	1.000	179.4	-226.73	.168	362.1	22.2	22.216					1.951	1.951		
36.000	310.027	.968	179.0	-227.31	.143	363.9	22.1	22.853					1.954	1.954		
37.000	320.149	.937	178.7	-227.87	.118	365.6	22.0	23.487					1.957	1.957		
38.000	330.247	.908	178.3	-228.42	.093	367.2	21.9	24.114					1.960	1.960		
39.000	340.296	.882	178.0	-228.95	.068	368.8	21.8	24.736					1.963	1.963		
40.000	350.354	.856	177.5	-229.46	.043	370.4	21.7	25.351					1.966	1.966		
41.000	360.264	.832	177.4	-229.94	.018	371.9	21.6	25.959					1.969	1.969		
42.000	370.169	.808	177.14	-230.45	-.007	373.4	21.5	26.563					1.972	1.972		
43.000	380.020	.789	176.85	-230.93	-.032	374.9	21.4	27.160					1.975	1.975		
44.000	389.812	.770	176.5	-231.39	-.057	376.4	21.4	27.750					1.978	1.978		
45.000	399.545	.753	176.2	-231.82	-.082	377.9	21.3	28.335					1.981	1.981		
46.000	409.217	.733	176.01	-232.28	-.107	379.4	21.2	28.917					1.982	1.982		
47.000	418.828	.716	175.75	-232.71	-.132	380.9	21.1	29.493					1.985	1.985		
48.000	428.379	.700	175.49	-233.12	-.157	382.4	21.0	30.068					1.987	1.987		
49.000	437.877	.685	175.24	-233.53	-.182	383.9	21.0	30.607					1.989	1.989		
50.000	447.219	.670	174.98	-233.94	-.207	385.4	21.0	31.140					1.992	1.992		
3.999	20.414	14.696	211.2	-173.91	.903	267.8	36.7	2.496	267.8	278.8	300.2	304.5	1.430	1.626		

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 300. PSIA PE 0.05 PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/O
298 H2*O2		1.448	-44.84	76.
298 B5*H9		0.620	+7.74	24.

PULK DENSITY = 1.097 GM/CC
MIXTURE RATIO = 3.167 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 329.52 EU/100GMS

CHAMBER THROAT

	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	170.2
TEMP, DEG K	3201.0	2801.2	2445.9	2129.9	1994.6	1848.9	1599.0	1376.8	1179.4	1004.8	850.8	715.8	2935.0
ENTHALPY (-)	97.24	123.57	146.60	166.67	175.14	184.13	199.25	212.31	223.52	233.10	241.24	248.11	114.80
CP	.6637	.6534	.6422	.6285	.6216	.6133	.5966	.5776	.5581	.5384	.5185	.4983	.6572
IMPUL OPT		151.35	207.21	245.77	260.31	274.93	297.90	316.39	331.45	343.79	353.94	362.28	123.60
IMPUL VAC		232.67	259.08	283.85	293.98	304.48	321.49	335.51	347.08	356.63	364.50	370.96	227.94
EPSILON		1.056	1.607	2.416	3.738	5.215	9.936	19.275	37.522	73.556	144.402	283.273	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.8
TEMP, DEG K	3201.0	2932.3	2675.1	2423.2	2306.0	2172.6	1924.7	1787.0	1696.4	1613.1	1536.4	1465.0	3030.7
ENTHALPY (-)	97.24	124.01	148.22	170.04	179.45	189.59	206.95	222.44	236.75	250.04	262.42	273.97	114.35
X BAR	5.082	5.021	4.771	4.934	4.921	4.910	4.898	4.811	4.700	4.596	4.498	4.407	5.043
N	5.082	5.021	4.971	4.934	4.921	4.910	4.898	4.896	4.895	4.894	4.894	4.894	5.043
CP	1.3636	1.2153	1.0573	.9027	.8356	.7694	.6771	4.4188	4.2990	4.1629	3.9955	3.7753	1.2726
IMPUL OPT		152.61	210.60	251.66	267.42	283.44	308.94	330.02	348.38	364.59	379.07	392.10	122.00
IMPUL VAC		236.02	265.18	292.73	304.11	315.37	335.32	352.54	368.16	382.17	394.83	406.33	230.30
EPSILON		1.065	1.664	2.987	4.006	5.648	10.931	22.273	46.700	99.039	211.946	456.917	1.000

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 H*H*O	.2019	.1515	.1055	.0658	.0503	.0353	.0155	.0076	.0040	.0021	.0011	.0005	.1699
-135.32 H*H*O2	1.3459	1.4229	1.4906	1.5470	1.5693	1.5915	1.6247	1.5212	1.3631	1.2025	1.0419	.8843	1.3953
66.00 H*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 H*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 H*H3*O3	.0006	.0004	.0003	.0003	.0003	.0003	.0004	.0004	.0003	.0002	.0002	.0001	.0005
5.74 H*O	.0422	.0231	.0106	.0037	.0020	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0295
-84.00 H*O2	.0918	.0682	.0450	.0252	.0178	.0111	.0036	.0018	.0011	.0006	.0004	.0002	.0771
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 H2*O2	.0111	.0076	.0046	.0024	.0016	.0010	.0003	.0001	.0000	.0000	.0000	.0000	.0088
-210.10 H2*O3	.0975	.1091	.1192	.1264	.1283	.1293	.1272	.0995	.0703	.0482	.0322	.0207	.1049
-541.69 H3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0001	.0001	.0001	.0001	.0000
52.10 H	.2008	.1421	.0897	.0480	.0332	.0202	.0062	.0032	.0022	.0015	.0010	.0006	.1634
9.33 H*O	.0388	.0207	.0096	.0036	.0021	.0010	.0002	.0001	.0000	.0000	.0000	.0000	.0265
.00 H2	2.0586	2.1286	2.1921	2.2451	2.2652	2.2839	2.3076	2.3163	2.3202	2.3223	2.3234	2.3240	2.1030
-57.80 H2*O	.9907	.9460	.9035	.8661	.8359	.8123	.8607	.9385	1.0181	1.0981	1.1769	.9626	
59.56 O	.0022	.0008	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012
.00 O2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-305.34 H2*O3*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0845	.1951	.2987	.3958	.4864	.0000

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Ford Motor Company,
AERONUTRONIC DIVISION

$N_2F_4 - B_5H_9$ SYSTEM

PRESSURE PROFILE DATA					
SYSTEM LIQUID BIPROPELLANT	PC 1000 PSIA				
COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. 0/0	
	LEG K	GM/CC	(KCAL/FORM.WT.)		
198	N2+H4	1.500	-2.0	80.	
298	H5+H9	0.620	+7.74	20.	

BULK DENSITY = 1.168 GM/CC
MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA													
CHAMBER ENTROPY 269.44 EU/100GMS													
CHAMBER	THROAT												
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	546.1
TEMP, DEG K	4202.9	3420.9	2775.2	2242.8	1804.4	1585.9	1443.7	1147.9	906.6	711.3	554.3	429.3	3672.5
ENTHALPY (-)	-91	31.39	57.65	78.91	96.06	104.43	109.82	120.79	129.49	136.34	141.70	145.87	21.05
CP	.4160	.4098	.4032	.3951	.3862	.3808	.3760	.3657	.3554	.3458	.3369	.3294	.4121
IMPUL OPT	167.64	225.71	265.52	290.45	302.73	310.37	325.39	336.82	345.55	352.23	357.34	358.23	138.23
IMPUL VAC	249.60	275.09	297.70	315.40	323.77	329.05	339.56	347.63	353.82	358.55	362.16	364.94	
EPSILON	1.054	1.595	2.773	5.084	7.327	9.561	12.213	14.909	17.055	18.778	20.066	21.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	546.8
TEMP, DEG K	4202.9	3420.9	2775.2	2242.8	1804.4	1585.9	1443.7	1147.9	906.6	711.3	554.3	429.3	3672.5
ENTHALPY (-)	-91	32.24	60.76	85.46	107.05	118.43	126.13	143.13	158.38	172.09	184.43	195.68	20.24
X BAR	4.646	4.547	4.450	4.353	4.254	4.197	4.156	4.064	3.978	3.902	3.839	3.737	4.584
N	4.646	4.547	4.450	4.353	4.254	4.197	4.156	4.064	3.978	3.902	3.839	3.802	4.584
CP	.9030	.8781	.8512	1.0141	1.1470	1.2165	1.2531	1.2925	1.3246	1.0926	1.3054	1.0926	.8828
IMPUL OPT	169.82	221.63	274.11	306.47	322.22	332.45	353.99	372.26	387.95	401.54	413.55	425.66	135.66
IMPUL VAC	255.20	285.63	313.81	337.68	349.82	357.99	375.45	390.59	403.79	415.26	425.98	438.85	
EPSILON	1.070	1.700	3.139	6.149	9.343	12.743	16.887	21.724	27.258	33.543	40.683	48.683	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
132.60 F	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
-45.47 F+F	1.3972	1.3941	1.3695	1.3209	1.2540	1.2102	1.1777	1.0991	1.0230	.9533	.8947	.7933	1.3974
-133.84 F+F2	.1391	.1185	.0990	.0791	.0598	.0495	.0428	.0292	.0189	.0114	.0062	.0044	.1261
-270.00 F+F2	.0458	.0702	.1144	.1830	.2692	.3243	.3625	.4547	.5411	.6182	.6821	.7199	.0591
114.76 F+F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 F+F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
18.00 F+F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 B3+F2+N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0302	.0103	.0029	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0158
-64.50 F+F	1.2334	1.2246	1.1627	1.0477	.8951	.7974	.7256	.5549	.3923	.2456	.1230	.1147	1.2338
56.60 F+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.4439	.2546	.1788	.1032	.0589	.0424	.0335	.0186	.0098	.0046	.0017	.0014	.3483
79.20 F+N	.0006	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 F2	.5855	.6649	.7534	.8492	.9477	1.0048	1.0451	1.1380	1.2236	1.2996	1.3623	1.3666	.6334
40.30 F2+N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 N2	.7684	.7689	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7688
-60.30 B+N/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT										PC 1000, PSIA				
COMPONENT										DENSITY				
LEG K										HEAT ENTH				
198 H2+FN										(KCAL/FORM.WT.)				
298 B5+H9										80.				
										20.				
										FROZEN EXPANSION				
										C STAR = 6288.8 FT/SEC				
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GP DEG		/P	/P	LVL	10000	50000		LVL	
1.000	1.000	1000.000	202.2	-8.1	90.1									
1.001	546.071	3672.5	-21.05	-412	138.2	106.7	1.195	242.1	242.9	244.6	244.9	1.239	1.254	
2.000	10.185	98.182	2523.9	-67.75	400	245.1	40.5	411	279.5	281.3	283.9	1.431	1.502	
3.000	18.100	55.282	2178.6	-81.45	394	267.7	32.6	491	291.7	294.3	299.4	1.493	1.537	
4.000	28.594	34.972	1963.7	-89.86	390	281.1	28.0	800	297.3	300.9	307.7	1.503	1.522	1.582
5.000	38.959	25.468	1814.9	-95.65	388	289.8	25.1	980	300.8	304.9	313.3	1.510	1.598	1.612
6.000	51.620	19.600	1701.6	-100.01	384	296.3	23.1	1177	302.1	307.3	317.8	1.518	1.584	1.635
7.000	63.772	15.681	1611.6	-103.45	381	301.3	21.5	1370	302.7	308.7	320.5	1.528	1.590	1.652
8.000	77.393	12.921	1537.5	-106.27	379	305.4	20.2	1565	303.5	310.9	323.8	1.538	1.596	1.688
9.000	91.761	10.898	1474.8	-108.64	377	308.7	19.2	1761	304.8	312.9	327.9	1.547	1.600	1.712
10.000	106.833	9.500	1420.9	-110.67	375	311.9	18.3	1957	306.5	315.3	332.9	1.556	1.608	1.723
11.000	122.959	8.133	1373.7	-112.44	374	314.0	17.6	2160	307.9	317.8	338.4	1.564	1.612	1.697
12.000	139.758	7.155	1331.9	-114.00	372	316.2	16.9	2364	309.7	319.1	343.1	1.571	1.615	1.705
13.000	157.087	6.366	1294.6	-115.30	371	318.1	16.3	2567	310.7	320.1	348.4	1.578	1.618	1.712
14.000	174.806	5.721	1260.9	-116.48	370	319.8	15.8	2768	311.8	321.6	353.8	1.584	1.621	1.718
15.000	192.787	5.181	1230.3	-117.57	369	321.3	15.4	2964	312.8	322.9	359.7	1.590	1.625	1.723
16.000	210.919	4.741	1202.3	-118.60	368	322.7	15.0	3155	313.7	324.1	365.7	1.595	1.628	1.728
17.000	229.113	4.365	1176.5	-119.74	367	324.0	14.6	3341	314.6	325.4	371.7	1.599	1.631	1.733
18.000	247.358	4.044	1152.7	-120.67	366	325.2	14.2	3521	315.4	326.5	377.7	1.603	1.634	1.737
19.000	265.781	3.737	1130.5	-121.43	365	326.2	13.9	3694	316.2	327.5	383.7	1.607	1.637	1.741
20.000	284.401	3.461	1109.9	-122.18	364	327.2	13.6	3863	316.9	328.4	389.7	1.610	1.640	1.744
21.000	310.698	3.219	1090.5	-122.88	363	328.2	13.3	4024	317.6	329.3	395.7	1.613	1.643	1.748
22.000	332.902	3.004	1072.4	-123.54	363	329.0	13.1	4176	318.2	330.2	401.7	1.615	1.645	1.751
23.000	355.852	2.811	1055.1	-124.16	362	329.9	12.8	4319	318.8	331.1	407.7	1.617	1.647	1.754
24.000	378.285	2.644	1039.2	-124.75	361	330.6	12.6	4454	319.3	332.0	413.7	1.619	1.649	1.757
25.000	401.310	2.492	1024.9	-125.30	361	331.4	12.4	4589	319.8	332.9	419.7	1.621	1.651	1.759
26.000	424.533	2.356	1009.5	-125.82	360	332.0	12.2	4716	320.3	333.8	425.7	1.623	1.653	1.762
27.000	447.936	2.233	995.7	-126.31	359	332.7	12.0	4834	320.8	334.7	431.7	1.625	1.655	1.764
28.000	471.189	2.124	982.6	-126.78	359	333.3	11.8	4944	321.3	335.6	437.7	1.627	1.657	1.766
29.000	494.945	2.022	970.2	-127.23	358	333.9	11.7	5047	321.8	336.5	443.7	1.629	1.659	1.768
30.000	517.886	1.931	958.3	-127.65	358	334.4	11.5	5144	322.3	337.4	449.7	1.631	1.661	1.770
31.000	541.115	1.849	946.9	-128.06	357	335.0	11.4	5234	322.8	338.3	455.7	1.633	1.663	1.772
32.000	564.710	1.772	936.0	-128.45	357	335.5	11.2	5319	323.3	339.2	461.7	1.635	1.665	1.774
33.000	588.712	1.703	925.5	-128.82	356	336.0	11.1	5399	323.8	340.1	467.7	1.637	1.667	1.776
34.000	613.229	1.639	915.4	-129.18	356	336.4	10.9	5474	324.3	341.0	473.7	1.639	1.669	1.778
35.000	638.367	1.579	905.8	-129.53	355	336.9	10.8	5544	324.8	341.9	479.7	1.641	1.671	1.779
36.000	664.018	1.516	896.4	-129.86	355	337.3	10.7	5609	325.3	342.8	485.7	1.643	1.673	1.781
37.000	689.222	1.454	887.2	-130.18	354	337.7	10.6	5669	325.8	343.7	491.7	1.645	1.675	1.782
38.000	715.076	1.397	878.4	-130.49	354	338.1	10.4	5724	326.3	344.6	497.7	1.647	1.677	1.784
39.000	741.601	1.345	870.4	-130.78	354	338.5	10.3	5774	326.8	345.5	503.7	1.649	1.679	1.785
40.000	772.054	1.295	862.3	-131.07	353	338.8	10.2	5819	327.3	346.4	509.7	1.651	1.681	1.786
41.000	800.132	1.248	854.5	-131.34	353	339.2	10.1	5859	327.8	347.3	515.7	1.653	1.683	1.788
42.000	829.474	1.205	846.9	-131.61	353	339.6	10.0	5894	328.3	348.2	521.7	1.655	1.685	1.789
43.000	858.858	1.168	839.6	-131.87	352	339.9	9.9	5924	328.8	349.1	527.7	1.657	1.687	1.790
44.000	888.261	1.126	832.4	-132.12	352	340.2	9.8	5949	329.3	350.0	533.7	1.659	1.689	1.791
45.000	917.682	1.089	825.5	-132.36	352	340.5	9.7	5969	329.8	350.9	539.7	1.661	1.691	1.792
46.000	947.136	1.056	818.8	-132.60	351	340.8	9.6	5984	330.3	351.8	545.7	1.663	1.693	1.794
47.000	977.570	1.023	812.3	-132.83	351	341.1	9.6	5994	330.8	352.7	551.7	1.665	1.695	1.795
48.000	1007.956	992	806.0	-133.05	351	341.4	9.5	5999	331.3	353.6	557.7	1.667	1.697	1.796
49.000	1037.616	964	799.8	-133.24	350	341.7	9.4	5999	331.8	354.5	563.7	1.669	1.699	1.797
50.000	1067.051	936	793.9	-133.41	350	341.9	9.3	5984	332.3	355.4	569.7	1.671	1.700	1.798
51.000	1096.046	908	788.0	-133.57	349	342.2	9.2	5949	332.8	356.3	575.7	1.673	1.702	1.799
52.000	1124.606	880	782.1	-133.72	349	342.4	9.1	5894	333.3	357.2	581.7	1.675	1.704	1.800
53.000	1152.736	852	776.2	-133.86	348	342.6	9.0	5819	333.8	358.1	587.7	1.677	1.706	1.801
54.000	1180.446	824	770.3	-133.99	348	342.8	8.9	5724	334.3	359.0	593.7	1.679	1.708	1.802
55.000	1207.736	796	764.4	-134.11	347	343.0	8.8	5669	334.8	360.0	599.7	1.681	1.710	1.803
56.000	1234.606	768	758.5	-134.23	347	343.2	8.7	5544	335.3	360.9	605.7	1.683	1.712	1.804
57.000	1261.056	740	752.6	-134.34	346	343.4	8.6	5474	335.8	361.8	611.7	1.685	1.714	1.805
58.000	1287.006	712	746.7	-134.45	346	343.6	8.5	5399	336.3	362.7	617.7	1.687	1.716	1.806
59.000	1312.556	684	740.8	-134.55	345	343.8	8.4	5319	336.8	363.6	623.7	1.689	1.718	1.807
60.000	1337.706	656	734.9	-134.65	345	344.0	8.3	5234	337.3	364.5	629.7	1.691	1.720	1.808
61.000	1362.456	628	729.0	-134.74	344	344.2	8.2	5144	337.8	365.4	635.7	1.693	1.722	1.809
62.000	1386.806	600	723.1	-134.83	344	344.4	8.1	5047	338.3	366.3	641.7	1.695	1.724	1.810
63.000	1410.756	572	717.2	-134.91	343	344.6	8.0	4944	338.8	367.2	647.7	1.697	1.726	1.811
64.000	1434.306	544	711.3	-134.99	343	344.8	7.9	4834	339.3	368.1	653.7	1.699	1.728	1.812
65.000	1457.456	516	705.4	-135.06	342	345.0	7.8	4716	339.8	369.0	659.7	1.701	1.730	1.813
66.000	1480.206	488	699.5	-135.13	342	345.2	7.7	4589	340.3	370.0	665.7	1.703	1.732	1.814
67.000	1502.556	460	693.6	-135.19	341	345.4	7.6	4454	340.8	370.9	671.7	1.705	1.734	1.815
68.000	1524.506	432	687.7	-135.25	341	345.6	7.5	4319	341.3	371.8	677.7	1.707	1.736	1.816
69.000	1546.056	404	681.8	-135.30	340	345.8	7.4	4176	341.8	372.7	683.7	1.709	1.738	1.817
70.000	1567.206	376	675.9	-135.35	340	346.0	7.3	4024	342.3	373.6	689.7	1.711	1.740	1.818
71.000	1587.956	348	669.9	-135.39	339	346.2	7.2	3863	342.8	374.5	695.7	1.713	1.742	1.819
72.000	1608.306	320	664.0	-135.43	339	346.4	7.1	3694	343.3	375.4	701.7	1.715	1.744	1.820
73.000	1628.256	292	658.1	-135.46	338	346.6	7.0	3521	343.8	376.3	707.7	1.717	1.746	1.821
74.000	1647.806	264	652.2	-135.49	338	346.8	6.9	3341	344.3	377.2	713.7	1.719	1.748	1.822
75.000	1666.956	236	646.3	-135.51	337	347.0	6.8	3155	344.8	378.1	719.7	1.721	1.750	1.823
76.000	1685.706	208	640.4	-135.53	337	347.2	6.7	2964	345.3	379.0	725.7	1.723	1.752	1.824
77.000	1704.056	180	634.5	-135.55	336	347.4	6.6	2768	345.8	380.0	731.7	1.725	1.754	1.825
78.000	1722.006	152	628.6	-135.57										

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA
COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O

19H N2O4 1.500 -2.0 83.
29H B5H9 0.620 +7.74 11.

BULK DENSITY = 1.208 GM/CC
MIXTURE RATIO = 4.002 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 261.51 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100
TEMP, DEG K	4536.2	3689.4	2991.9	2417.9	1946.0	1711.1	1558.3	1240.4	980.9	770.4	601.2	466.1
ENTHALPY (-)	-49	32.72	59.70	81.54	99.15	107.77	114.30	124.59	133.55	140.62	146.15	150.46
CP	.3946	.3855	.3836	.3770	.3693	.3639	.3602	.3500	.3404	.3310	.3225	.3152
IMPUL OPT	169.57	228.82	267.13	294.42	306.88	314.62	329.87	341.48	350.37	357.17	362.57	367.30
IMPUL VAC	253.04	278.05	301.77	319.71	328.22	333.57	344.26	352.47	358.78	363.61	367.30	369.33
EPSILON	1.053	1.594	2.772	5.084	7.330	9.569	18.248	35.014	67.328	129.464	246.499	1.000

	SHIFTING EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100
TEMP, DEG K	4536.2	4013.5	3544.9	3142.8	2813.5	2652.1	2547.7	2330.5	2147.9	1990.6	1851.0	1723.3
ENTHALPY (-)	-49	33.72	63.30	88.91	111.20	122.91	130.82	148.24	163.06	177.97	190.77	202.44
X BAR	4.427	4.327	4.235	4.145	4.051	3.995	3.955	3.861	3.770	3.684	3.605	3.532
N	4.427	4.327	4.235	4.145	4.051	3.995	3.955	3.861	3.770	3.684	3.605	3.532
CP	1.0003	.9004	.8654	.8201	1.0459	1.1373	1.2041	1.3492	1.4546	1.4941	1.4749	1.3672
IMPUL OPT	172.51	235.57	278.87	311.71	327.64	337.98	359.70	378.12	394.01	407.91	420.16	437.69
IMPUL VAC	259.54	290.67	319.25	343.32	355.60	361.75	381.33	396.64	410.11	422.05	432.69	452.92
EPSILON	1.072	1.704	3.138	6.169	9.327	12.637	26.631	57.273	125.036	276.000	613.982	1.000

	COMPOSITION SHIFTING (MOL/100 GM)											
132.60 B	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
-45.47 B+F	1.1188	1.1240	1.1161	1.0867	1.0351	.9974	.9679	.8925	.8144	.7372	.6633	.5943
-133.84 B+F2	.1688	.1434	.1179	.0938	.0716	.0601	.0526	.0372	.0256	.0171	.0110	.0068
-270.00 B+F3	.0571	.0778	.1114	.1650	.2388	.2881	.3251	.4159	.5055	.5912	.6712	.7444
114.76 B+F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 B+F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B+F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 B3+H+N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.1137	.0488	.0163	.0045	.0012	.0005	.0003	.0001	.0000	.0000	.0000	.0000
-64.50 F+B	1.4505	1.4987	1.4893	1.4179	1.2960	1.2095	1.1433	.9773	.8096	.6467	.4928	.3506
58.60 F+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.4641	.3480	.2397	.1542	.0944	.0711	.0580	.0357	.0219	.0132	.0077	.0042
79.20 F+N	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
.00 H2	.2532	.2874	.3464	.4254	.5158	.5707	.6104	.7045	.7952	.8810	.9607	1.0336
40.30 F2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0022	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011
.00 N2	.7984	.7975	.7978	.7979	.7979	.7980	.7980	.7980	.7980	.7980	.7980	.7972

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 158 N2O4 1.500 -2.0 85.
 298 B5H9 0.620 +7.74 15.

BULK DENSITY = 1.237 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 255.53 EU/100GMS

CHAMBER														THROAT
FROZEN EXPANSION														
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	568.0	
TEMP, DEG K	4728.7	3845.3	3118.6	2521.1	2030.2	1786.0	1627.2	1296.7	1026.7	807.5	631.0	490.0	4128.8	
ENTHALPY (-)	-20	33.20	60.33	82.31	100.03	108.71	114.28	125.67	134.71	141.86	147.46	151.82	22.53	
CP	.3806	.3757	.3707	.3647	.3573	.3526	.3489	.3396	.3302	.3211	.3130	.3058	.3774	
IMPLL OPT	170.47	229.48	267.92	295.30	307.81	315.59	330.91	342.60	351.55	358.41	363.56	364.62	140.62	
IMPLL VAC	253.78	279.67	302.67	320.69	329.24	334.63	345.38	353.66	360.03	364.91	368.64	369.05		
EPSILON	1.053	1.594	2.772	5.087	7.338	9.583	18.294	35.144	67.662	130.263	250.424	1.000		
SHIFTING EXPANSION														
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	568.0	
TEMP, DEG K	4728.7	4240.2	3785.5	3367.9	2997.4	2812.9	2694.3	2450.7	2251.4	2084.1	1940.1	1813.2	4423.0	
ENTHALPY (-)	-20	34.38	64.59	90.95	113.89	125.88	133.96	151.69	167.52	181.77	194.70	206.48	21.58	
X BAR	4.272	4.162	4.068	3.985	3.903	3.853	3.816	3.727	3.638	3.553	3.472	3.395	4.203	
N	4.272	4.162	4.068	3.985	3.903	3.853	3.816	3.727	3.638	3.553	3.472	3.395	4.203	
CP	1.2147	1.0745	.9128	.8331	.8920	.9700	1.0382	1.2131	1.3737	1.5040	1.5824	1.6073	1.1355	
IMPLL OPT	173.44	237.43	281.60	315.05	331.19	341.63	363.51	381.98	397.88	411.77	424.01	437.68		
IMPLL VAC	261.41	293.56	322.80	347.15	359.48	367.65	385.73	400.52	413.97	425.91	435.59	254.40		
EPSILON	1.075	1.723	3.177	6.218	9.367	12.660	26.548	56.916	124.073	273.924	610.774	1.000		
COMPOSITION SHIFTING (MOL/100 GM)														
132.60 B	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	
-45.47 P=F	.9205	.9205	.9177	.9057	.8739	.8455	.8214	.7550	.6818	.6068	.5325	.4610	.9207	
-133.84 B=F2	.1921	.1688	.1410	.1110	.0831	.0691	.0602	.0424	.0292	.0196	.0129	.0083	.1783	
-270.00 B=F3	.0738	.0977	.1284	.1705	.2302	.2726	.3057	.3899	.4762	.5608	.6418	.7179	.0878	
114.76 B=H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
66.00 P=H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.00 B=H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
179.30 P2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-124.20 P3=H6=N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.86 F	.2486	.1402	.0619	.0199	.0051	.0022	.0012	.0003	.0001	.0000	.0000	.0000	.1789	
-64.50 F=H	1.4939	1.5774	1.6219	1.6096	1.5329	1.4649	1.4087	1.2591	1.0998	.9401	.7850	.6374	1.5491	
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 F	.4028	.3195	.2438	.1744	.1163	.0903	.0750	.0480	.0307	.0196	.0124	.0077	.3506	
79.20 F=H	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	
.00 F2	.1198	.1199	.1256	.1765	.2439	.2909	.3267	.4150	.5033	.5886	.6698	.7460	.1184	
40.30 F2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-11.04 F3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
113.00 N	.0038	.0014	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0021	
.00 N2	.8149	.8163	.8169	.8171	.8172	.8172	.8172	.8172	.8172	.8172	.8172	.8172	.8159	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 198 N2O4 1.500 -2.0 87.
 298 H5OH 0.620 +7.74 13.

BULK DENSITY = 1.266 GM/CC
 MIXTURE RATIO = 6.692 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 248.97 EU/100GMS

CHAMBER	THROAT													
	FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	548.4	
TEMP, DEG K	4850.9	3942.9	3196.9	2584.3	2081.5	1831.5	1668.9	1330.9	1054.8	830.4	649.6	505.1	4238.7	
ENTHALPY (-)	.08	33.16	60.00	81.74	99.28	107.87	113.39	124.66	133.63	140.72	146.28	150.61	22.42	
CP	.3661	.3619	.3575	.3521	.3453	.3410	.3376	.3292	.3201	.3113	.3036	.2966	.3634	
IMPLL OPT		169.63	228.32	266.54	293.77	306.22	313.96	329.21	340.85	349.78	356.63	361.88	139.42	
IMPLL VAC		252.49	278.23	301.10	319.03	327.54	332.91	343.62	351.48	358.24	363.12	366.85	247.79	
EPSILON		1.053	1.594	2.772	5.088	7.341	9.588	18.317	35.217	67.869	130.802	251.778	1.000	
	SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.5	
TEMP, DEG K	4850.9	4402.0	4008.3	3646.9	3292.3	3083.8	2937.7	2628.6	2384.9	2190.1	2029.1	1891.5	4569.5	
ENTHALPY (-)	.08	34.43	64.76	91.65	115.46	128.00	136.43	154.79	171.00	185.47	198.51	210.36	21.53	
X BAR	4.123	4.000	3.888	3.791	3.711	3.672	3.645	3.576	3.500	3.421	3.343	3.268	4.047	
N	4.123	4.000	3.888	3.791	3.711	3.672	3.645	3.576	3.500	3.421	3.343	3.268	4.047	
CP	1.5045	1.4773	1.3457	1.1080	.8403	.7511	.7433	.8701	1.0727	1.2666	1.4229	1.5278	1.4970	
IMPLL OPT		172.87	237.20	282.24	316.83	333.59	344.41	366.87	385.60	401.59	415.48	427.71	136.60	
IMPLL VAC		260.92	294.00	324.59	350.17	362.94	371.29	389.02	404.31	417.72	429.59	440.20	253.63	
EPSILON		1.078	1.747	3.272	6.471	9.736	13.106	27.128	57.559	124.603	273.909	609.144	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)													
132.60 B	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003	
-45.47 B*F	.7150	.6996	.6834	.6685	.6559	.6474	.6380	.5994	.5421	.4756	.4062	.3372	.7058	
-133.84 B*F2	.2112	.1920	.1682	.1402	.1088	.0897	.0767	.0513	.0339	.0222	.0144	.0091	.2001	
-270.00 B*F3	.1022	.1371	.1773	.2201	.2642	.2919	.3142	.3782	.4529	.5310	.6083	.6826	.1228	
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
66.00 B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
199.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-124.20 F3*H6*N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.86 F	.4553	.3245	.2089	.1124	.0433	.0199	.0104	.0021	.0004	.0001	.0000	.0000	.3739	
-64.50 F*H	1.4462	1.5262	1.5851	1.6238	1.6361	1.6234	1.6012	1.5069	1.3765	1.2323	1.0856	.9421	1.4974	
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.0210 F	.3018	.2393	.1698	.1502	.1169	.0987	.0860	.0590	.0392	.0258	.0169	.0109	.2621	
79.20 F*N	.0000	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	
.00 F2	.0517	.0432	.0386	.0390	.0495	.0650	.0825	.1431	.2182	.2970	.3748	.4494	.0461	
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
113.00 N	.0051	.0023	.0010	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0032	
.00 N2	.8335	.8351	.8359	.8362	.8364	.8364	.8364	.8364	.8364	.8364	.8364	.8364	.8364	

EPSILON	PC/F	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	SWISTING EXPANSION										
					CP CAL/G	C STAR	S 590.4	PT/SEC	I SEA	I AT	I VAC	CP SEA	CP VAC		
					GM DEG	I OPT	DEL VAC	DEL VAC	/P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CP SEA LVL	CP VAC LVL
1.000	1.010	1000.000	4850.9	-7.08	1.905										
1.000	1.576	54.7	4649.5	-2.15	1.497	136.4	117.0	-205	250.6	251.5	253.3	253.6	1.236	1.222	
2.000	1.222	122.740	3920.1	-71.47	1.299	247.7	51.9	-423	295.4	297.2	300.8	301.6	1.440	1.470	
3.000	14.489	68.678	3691.4	-88.45	1.143	277.6	43.4	-637	311.6	314.4	319.9	320.9	1.519	1.565	
4.000	21.315	46.937	3539.9	-59.15	1.022	294.6	39.2	-835	320.6	324.5	331.4	332.8	1.563	1.623	
5.000	28.960	27.967	3424.0	-16.07	.931	305.0	36.2	-1,050	325.8	330.5	339.4	341.2	1.588	1.684	
6.000	36.488	20.544	3326.6	-113.01	.865	315.7	33.9	-1,279	329.4	334.9	345.5	347.6	1.608	1.726	
7.000	44.260	12.594	3251.7	-117.97	.817	322.2	32.5	-1,439	331.6	338.0	350.3	352.8	1.617	1.770	
8.000	52.834	10.627	3183.2	-122.12	.784	325.8	31.2	-1,647	332.8	340.1	354.2	357.0	1.622	1.740	
9.000	61.551	16.247	3123.3	-125.68	.762	330.6	30.1	-1,850	333.4	341.6	357.5	360.6	1.625	1.758	
10.000	70.440	20.161	3070.7	-128.10	.748	335.4	29.0	-2,052	334.2	343.2	360.2	363.6	1.628	1.766	
11.000	79.494	22.524	3022.9	-131.53	.735	338.2	28.3	-2,259	334.9	343.6	363.3	366.5	1.635	1.787	
12.000	89.368	11.900	2980.2	-133.99	.741	341.3	27.6	-2,465	335.6	344.7	366.7	369.9	1.638	1.798	
13.000	98.982	10.103	2941.6	-136.71	.744	344.1	26.9	-2,667	336.3	345.8	369.5	371.1	1.640	1.809	
14.000	109.070	8.771	2905.8	-139.22	.746	346.9	26.4	-2,866	337.0	346.9	372.3	373.3	1.641	1.817	
15.000	119.454	8.371	2871.5	-140.07	.747	349.0	25.9	-3,091	337.6	347.8	374.9	376.9	1.642	1.827	
16.000	130.034	7.690	2840.0	-141.77	.751	351.1	25.4	-3,305	338.1	348.6	377.9	378.5	1.634	1.836	
17.000	140.717	7.103	2819.2	-143.34	.750	353.0	25.0	-3,519	338.2	349.0	377.2	378.0	1.643	1.843	
18.000	151.463	6.590	2799.3	-144.81	.754	354.8	24.6	-3,732	338.3	349.3	377.1	378.5	1.650	1.850	
19.000	162.544	6.122	2780.4	-146.18	.756	356.5	24.3	-3,944	338.4	349.5	377.0	378.6	1.656	1.856	
20.000	173.555	5.761	2762.9	-147.46	.758	358.1	23.9	-4,155	338.5	349.6	377.0	378.7	1.662	1.862	
21.000	184.415	5.417	2729.4	-148.67	.759	359.5	23.6	-4,362	338.6	349.7	377.7	378.2	1.668	1.868	
22.000	195.624	5.112	2710.4	-149.81	.760	360.9	23.3	-4,567	338.7	349.8	377.6	378.3	1.673	1.873	
23.000	206.670	4.840	2692.4	-150.68	.761	362.2	23.1	-4,769	338.8	349.9	377.5	378.4	1.678	1.878	
24.000	217.521	4.597	2675.7	-151.90	.762	363.4	22.8	-4,967	338.9	350.0	377.8	378.3	1.683	1.883	
25.000	228.373	4.379	2659.8	-152.87	.764	364.6	22.6	-5,162	339.0	350.1	377.8	378.2	1.688	1.888	
26.000	239.143	4.182	2644.7	-153.80	.765	365.7	22.4	-5,353	339.1	350.2	377.9	378.1	1.692	1.892	
27.000	249.826	4.003	2630.4	-154.68	.766	366.7	22.2	-5,541	339.2	350.3	377.9	378.0	1.696	1.896	
28.000	261.016	3.818	2616.1	-155.53	.767	367.7	22.0	-5,725	339.3	350.4	377.9	378.0	1.700	1.900	
29.000	274.225	3.646	2604.2	-156.33	.768	368.7	21.8	-5,978	339.4	350.5	377.9	378.0	1.704	1.904	
30.000	286.745	3.487	2592.0	-157.11	.769	369.6	21.6	-6,200	339.5	350.6	377.8	378.1	1.707	1.907	
31.000	299.366	3.340	2580.4	-157.85	.770	370.5	21.5	-6,422	339.6	350.7	377.8	378.1	1.711	1.911	
32.000	312.053	3.205	2569.3	-158.57	.771	371.5	21.3	-6,644	339.7	350.8	377.8	378.1	1.715	1.915	
33.000	324.813	3.079	2558.6	-159.26	.772	372.1	21.1	-6,866	339.8	350.8	377.8	378.1	1.717	1.917	
34.000	337.613	2.962	2548.4	-159.92	.772	372.9	21.0	-7,087	339.9	350.9	377.8	378.1	1.720	1.920	
35.000	350.454	2.853	2538.6	-160.56	.773	373.7	20.9	-7,308	339.9	351.0	377.8	378.0	1.723	1.923	
36.000	363.299	2.752	2529.1	-161.18	.774	374.6	20.7	-7,528	340.0	351.1	377.8	378.0	1.726	1.926	
37.000	376.130	2.657	2520.0	-161.78	.775	375.1	20.6	-7,747	340.0	351.2	377.8	378.0	1.729	1.929	
38.000	389.219	2.569	2511.2	-162.36	.775	375.7	20.5	-7,964	340.1	351.3	377.8	378.0	1.732	1.932	
39.000	402.132	2.487	2502.8	-162.92	.776	376.0	20.3	-8,181	340.1	351.3	377.8	378.0	1.734	1.934	
40.000	415.029	2.409	2494.6	-163.46	.777	376.4	20.2	-8,395	340.2	351.4	377.8	378.0	1.737	1.937	
41.000	427.859	2.337	2486.7	-163.99	.777	376.7	20.1	-8,607	340.2	351.4	377.8	378.0	1.739	1.939	
42.000	440.732	2.269	2479.1	-164.51	.778	376.2	20.0	-8,819	340.3	351.5	377.8	378.0	1.741	1.941	
43.000	453.520	2.205	2471.7	-165.00	.778	376.8	19.9	-9,028	340.3	351.5	377.8	378.0	1.744	1.944	
44.000	466.254	2.145	2464.5	-165.49	.779	376.3	19.8	-9,235	340.4	351.6	377.8	378.0	1.746	1.946	
45.000	478.927	2.089	2457.7	-165.96	.779	376.7	19.7	-9,441	340.4	351.6	377.8	378.0	1.749	1.949	
46.000	491.530	2.034	2450.8	-166.42	.780	376.4	19.6	-9,642	340.5	351.7	377.8	378.0	1.750	1.950	
47.000	504.080	1.984	2444.3	-166.87	.780	376.9	19.5	-9,842	340.5	351.7	377.8	378.0	1.752	1.952	
48.000	516.510	1.936	2437.9	-167.30	.781	376.4	19.4	-10,040	340.6	351.8	377.8	378.0	1.754	1.954	
49.000	528.817	1.891	2431.7	-167.73	.781	376.9	19.4	-10,235	340.6	351.8	377.8	378.0	1.756	1.956	
50.000	541.136	1.846	2425.8	-168.15	.781	377.4	19.3	-10,429	340.7	351.9	377.8	378.0	1.757	1.957	
9.734	68.044	1.464	3083.8	-128.00	.751	333.6	29.3	-1.997	333.6	342.4	359.5	362.9	1.626	1.766	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/F3RM.WT.)
 198 N2*F4 1.500 -2.0 90.
 298 H5*H9 0.620 +7.74 10.

PULK DENSITY = 1.314 GM/CC
 MIXTURE RATIO = 9.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 238.07 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT									
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	545.2							
TEMP, DEG K	4893.3	3970.1	3211.7	2594.5	2087.6	1836.1	1672.7	1333.5	1056.9	832.4	651.6	507.1	4264.8							
ENTHALPY (-)	.51	32.24	57.97	78.76	92.53	103.72	108.99	119.75	128.31	135.07	140.38	144.52	22.15							
CP	.3454	.3418	.3381	.3334	.3276	.3238	.3209	.3134	.3051	.2971	.2899	.2834	.3431							
IMPLL OPT		166.17	223.59	260.93	287.51	299.66	307.21	322.08	333.44	342.15	348.83	353.96	137.21							
IMPLL VAC		247.27	272.39	294.68	312.16	320.46	325.69	336.14	344.20	350.40	355.17	358.82	242.72							
EPSILON		1.053	1.591	2.764	5.071	7.314	9.551	18.244	35.084	67.643	130.454	251.311	1.000							
	SHIFTING EXPANSION																			
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.9							
TEMP, DEG K	4893.3	4473.0	4130.1	3824.9	3566.1	3425.4	3329.0	3110.3	2899.7	2679.9	2413.2	2124.6	4633.1							
ENTHALPY (-)	.51	33.57	62.93	69.21	112.89	125.62	134.33	153.61	171.55	187.67	202.15	214.87	21.05							
X BAR	3.926	3.793	3.669	3.554	3.448	3.391	3.351	3.264	3.187	3.123	3.083	3.055	3.844							
N	3.926	3.793	3.669	3.554	3.448	3.391	3.351	3.264	3.187	3.123	3.083	3.055	3.844							
CP	1.8655	2.0696	2.2022	2.2492	2.1882	2.1029	2.0197	1.7390	1.3486	.8767	.4998	.5479	1.9962							
IMPLL OPT		169.60	233.04	277.90	312.68	329.91	341.20	365.20	385.74	403.51	418.83	431.84	133.68							
IMPLL VAC		256.20	289.25	320.15	346.67	360.35	369.47	389.23	406.45	421.44	434.19	444.84	248.87							
EPSILON		1.080	1.761	3.333	6.720	10.282	14.035	29.971	64.980	141.125	303.527	645.050	1.000							
	COMPOSITION SHIFTING (MOL/100 GM)																			
132.60 F	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001							
-45.47 F*F	.4024	.3673	.3324	.2985	.2660	.2478	.2351	.2063	.1802	.1591	.1466	.1302	.3811							
-133.84 F*F2	.2124	.1899	.1643	.1380	.1129	.0992	.0899	.0695	.0517	.0361	.0219	.0109	.1992							
-270.00 F*F3	.1766	.2343	.2548	.3550	.4126	.4445	.4665	.5157	.5596	.5963	.6229	.6504	.2110							
114.76 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
66.00 F*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
18.00 F*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
179.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-124.20 F3*H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
18.86 F	.8544	.7184	.5523	.4761	.3696	.3119	.2724	.1847	.1075	.0447	.0077	.0005	.7707							
-64.50 F*H	1.2454	1.2926	1.3232	1.3454	1.3618	1.3695	1.3743	1.3839	1.3912	1.3961	1.3941	1.3573	1.2774							
58.60 F*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
.00 F2	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001							
52.10 F	.1505	.1150	.0894	.0704	.0561	.0493	.0450	.0362	.0291	.0232	.0180	.0126	.1276							
79.20 F*H	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002							
.00 F2	.0122	.0085	.0060	.0044	.0034	.0029	.0027	.0023	.0022	.0027	.0063	.0274	.0097							
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000							
113.00 N	.0057	.0029	.0015	.0008	.0004	.0003	.0002	.0001	.0000	.0000	.0000	.0000	.0038							
.00 N2	.8622	.8637	.8645	.8649	.8650	.8651	.8652	.8652	.8652	.8652	.8652	.8653	.8632							

PSILION	PC/F	P PSIA	TEMP DEG K	ENTHALPY KCAL/100KG	SH-PIPING EXPANSION C STAR = 6480.1 F/1SEC							I VAC	CF SEA	CF VAC
					CM DELC	I OPT	DELVC	DELVC	I SEA	I AT	I SECCO			
					CM DELC	I OPT	DELVC	DELVC	I SEA	I AT	I SECCO	I VAC	CF SEA	CF VAC
1.000	1.000	1000.000	1.000											
1.000	1.749	571.884	4651.31	-21.05	1.996	133.7	115.2	.201	245.9	246.0	248.5	248.9	1.236	1.221
1.000	1.800	124.251	4059.3	-69.02		144.6	51.7	.414	200.2	292.1	295.6	296.3	1.441	1.471
3.000	14.468	69.119	1871.8	-85.47		272.2	35.2	.630	306.5	309.3	314.7	315.7	1.522	1.568
4.000	20.000	48.000	1871.8	-85.47		395.0	39.5	.819	315.6	319.3	326.3	327.7	1.567	1.627
5.000	27.955	35.774	1671.2	-10.93		508.3	39.2	1.032	321.1	325.6	334.2	336.2	1.594	1.668
6.000	34.980	28.588	3465.4	-109.34		307.7	35.1	1.226	374.8	330.2	340.7	342.8	1.612	1.702
7.000	41.954	23.813	3552.0	-114.16	2.182	312.4	33.6	1.412	327.3	333.6	345.7	348.1	1.625	1.728
8.000	49.865	20.054	3506.9	-118.24	2.157	320.0	32.4	1.617	328.7	335.9	349.7	352.5	1.632	1.750
9.000	57.676	17.000	3506.9	-122.32	2.156	327.9	31.8	1.832	329.5	337.6	353.5	357.1	1.638	1.785
10.000	65.487	15.201	3434.3	-127.42	2.110	328.9	30.6	2.016	329.9	338.8	358.5	359.5	1.638	1.785
11.000	74.073	13.500	3464.1	-127.55	2.086	332.4	29.9	2.217	339.6	358.6	362.4		1.799	
12.000	82.563	12.112	3376.9	-130.00	2.064	335.6	29.3	2.421	340.1	360.0	365.0		1.812	
13.000	90.958	10.715	3352.3	-132.73	2.042	339.5	28.8	2.622	340.4	362.8	367.3		1.824	
14.000	99.764	10.310	3329.8	-136.13	1.995	343.5	28.0	2.826		364.6	366.6		1.836	
15.000	108.722	9.908	3309.0	-136.13	1.995	343.5	27.0	3.027		366.2	371.3		1.844	
16.000	117.926	8.880	3299.8	-137.86	1.979	345.7	27.4	3.236		367.6	375.1		1.853	
17.000	127.273	7.857	3271.9	-139.47	1.959	347.7	27.1	3.445		368.9	378.8		1.861	
18.000	136.768	7.146	3239.8	-140.78	1.940	349.5	26.8	3.654		370.1	382.5		1.869	
19.000	146.424	6.636	3239.4	-142.39	1.920	351.3	26.4	3.865		371.2	377.8		1.876	
20.000	155.858	6.414	3224.5	-143.71	1.902	353.0	26.1	4.073		372.2	379.1		1.882	
21.000	165.552	6.240	3210.5	-144.96	1.884	354.5	25.9	4.281		373.1	380.4		1.889	
22.000	175.224	5.957	3197.2	-146.15	1.866	356.0	25.6	4.487		373.9	381.6		1.895	
23.000	184.855	5.404	3185.5	-147.18	1.848	357.5	25.4	4.692		374.7	382.7		1.901	
24.000	194.530	5.140	3172.5	-148.34	1.832	358.6	25.1	4.892		375.4	383.8		1.905	
25.000	204.172	4.898	3161.0	-149.36	1.816	359.9	24.9	5.090		376.1	384.8		1.911	
26.000	213.749	4.678	3149.9	-150.31	1.800	361.0	24.7	5.286		376.7	385.8		1.915	
27.000	223.273	4.453	3139.2	-151.17	1.784	362.1	24.5	5.481		377.3	386.7		1.919	
28.000	232.773	4.297	3129.2	-152.15	1.768	363.2	24.4	5.670		377.9	387.6		1.924	
29.000	242.128	4.130	3119.4	-153.01	1.753	364.2	24.2	5.857		378.4	388.4		1.929	
30.000	251.453	3.976	3110.0	-153.83	1.739	365.2	24.0	6.043		378.9	389.3		1.933	
31.000	261.166	3.818	3101.2	-154.63	1.724	366.2	23.8	6.258		379.4	390.0		1.937	
32.000	271.022	3.652	3092.2	-155.40	1.709	367.2	23.6	6.469		379.9	390.7		1.941	
33.000	281.773	3.524	3083.8	-156.13	1.696	367.9	23.6	6.689		380.1	391.5		1.944	
34.000	294.650	3.393	3075.6	-156.86	1.682	368.8	23.4	6.905		380.4	392.2		1.947	
35.000	305.671	3.271	3067.6	-157.53	1.668	369.8	23.3	7.122		380.8	392.9		1.951	
36.000	316.768	3.157	3059.9	-158.20	1.655	370.8	23.2	7.337		381.0	393.6		1.954	
37.000	327.789	3.051	3052.5	-158.84	1.642	371.1	23.0	7.554		381.3	394.2		1.957	
38.000	338.911	2.951	3045.2	-159.47	1.629	371.9	22.9	7.769		381.6	394.8		1.960	
39.000	350.063	2.857	3038.1	-160.07	1.616	372.6	22.8	7.984		381.8	395.4		1.963	
40.000	361.238	2.768	3031.2	-160.66	1.604	373.3	22.7	8.198		382.0	396.0		1.966	
41.000	372.429	2.682	3024.5	-161.23	1.592	374.0	22.6	8.412		382.2	396.5		1.969	
42.000	383.428	2.607	3017.9	-161.80	1.580	374.6	22.5	8.625		382.4	397.1		1.972	
43.000	394.828	2.533	3011.5	-162.34	1.568	375.2	22.4	8.837		382.5	397.6		1.974	
44.000	406.023	2.463	3005.3	-162.87	1.556	375.8	22.3	9.047		382.7	398.1		1.977	
45.000	417.240	2.397	2999.2	-163.38	1.545	376.4	22.2	9.256		382.8	398.6		1.979	
46.000	428.372	2.334	2993.2	-163.88	1.534	377.0	22.1	9.464		383.0	399.1		1.982	
47.000	439.551	2.275	2987.4	-164.37	1.523	377.6	22.0	9.671		383.1	399.6		1.984	
48.000	450.630	2.219	2981.7	-164.85	1.512	378.1	21.9	9.876		383.2	400.0		1.986	
49.000	461.713	2.166	2976.1	-165.32	1.501	378.7	21.8	10.077		383.3	400.5		1.988	
50.000	472.795	2.116	2970.6	-165.78	1.490	379.2	21.7	10.277		383.4	401.0		1.990	
10.282	68.046	14.696	3425.4	-125.62	1.913	329.9	30.4	2.071	329.9	339.1	356.8	360.3	1.638	1.785

PRESSURE PROFILE DATA
 SYSTEM LIQUID HIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEC K GM/CC (KCAL/FORM.WT.)
 158 A2F4 1.500 -2.0 8C.
 258 55H9 0.620 +7.74 2C.

BULK DENSITY = 1.168 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 280.66 FU/100GMS

CHAMBER	THROAT											
	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4002.2	3280.3	2680.6	2182.7	1980.2	1769.8	1427.7	1145.2	913.0	723.5	569.9	446.4
ENTHALPY (-)	-51	28.80	53.12	72.36	80.91	89.08	102.12	112.61	121.00	127.68	132.95	137.09
CP	.4145	.4045	.4020	.3946	.3907	.3858	.3760	.3663	.3565	.3474	.3390	.3320
IMPLL OPT	160.78	216.80	253.50	266.80	279.80	299.39	314.76	325.67	334.46	341.25	346.49	348.38
IMPLL VAC	244.28	267.41	288.74	297.17	305.69	318.91	329.18	337.15	343.32	348.09	351.77	351.93
EPSILON	1.038	1.501	2.495	3.229	4.375	7.872	14.358	26.365	48.554	89.472	164.742	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4002.2	3560.8	3172.8	2841.9	2707.8	2569.6	2347.2	2161.1	2000.7	1856.9	1727.6	1589.2
ENTHALPY (-)	-51	29.67	56.31	79.60	89.50	100.12	113.36	134.71	149.49	162.91	175.12	186.23
X BAR	4.734	4.631	4.535	4.440	4.395	4.344	4.248	4.155	4.067	3.985	3.912	3.850
N	4.734	4.631	4.535	4.440	4.395	4.344	4.248	4.155	4.067	3.985	3.912	3.850
CP	1.0052	.9538	.9468	1.0162	1.0771	1.1561	1.3067	1.4139	1.4454	1.3849	1.2235	.9698
IMPLL OPT	163.11	223.11	264.66	280.45	296.47	322.11	343.49	361.72	377.51	391.33	403.49	133.36
IMPLL VAC	250.51	278.86	305.88	317.14	329.02	348.88	366.09	381.17	394.46	406.22	416.60	245.52
EPSILON	1.054	1.605	2.832	3.784	5.337	10.474	21.111	43.355	90.183	189.088	397.404	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
132.60 P	.0000	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 B*F	1.4510	1.4509	1.4349	1.3968	1.3714	1.3375	1.2648	1.1868	1.1087	1.0340	.9654	.9063
-133.84 P*F2	.0101	.0868	.0745	.0624	.0566	.0498	.0377	.0273	.0189	.0125	.0079	.0045
-270.00 B*F3	.0304	.0451	.0736	.1237	.1550	.1956	.2805	.3689	.4554	.5364	.6097	.6722
114.76 P*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 P*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 P*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
179.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 B3*H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0372	.0137	.0042	.0011	.0006	.0003	.0001	.0000	.0000	.0000	.0000	.0000
-64.50 F*H	1.2952	1.3030	1.2677	1.1825	1.1263	1.0521	.8947	.7283	.5638	.4081	.2663	.1446
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.5447	.3784	.2397	.1415	.1097	.0821	.0480	.0281	.0162	.0090	.0045	.0019
79.20 F*N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.5045	.5839	.6711	.7627	.8067	.8576	.9533	1.0464	1.1347	1.2162	1.2893	1.3515
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 H	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 A2	.7666	.7690	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7691	.7689

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEC K GM/CC (KCAL/FORM.WT.)
 198 N2*F4 1.500 -2.0 83.
 298 H5*H9 0.620 +7.74 17.

BULK DENSITY = 1.208 GM/CC
 MIXTURE RATIO = 4.882 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 272.21 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	163.2
TEMP, DEG K	4303.8	3524.5	2878.3	2343.1	2125.6	1899.8	1533.2	1230.6	981.8	778.4	613.7	481.0	3743.1
ENTHALPY (-)	-49	29.98	54.89	75.21	83.35	91.72	105.08	115.83	124.43	131.28	136.69	140.95	21.47
CP	.3935	.3483	.3826	.3762	.3728	.3686	.3599	.3502	.3411	.3323	.3244	.3175	.3899
IMPLL OPT	162.80	219.49	256.62	270.07	283.23	303.04	318.10	329.66	338.57	345.46	350.77	358.20	138.20
IMPLL VAC	247.33	270.69	292.27	300.80	309.42	322.80	333.21	341.29	347.55	352.39	356.13	363.95	243.95
EPSILON	1.038	1.500	2.493	3.227	4.372	7.870	14.363	26.391	48.631	89.677	165.226	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	169.9
TEMP, DEG K	4303.8	3865.3	3457.4	3091.2	2938.9	2780.8	2527.1	2320.2	2147.6	2000.5	1871.5	1756.0	4014.4
ENTHALPY (-)	-49	31.02	58.64	82.82	93.07	104.04	122.82	139.58	154.68	168.39	180.91	192.39	20.51
X BAR	4.516	4.413	4.320	4.232	4.191	4.143	4.051	3.959	3.870	3.784	3.702	3.626	4.448
N	4.516	4.413	4.320	4.232	4.191	4.143	4.051	3.959	3.870	3.784	3.702	3.626	4.448
CP	1.1534	1.0065	.9154	.9230	.9599	1.0239	1.1858	1.3635	1.5205	1.6311	1.6835	1.6626	1.0548
IMPLL OPT	165.56	226.80	269.20	285.29	301.55	327.52	349.07	367.41	383.29	397.25	409.63	423.07	249.36
IMPLL VAC	254.63	283.74	311.22	322.61	334.58	354.54	371.82	386.96	400.37	412.33	423.07	429.36	
EPSILON	1.054	1.609	2.833	3.779	5.316	10.382	20.862	42.797	89.176	188.005	399.920	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 E	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
-45.47 E*F	1.1758	1.1806	1.1775	1.1578	1.1411	1.1164	1.0565	.9855	.9096	.8330	.7581	.6866	1.1795
-133.84 P*F2	.1282	.1103	.0921	.0752	.0678	.0597	.0457	.0339	.0244	.0171	.0117	.0078	.1167
-270.00 P*F3	.0408	.0543	.0759	.1126	.1367	.1694	.2433	.3262	.4116	.4955	.5757	.6512	.0490
114.76 P*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 P*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 P*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
139.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 H3*H6*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.1454	.0684	.0251	.0075	.0041	.0020	.0005	.0001	.0000	.0000	.0000	.0000	.0914
-64.50 F*H	1.4918	1.5591	1.5774	1.5385	1.5011	1.4457	1.3135	1.1599	.9988	.8383	.6832	.5362	1.5406
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.5352	.4204	.3042	.2022	.1635	.1273	.0793	.0498	.0316	.0201	.0126	.0077	.4619
79.20 F*H	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 F2	.1953	.2211	.2702	.3406	.3787	.4245	.5146	.6061	.6958	.7818	.8631	.9390	.2096
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 H	.0021	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010
.00 H2	.7967	.7975	.7978	.7979	.7979	.7979	.7980	.7980	.7980	.7980	.7980	.7980	.7973

EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	SHIFTING EXPANSION											
					CM CAL/	C STAR	I OPT	DELTA	DELTA	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
				DEG K	CM DEG	1000	DEG	/SEC	/F	LVL	10000	50000	LVL	LVL		
1.000	1.000	300.000	4303.8	-	1.153	-	-	-	-	-	-	-	-	-	-	-
1.000	1.765	149.943	3291.1	-20.31	1.055	135.1	114.2	-672	239.5	242.5	248.2	249.4	1.237	1.188		
2.000	3.581	35.384	3299.1	-69.12		146.6	48.9	1.392	275.0	281.2	283.1	295.9	1.364	1.465		
3.000	14.789	20.285	3059.4	-84.94		272.6	41.0	2.020	283.9	292.9	310.2	313.6	1.408	1.555		
4.000	24.120	13.372	2911.0	-64.98		272.6	36.5	2.491		297.1	320.1	324.7		1.610		
5.000	29.950	10.717	2807.4	-112.15			33.7	3.078			324.8			1.375		
6.000	38.317	7.829	2729.9	-157.48		308.8	31.7	4.053			331.4	338.5		1.679		
7.000	47.218	6.354	2608.4	-112.16			31.0	30.2	4.758		335.2	343.3		1.703		
8.000	56.280	5.130	2618.1	-115.89		318.2	29.1	5.450			338.0	347.3		1.722		
9.000	64.925	4.192	2517.5	-119.07		323.5	28.1	6.192			340.2			1.740		
10.000	74.141	4.044	2539.7	-121.85		326.9	27.3	6.746			342.0	353.5		1.753		
11.000	83.651	3.585	2508.0	-124.30		329.5	26.6	7.422			343.4	356.1		1.766		
12.000	93.975	3.172	2480.0	-126.50		332.4	26.0	8.144			344.5	358.4		1.777		
13.000	104.421	2.873	2453.9	-128.49		335.0	25.5	8.885			345.3	360.5		1.788		
14.000	114.950	2.612	2402.4	-130.32		337.4	25.0	9.640			346.0			1.799		
15.000	125.488	2.391	2411.9	-121.96		339.5	24.6	10.279			346.5	364.0		1.805		
16.000	135.970	2.206	2393.2	-133.49		341.4	24.2	10.965			346.9	365.6		1.813		
17.000	146.346	2.050	2375.9	-134.91		343.2	23.8	11.633			347.2	367.1		1.820		
18.000	156.518	1.907	2340.0	-136.73		344.9	23.5	12.300			347.5			1.828		
19.000	166.454	1.870	2365.2	-137.47		346.4	23.2	12.904			347.7	369.7		1.833		
20.000	176.516	1.700	2331.4	-138.63		347.9	23.0	13.516				370.9				
21.000	186.462	1.609	2318.4	-139.72		349.3	22.7	14.120				372.0				
22.000	197.478	1.515	2306.1	-140.76		350.5	22.5	14.835				373.0			1.850	
23.000	208.462	1.421	2286.8	-141.76		351.8	22.3	15.481				374.0			1.859	
24.000	221.376	1.355	2283.7	-142.68		352.9	22.0	16.269				375.0			1.860	
25.000	233.215	1.286	2273.3	-143.57		354.0	21.8	16.986				375.9			1.864	
26.000	245.121	1.224	2263.5	-144.41		355.0	21.7	17.701				376.7			1.868	
27.000	257.013	1.162	2244.2	-145.22		356.0	21.5	18.416				377.5			1.872	
28.000	269.053	1.115	2226.3	-146.00		357.0	21.3	19.122				378.3			1.876	
29.000	281.044	1.067	2236.7	-146.74		357.9	21.2	19.825				379.1			1.880	
30.000	293.020	1.024	2228.6	-147.45		358.8	21.0	20.524				379.8			1.883	
31.000	304.955	.984	2220.8	-148.16		359.6	20.9	21.216				380.5			1.887	
32.000	316.927	.943	2213.3	-148.87		360.4	20.7	21.909				381.2			1.891	
33.000	328.813	.912	2206.1	-149.44		361.2	20.6	22.578				381.8			1.893	
34.000	340.642	.881	2199.2	-150.05		361.9	20.5	23.240				382.4			1.896	
35.000	352.425	.851	2192.5	-150.64		362.6	20.4	23.909				383.0			1.899	
36.000	364.054	.824	2186.1	-151.22		363.2	20.3	24.568				383.6			1.902	
37.000	375.754	.799	2179.9	-151.77		363.8	20.1	25.205				384.1			1.905	
38.000	387.229	.775	2173.9	-152.31		364.4	20.0	25.840				384.6			1.907	
39.000	398.667	.753	2168.1	-152.83		365.2	19.9	26.466				385.1			1.910	
40.000	410.014	.732	2162.5	-153.34		365.8	19.8	27.085				385.6			1.913	
41.000	421.270	.711	2157.0	-153.83		366.4	19.7	27.697				386.1			1.916	
42.000	432.436	.694	2151.7	-154.31		367.0	19.6	28.292				386.6			1.917	
43.000	443.859	.676	2146.6	-154.77		367.5	19.5	28.908				387.1			1.920	
44.000	456.883	.657	2141.6	-155.23		368.1	19.4	29.620				387.5			1.922	
45.000	469.937	.639	2136.7	-155.67		368.6	19.3	30.326				388.0			1.924	
46.000	483.056	.621	2132.0	-156.10		369.1	19.3	31.045				388.5			1.926	
47.000	496.234	.603	2127.4	-156.52		369.6	19.2	31.759				388.8			1.928	
48.000	509.468	.589	2122.9	-156.93		370.1	19.1	32.473				389.2			1.930	
49.000	522.751	.573	2118.6	-157.33		370.6	19.0	33.182				389.5			1.932	
50.000	536.078	.558	2114.3	-157.72		371.0	19.0	33.902				390.0			1.934	
3.779	20.414	14.696	2938.9	-93.07	.960	285.3	37.3	2.540	265.3	296.5	318.3	322.6	1.415	1.600		

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 198 N2*F4 1.500 -2.0 85.
 298 B5*H9 0.620 +7.74 15.

FULK DENSITY = 1.237 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 265.86 EU/100GMS

CHAMBER	THROAT											
	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4461.2	3651.9	2981.9	2427.3	2202.1	1968.6	1589.4	1276.4	1019.1	808.7	638.0	500.6
ENTHALPY (-)	-1.20	30.30	55.24	75.58	83.73	92.10	105.47	116.25	124.87	131.74	137.17	141.45
CP	.3750	.3746	.3694	.3635	.3604	.3567	.3486	.3394	.3306	.3220	.3145	.3079
IMPLL OPT	162.91	219.62	256.76	270.22	283.34	303.21	318.29	329.86	338.80	345.71	351.04	357.74
IMPLL VAC	247.47	270.84	292.42	300.96	309.58	322.98	333.41	341.52	347.80	352.67	356.42	360.10
EPSILON	1.038	1.500	2.493	3.226	4.372	7.875	14.379	26.440	48.755	89.972	165.945	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4461.2	4060.4	3687.4	3375.3	3160.5	2981.4	2685.8	2446.6	2252.7	2091.6	1954.5	1834.9
ENTHALPY (-)	-1.20	31.49	59.61	84.51	95.10	106.44	125.75	142.88	158.22	172.09	184.72	196.29
X BAR	4.363	4.250	4.150	4.066	4.029	3.988	3.908	3.824	3.738	3.654	3.573	3.496
N	4.363	4.250	4.150	4.066	4.029	3.988	3.908	3.824	3.738	3.654	3.573	3.496
CP	1.4383	1.2486	1.0778	.8916	.8530	.8587	.9743	1.1594	1.3532	1.5328	1.6727	1.7657
IMPLL OPT	166.05	228.11	271.46	287.94	304.59	331.02	352.81	371.24	387.15	401.09	413.45	424.82
IMPLL VAC	255.89	286.11	314.52	326.18	338.34	358.44	375.74	390.85	404.22	416.14	426.86	436.26
EPSILON	1.059	1.631	2.891	3.854	5.408	10.485	20.928	42.728	88.761	186.848	397.430	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
132.60 F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 F*F	.9803	.9776	.9732	.9652	.9580	.9448	.9035	.8449	.7764	.7039	.6308	.5592
-133.84 F*F2	.1459	.1350	.1165	.0948	.0842	.0727	.0540	.0392	.0280	.0196	.0135	.0092
-270.00 F*F3	.0558	.0744	.0575	.1272	.1450	.1698	.2298	.3032	.3829	.4637	.5429	.6188
114.76 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
46.00 H*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
149.30 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 F3*H*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.3068	.1926	.0593	.0378	.0213	.0104	.0075	.0006	.0002	.0000	.0000	.2315
-64.50 F*H	1.5118	1.6054	1.6709	1.6946	1.6850	1.6589	1.5655	1.4353	1.2876	1.1344	.9821	.8347
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.4421	.3615	.2649	.2151	.1841	.1511	.1002	.0654	.0428	.0282	.0186	.0122
79.20 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0033	.0014	.0005	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0019
.00 N2	.8153	.8164	.8169	.8171	.8171	.8172	.8172	.8172	.8172	.8172	.8172	.8161

SYSTEM LIQUID BIPROPELLANT										PC 300, PSIA		HEAT FORM		WT. O/D	
COMBUSTANT										DENSITY		INICAL/FORM.WT.1			
TREF FORMULA										GM/CC		1.500		85.	
DEG K										1.500		-7.0		85.	
198 A20FA										0.620		+1.74		15.	
25R B50H9										FROZEN EXPANSION		C STAR = 6257.8 FT/SEC			
										I SEA		I AT		I VAC	
										10000		50000		CF SEA	
										LVL		LVL		LVL	
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/G	DEG K	ENTHALPY	CP CAL/G	DEG K	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
1.000	1.000	100.000	4861.2	-20	.379					106.4	234.6	234.6	244.1	1.255	
2.000	1.829	164.654	3883.7	-21.60	.376	137.7	106.4	.644	234.6	234.6	244.1	1.206	1.461		
3.000	10.110	29.416	2635.2	-68.00	.366	244.1	40.0	1.352	264.3	274.3	281.8	1.159	1.536		
4.000	18.217	16.414	2262.7	-81.54	.361	266.7	32.0	1.949	270.0	278.7	285.4	1.108	1.579		
5.000	26.476	10.550	2013.8	-89.77	.358	279.8	27.4	2.549		280.5	302.8	307.2	1.049		
6.000	34.927	7.514	1874.3	-95.46	.355	288.5	24.5	3.263			307.4	317.3	1.031		
7.000	42.612	5.497	1753.9	-99.71	.352	294.8	22.4	3.936			310.6	320.4	1.048		
8.000	49.869	4.254	1658.8	-103.06	.350	299.7	20.9	4.581			312.8	323.3	1.062		
9.000	56.910	3.781	1580.3	-105.73	.348	303.7	19.6	5.192			314.4	325.5	1.074		
10.000	64.910	3.153	1514.1	-108.09	.347	306.9	18.6	5.884			315.5	327.5	1.084		
11.000	72.864	2.696	1457.1	-110.06	.345	309.7	17.7	6.580			316.2	329.1	1.092		
12.000	80.780	2.343	1407.4	-111.77	.343	312.1	17.0	7.255			317.1	330.6	1.100		
13.000	88.657	2.070	1364.5	-113.28	.342	314.2	16.4	7.904			317.3	331.9	1.106		
14.000	96.511	1.840	1328.9	-114.62	.341	316.1	15.8	8.523					1.112		
15.000	104.348	1.643	1296.8	-115.81	.340	317.7	15.3	9.109					1.117		
16.000	112.169	1.473	1267.3	-116.91	.339	319.2	14.9	9.751					1.122		
17.000	120.000	1.321	1240.2	-117.91	.338	320.6	14.4	10.449					1.127		
18.000	127.846	1.183	1215.2	-118.82	.337	321.8	14.1	11.136					1.131		
19.000	135.717	1.061	1192.2	-119.67	.336	322.9	13.7	11.823					1.135		
20.000	143.614	0.950	1170.4	-120.45	.335	324.0	13.4	12.503					1.138		
21.000	151.536	.844	1150.4	-121.17	.335	325.0	13.1	13.177					1.141		
22.000	159.481	.742	1131.1	-121.85	.334	325.9	12.8	13.842					1.144		
23.000	167.447	.644	1112.2	-122.48	.333	326.7	12.6	14.497					1.146		
24.000	175.434	.550	1093.4	-123.07	.333	327.5	12.4	15.144					1.147		
25.000	183.441	.461	1074.5	-123.63	.332	328.2	12.1	15.786					1.149		
26.000	191.467	.376	1055.6	-124.16	.331	328.9	11.9	16.423					1.151		
27.000	199.512	.295	1036.5	-124.66	.331	329.6	11.7	16.891					1.155		
28.000	207.576	.218	1017.4	-125.14	.330	330.2	11.6	17.527					1.157		
29.000	215.658	.144	998.4	-125.59	.330	330.8	11.4	18.157					1.159		
30.000	223.758	.074	979.4	-126.02	.329	331.4	11.2	18.784					1.161		
31.000	231.874	.004	960.4	-126.43	.329	331.9	11.0	19.408					1.163		
32.000	239.999	.000	941.4	-126.82	.328	332.4	10.9	20.028					1.165		
33.000	248.134	.000	922.4	-127.19	.328	332.9	10.7	20.645					1.167		
34.000	256.278	.000	903.4	-127.55	.327	333.4	10.6	21.262					1.168		
35.000	264.431	.000	884.4	-127.89	.327	333.9	10.5	21.879					1.170		
36.000	272.593	.000	865.4	-128.22	.327	334.3	10.3	22.497					1.172		
37.000	280.764	.000	846.4	-128.54	.326	334.7	10.2	23.114					1.173		
38.000	288.944	.000	827.4	-128.86	.326	335.1	10.1	23.735					1.175		
39.000	297.133	.000	808.4	-129.16	.325	335.4	10.0	24.354					1.176		
40.000	305.331	.000	789.4	-129.46	.325	335.8	9.9	24.966					1.177		
41.000	313.538	.000	770.4	-129.69	.325	336.2	9.8	25.578					1.179		
42.000	321.754	.000	751.4	-129.96	.324	336.5	9.7	26.194					1.180		
43.000	329.979	.000	732.4	-130.21	.324	336.9	9.6	26.811					1.181		
44.000	338.212	.000	713.4	-130.47	.324	337.2	9.5	27.429					1.182		
45.000	346.453	.000	694.4	-130.70	.323	337.5	9.4	28.048					1.183		
46.000	354.701	.000	675.4	-130.93	.323	337.8	9.3	28.668					1.184		
47.000	362.956	.000	656.4	-131.15	.323	338.0	9.2	29.289					1.185		
48.000	371.218	.000	637.4	-131.37	.323	338.3	9.1	29.911					1.187		
49.000	379.486	.000	618.4	-131.59	.322	338.6	9.1	30.534					1.187		
50.000	387.759	.000	599.4	-131.79	.322	338.9	9.0	31.157					1.188		
51.000	396.037	.000	580.4	-131.99	.322	339.1	8.9	31.780					1.189		
52.000	404.319	.000	561.4	-132.18	.320	339.2	8.7	32.402					1.190		

SHIFTING EXPANSION															
C STAR = 6516.0 FT/SEC															
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/G	DEG K	ENTHALPY	CP CAL/G	DEG K	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
										LVL	LVL	10000	50000		
1.000	1.000	100.000	4861.2	-20.00	.379					134.8	115.4	.675	240.3	243.3	1.187
2.000	1.829	164.654	3883.7	-21.60	.376	246.9	50.5	1.195	276.9	283.1	295.0	297.4	1.167	1.468	
3.000	10.110	29.416	2635.2	-68.00	.366	273.8	42.4	2.027	286.3	295.3	312.6	316.1	1.141	1.561	
4.000	18.217	16.414	2262.7	-81.54	.361	285.9	37.7	2.702		299.8	323.0	327.6	1.108	1.618	
5.000	26.476	10.550	2013.8	-89.77	.358	301.0	34.7	3.381			329.9	335.7	1.067		
6.000	34.927	7.514	1874.3	-95.46	.355	309.2	32.6	4.069			334.8	341.8	1.031		
7.000	42.612	5.497	1753.9	-99.71	.352	315.7	30.9	4.775			338.5	346.7	1.012		
8.000	50.353	4.254	1658.8	-103.06	.350	321.1	29.7	5.472			341.4	350.7	1.012		
9.000	58.049	3.781	1580.3	-105.73	.348	325.9	28.6	6.144			343.7	354.2	1.049		
10.000	65.710	3.153	1514.1	-108.09	.347	329.4	27.8	6.781			345.6	357.1	1.074		
11.000	73.345	2.696	1457.1	-110.06	.345	332.7	27.0	7.451			347.0	359.7	1.074		
12.000	80.957	2.343	1407.4	-111.77	.343	335.7	26.4	8.176			348.1	362.1	1.084		
13.000	88.547	2.070	1364.5	-113.28	.341	338.3	25.8	8.901			349.0	364.2	1.092		
14.000	96.120	1.840	1328.9	-114.62	.340	340.7	25.3	9.618			349.7	366.1	1.100		
15.000	103.685	1.643	1296.8	-115.81	.339	342.9	24.9	10.324			350.2	367.8	1.106		
16.000	111.243	1.473	1267.3	-116.91	.338	344.9	24.5	11.015			350.6	369.4	1.112		
17.000	118.794	1.321	1240.2	-117.91	.337	346.8	24.1	11.697			350.9	370.9	1.117		
18.000	126.340	1.183	1215.2	-118.82	.336	348.5	23.8	12.370			351.2	372.2	1.122		
19.000	133.882	1.061	1192.2	-119.67	.335	350.0	23.5	13.037			351.4	373.5	1.127		
20.000	141.421	0.950	1170.4	-120.45	.334	351.5	23.2	13.699			351.5	374.7	1.131		
21.000	148.959	0.849	1149.4	-121.23	.333	352.9	22.9	14.356			351.6	375.8	1.135		
22.000	156.497	0.757	1129.4	-122.01	.332	354.2	22.7	14.999			351.7	376.9	1.139		
23.000	164.035	0.675	1110.4	-122.79	.331	355.5	22.4	15.637			351.8	377.9	1.143		
24.000	171.573	0.593	1091.4	-123.57	.330	356.8	22.2	16.270			351.9	378.9	1.147		
25.000	179.111	0.511	1072.4	-124.35	.329	357.7	22.0	16.902			352.0	379.9	1.151		
26.000	186.649	0.429	1053.4	-125.13	.328	358.8	21.8	17.529			352.1	380.9	1.155		
27.000	194.187	0.347	1034.4	-125.91	.327	359.8	21.6	18.156			352.2	381.9	1.159		
28.000	201.725	0.265	1015.4	-126.69	.326	360.8	21.4	18.783			352.3	382.9	1.163		
29.000	209.263	0.183	996.4	-127.47	.325	361.7	21.3	19.410			352.4	383.9	1.167		
30.000	216.801	0.101	977.4	-128.25	.324	362.7	21.1	20.037			352.5	384.9	1.171		
31.000	224.339	0.019	958.4	-129.03	.323	363.6	21.0	20.664			352.6	385.9	1.175		
32.000	231.877		939.4	-129.81	.322	364.5	20.9	21.291			352.7	386.9	1.179		
33.000	239.415		920.4	-130.59	.321	365.4	20.7	21.918			352.8	387.9	1.183		
34.000	246.953		901.4	-131.37	.320	366.3	20.6	22.545			352.9	388.9	1.187		
35.000	254.491		882.4	-132.15	.319	367.2	20.5	23.172			353.0	389.9	1.191		
36.000	262.029		863.4	-132.93	.318	368.1	20.4	23.799			353.1	390.9	1.195		
37.000	269.567		844.4	-133.71	.317	369.0	20.3	24.426			353.2	391.9	1.199		
38.000	277.105		825.4	-134.49	.316	369.9	20.2	25.053			353.3	392.9	1.203		
39.000	284.643		806.4	-135.27	.315	370.8	20.1	25.680			353.4	393.9	1.207		
40.000	292.181		787.4	-136.05	.314	371.7	20.0	26.307			353.5	394.9	1.211		
41.000	299.719		768.4	-136.83	.313	372.6	19.9	26.934			353.6	395.9	1.215		
42.000	307.257		749.4	-137.61	.312	373.5	19.8	27.561			353.7	396.9	1.219		
43.000	314.795		730.4	-138.39	.311	374.4	19.7	28.188			353.8	397.9	1.223		
44.000	322.333		711.4	-139.17	.310	375.3	19.6	28.815			353.9	398.9	1.227		
45.000	329.871		692.4	-139.95	.309	376.2	19.5	29.442			354.0	399.9	1.231		
46.000	337.409		673.4	-140.73	.308	377.1	19.4	30.069			354.1	400.9	1.235		
47.000	344.947		654.4	-141.51	.307	378.0	19.3	30.696			354.2	401.9	1.239		
48.000	352.485		635.4	-142.29	.306	378.9	19.2	31.323			354.3	402.9	1.243		
49.000	360.023		616.4	-143.07	.305	379.8	19.1	31.950			354.4	403.9	1.247		
50.000	367.561		597.4	-143.85	.304	380.7	19.0	32.577			354.5	404.9	1.251		
51.000	375.099		578.4	-144.63	.303	381.6	18.9	33.204			354.6	405.9	1.255		
52.000	382.637		559.4	-145.41	.302	382.5	18.8	33.831			354.7	406.9	1.259		
53.000	390.175		540.4	-146.19	.301	383.4	18.7	34.458			354.8	407.9	1.263		
54.000	397.713		521.4	-146.97	.300	384.3	18.6	35.085			354.9	408.9	1.267		
55.000	405.251		502.4	-147.75	.299	385.2	18.5	35.712			355.0	409.9	1.271		
56.000	412.789		483.4	-148.53	.298	386.1	18.4	36.339			355.1	410.9	1.275		
57.000	420.327		464.4	-149.31	.297	387.0	18.3	36.966			355.2	411.9	1.279		
58.000	427.865		445.4	-150.09	.296	387.9	18.2	37.593			355.3	412.9	1.283		
59.000	435.403		426.4	-150.87	.295	388.8	18.1	38.220			355.4	413.9	1.287		
60.000	442.941		407.4	-151.65	.294	389.7	18.0	38.847			355.5	414.9	1.291		
61.000	450.479		388.4	-152.43	.293	390.6	17.9	39.474			355.6	415.9	1.295		
62.000	458.017		369.4	-153.21	.292	391.5	17.8	40.101			355.7	416.9	1.299		
63.000	465.555		350.4	-153.99	.291	392.4	17.7	40.728			355.8	417.9	1.303		
64.000	473.093		331.4	-154.77	.290	393.3	17.6	41.355			355.9	418.9	1.307		
65.000	480.631		312.4	-155.55	.289	394.2	17.5	41.982			356.0	419.9	1.311		
66.000	488.169		293.4	-156.33	.288	395.1	17.4	42.609			356.1	420.9	1.315		
67.000	495.707		274.4	-157.11	.287	396.0	17.3	43.236			356.2	421.9	1.319		
68.000	503.245		255.4	-157.89	.286	396.9	17.2	43.863			356.3	422.9	1.323		
69.000	510.783		236.4	-158.67	.285	397.8	17.1	44.490			356.4	423.9	1.327		
70.000	518.321		217.4	-159.45	.284	398.7	17.0	45.117			356.5	424.9	1.331		
71.000	525.859		198.4	-160.23	.283	399.6	16.9	45.744			356.6	425.9	1.335		
72.000	533.397		179.4	-161.01	.282	400.5	16.8	46.371			356.7	426.9	1.339		
73.000	540.935		160.4	-161.79	.281	401.4	16.7	46.998			356.8	427.9	1.343		
74.000	548.473		141.4	-162.57	.280	402.3	16.6	47.625			356.9	428.9	1.347		
75.000	556.011		122.4	-163.35	.279	403.2	16.5	48.252			357.0	429.9	1.351		
76.000	563.549		103.4	-164.13	.278	404.1	16.4	48.879			357.1	430.9	1.355		
77.000	571.087		84.4	-164.91	.277	405.0	16.3	49.506			357.2	431.9	1.359		
78.000	578.625		65.4	-165.69	.276	405.9	16.2	50.133			357.3	432.9	1.363		
79.000	586.163		46.4	-166.47	.275	406.8	16.1	50.760			357.4	433.9	1.367		
80.000	593.701		27.4	-167.25	.274	407.7	16.0	51.387			357.5	434.9	1.371		
81.000	601.239		8.4	-168.03	.273	408.6	15.9	52.014			357.6	435.9	1.375		
82.000	608.777		-10.4	-168.81	.272	409.5	15.8	52.641			357.7	436.9	1.379		
83.000	616.315		-29.4	-169.59	.271	410.4	15.7	53.268			357.8	437.9	1.383		
84.000	623.853		-48.4	-170.37	.270	411.3	15.6	53.895			357.9	438.9	1.387		
85.000	631.391		-67.4	-171.15	.269	412.2	15.5	54.522			358.0	439.9	1.391		
86.000	638.929		-86.4	-171.93	.268	413.1	15.4	55.149			358.1	440.9	1.395		
87.000	646.467		-105.4	-172.71	.267	414.0	15.3	55.776			358.2	441.9	1.399		
88.000	654.005		-124.4	-173.49	.266	414.9	15.2	56.403							

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREE FORMULA DENSITY HEAT FORM WT. O/O
 DEC K GM/CC (KCAL/FORM.WT.)
 198 N2O4 1.500 -2.0 87.
 298 H5OH 0.620 +7.74 13.

PULK DENSITY = 1.266 GM/CC
 MIXTURE RATIO = 6.692 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 258.95 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	162.8
TEMP, DEG K	4548.4	3720.7	3036.2	2470.4	2241.0	2003.1	1617.1	1298.8	1037.2	823.4	649.9	510.2	3950.5
ENTHALPY (-)	.08	30.13	54.69	74.70	82.72	90.95	104.11	114.70	123.19	129.95	135.30	139.51	21.83
CP	.3649	.3610	.3562	.3508	.3479	.3443	.3368	.3285	.3200	.3118	.3047	.2984	.3620
IMPELL OPT	161.69	217.76	254.79	268.12	281.17	300.83	315.78	327.26	336.12	342.97	348.27	353.61	137.54
IMPELL VAC	245.60	268.75	250.14	258.60	307.15	320.43	330.77	338.81	345.05	349.88	353.61	242.27	
EPSILON	1.038	1.499	2.491	3.223	4.368	7.866	14.365	26.421	48.739	89.984	166.058	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	170.7
TEMP, DEG K	4548.4	4177.6	3851.6	3555.8	3423.4	3273.1	2980.4	2675.8	2415.6	2213.4	2051.6	1916.6	4302.3
ENTHALPY (-)	.08	31.39	59.39	84.53	95.39	107.14	127.43	145.44	161.36	175.57	188.38	200.06	20.78
X BAR	4.218	4.093	3.979	3.877	3.833	3.788	3.716	3.657	3.591	3.518	3.443	3.369	4.136
N	4.218	4.093	3.979	3.877	3.833	3.788	3.716	3.657	3.591	3.518	3.443	3.369	4.136
CP	1.7526	1.7603	1.6786	1.4719	1.3318	1.1486	.8178	.7355	.9157	1.1539	1.3763	1.5544	1.7652
IMPELL OPT	165.05	227.15	271.04	287.95	305.18	332.84	355.61	374.58	390.72	404.74	417.10	134.21	
IMPELL VAC	254.62	285.48	315.01	327.34	340.30	361.61	379.40	394.60	407.95	419.83	430.48	248.83	
EPSILON	1.061	1.650	2.968	3.993	5.658	11.061	21.831	43.860	90.084	188.283	398.653	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-45.47 F*F	.7786	.7604	.7402	.7200	.7111	.7019	.6873	.6672	.6256	.5674	.5021	.4349	.7671
-133.84 F*F2	.1689	.1573	.1421	.1234	.1137	.1018	.0773	.0529	.0350	.0233	.0156	.0103	.1618
-270.00 F*F3	.0811	.1111	.1466	.1855	.2041	.2252	.2644	.3088	.3644	.4382	.5113	.5837	.0998
114.76 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 F*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 F*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 E2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 F3*H6*N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.5364	.4059	.2875	.1828	.1395	.0953	.0335	.0069	.0013	.0003	.0001	.0000	.4505
-64.50 F*H	1.4457	1.5315	1.5940	1.6395	1.6553	1.6691	1.6772	1.6393	1.5437	1.4166	1.2785	1.1390	1.5050
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.3260	.2589	.2061	.1650	.1490	.1324	.1044	.0773	.0536	.0364	.0246	.0166	.2808
79.20 F*H	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 F2	.0380	.0308	.0260	.0238	.0239	.0253	.0353	.0677	.1274	.1995	.2745	.3483	.0331
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0042	.0021	.0010	.0004	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0027
.00 N2	.8341	.8353	.8359	.8362	.8363	.8363	.8364	.8364	.8364	.8364	.8364	.8364	.8350

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		HEAT FORM		WT. G/G	
COMPONENT										DENSITY		(KCAL/POUN.WT.)		BT.	
TREF FORMULA										G/CC					
DEG K										1.500		-2.0		13.	
198 H2+H4										0.620		+7.74			
298 H2+H4															
FROZEN EXPANSION															
C STAR = 6210.3 FT/SEC															
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL / I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
			DEG K	KCAL/100GM	GM DEG	/P	/P	LVL	10000	50000		LVL			
1.000	1.000	300.000	4548.4	-0.08	-365	137.5	104.7	232.8	235.7	241.2	242.3	1.206	1.259		
2.000	1.043	162.774	3950.5	-21.83	-362	242.3	39.7	1.341	262.3	268.2	279.7	1.359	1.461		
3.000	18.307	16.388	2301.8	-80.60	-349	264.7	31.7	1.936	267.9	276.5	293.1	1.388	1.535		
4.000	28.443	10.533	2048.4	-88.49	-345	277.7	27.2	2.579		278.3	300.4	304.8	1.579		
5.000	39.958	7.500	1906.2	-54.28	-343	286.3	24.3	3.236			305.0	310.5	1.609		
6.000	52.755	5.487	1783.8	-58.46	-340	292.6	22.2	3.907			308.1	314.8	1.631		
7.000	65.919	4.547	1686.8	-101.75	-338	297.4	20.7	4.546			310.3	318.1	1.648		
8.000	79.450	3.774	1607.2	-104.44	-337	301.3	19.4	5.153			312.0	320.8	1.662		
9.000	93.137	3.151	1536.8	-106.70	-335	304.6	18.4	5.844			313.8	324.9	1.673		
10.000	111.475	2.691	1481.9	-108.32	-332	307.3	17.6	6.530			314.3	326.5	1.683		
11.000	128.228	2.340	1431.5	-110.32	-332	309.7	16.8	7.200			314.3	326.5	1.692		
12.000	145.149	2.067	1386.8	-111.80	-331	311.8	16.2	7.844			314.6	328.0	1.699		
13.000	162.048	1.851	1347.0	-113.12	-330	313.6	15.7	8.458			314.8	329.2	1.706		
14.000	178.807	1.678	1311.1	-114.30	-329	316.7	14.7	9.078					1.712		
15.000	195.219	1.521	1278.4	-115.37	-328	318.0	14.7	9.678					1.717		
16.000	212.242	1.381	1248.5	-116.35	-327	318.0	14.3	10.252					1.722		
17.000	227.824	1.261	1220.9	-117.25	-326	319.3	13.9	10.811					1.726		
18.000	242.824	1.154	1195.5	-118.08	-324	321.4	13.5	11.359					1.730		
19.000	258.756	1.071	1171.9	-118.65	-323	324.9	13.3	11.849					1.734		
20.000	274.642	.995	1150.0	-119.56	-324	322.4	13.0	13.074					1.738		
21.000	290.482	.928	1129.4	-120.22	-323	323.3	12.7	13.727					1.741		
22.000	306.281	.869	1110.2	-120.84	-323	324.1	12.5	14.365					1.744		
23.000	322.040	.817	1092.0	-121.43	-322	324.8	12.3	14.999					1.746		
24.000	337.761	.772	1074.9	-121.98	-321	325.6	12.0	15.596					1.749		
25.000	353.444	.731	1058.8	-122.50	-321	326.3	11.8	16.187					1.752		
26.000	369.089	.694	1043.4	-122.99	-320	327.0	11.6	16.762					1.754		
27.000	384.696	.658	1028.6	-123.45	-320	327.8	11.5	17.333					1.756		
28.000	400.266	.624	1015.0	-123.90	-319	328.2	11.3	17.879					1.759		
29.000	415.800	.592	1001.7	-124.32	-319	328.8	11.1	18.765					1.761		
30.000	431.299	.563	989.1	-124.72	-318	329.3	11.0	19.450					1.763		
31.000	446.761	.536	977.0	-125.11	-318	329.8	10.8	20.134					1.765		
32.000	462.186	.512	965.4	-125.48	-317	330.3	10.7	20.819					1.766		
33.000	477.574	.489	954.3	-125.83	-317	330.7	10.5	21.496					1.768		
34.000	492.924	.469	943.7	-126.16	-317	331.2	10.4	22.172					1.770		
35.000	508.236	.449	933.4	-126.49	-316	331.6	10.3	22.844					1.771		
36.000	523.510	.431	923.4	-126.80	-316	332.0	10.2	23.511					1.773		
37.000	538.746	.415	914.1	-127.10	-315	332.4	10.0	24.170					1.774		
38.000	553.944	.399	904.9	-127.39	-315	332.8	9.8	24.825					1.775		
39.000	569.104	.385	896.1	-127.67	-315	333.2	9.8	25.477					1.777		
40.000	584.226	.372	887.5	-127.94	-314	333.5	9.7	26.112					1.778		
41.000	599.310	.359	879.3	-128.20	-314	333.9	9.6	26.744					1.779		
42.000	614.356	.347	871.3	-128.45	-314	334.2	9.5	27.368					1.781		
43.000	629.364	.336	863.5	-128.69	-313	334.5	9.4	27.984					1.782		
44.000	644.334	.326	856.0	-128.92	-313	334.8	9.3	28.591					1.783		
45.000	659.266	.316	848.8	-129.15	-313	335.1	9.2	29.191					1.785		
46.000	674.160	.307	841.7	-129.37	-313	335.4	9.1	29.782					1.787		
47.000	689.016	.299	834.8	-129.59	-312	335.7	9.1	30.365					1.786		
48.000	703.834	.291	828.2	-129.80	-312	335.9	9.0	30.939					1.787		
49.000	718.614	.283	821.7	-130.00	-312	336.2	8.9	31.537					1.788		
50.000	733.356	.276	815.5	-130.19	-312	336.5	8.8	32.135					1.789		
3.223	20.914	1.696	2251.0	-82.72	-338	298.1	30.5	2.074	248.1	277.3	295.1	298.6	1.389	1.395	

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 CEG K GM/CC (KCAL/FORM.WT.)
 158 N2*F4 1.500 -2.0 90.
 258 H5*H9 0.620 +7.74 10.

PULK DENSITY = 1.314 GM/CC
 MIXTURE RATIO = 9.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 247.58 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	162.5
TEMP, DEG K	4563.6	3725.8	3035.0	2465.8	2235.3	1996.7	1610.5	1292.7	1032.0	819.2	646.7	507.9	3956.6
ENTHALPY (-)	.51	29.21	52.63	71.68	79.30	87.13	99.62	109.67	117.72	124.13	129.20	133.19	21.34
CP	.3442	.3409	.3369	.3322	.3296	.3266	.3198	.3123	.3047	.2973	.2908	.2849	.3417
IMPLL OPT	158.04	212.94	248.83	261.82	274.52	293.64	308.17	319.33	327.94	334.60	339.76	344.95	134.61
IMPLL VAC	239.96	262.47	283.27	291.49	299.80	312.70	322.75	330.56	336.62	341.32	344.95	346.75	
EPSILON	1.037	1.497	2.483	3.212	4.351	7.831	14.294	26.286	48.492	89.554	165.340	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	171.3
TEMP, DEG K	4563.6	4219.5	3926.1	3671.4	3563.1	3446.4	3244.2	3059.2	2886.0	2718.6	2546.2	2342.0	4335.3
ENTHALPY (-)	.51	30.50	57.43	81.78	92.37	103.92	124.15	142.70	159.76	175.46	189.91	203.10	20.21
X BAR	4.020	3.889	3.767	3.654	3.603	3.548	3.451	3.361	3.279	3.206	3.142	3.095	3.935
N	4.020	3.889	3.767	3.654	3.603	3.548	3.451	3.361	3.279	3.206	3.142	3.095	3.935
CP	2.1275	2.3787	2.5735	2.6837	2.7002	2.6908	2.5935	2.3836	2.0681	1.6451	1.1283	.6120	2.2922
IMPLL OPT	161.54	222.53	265.90	282.70	299.94	327.97	351.71	372.21	390.13	405.92	419.82	430.94	
IMPLL VAC	249.36	279.99	309.51	321.97	335.19	357.48	376.99	394.19	409.44	422.96	434.75	443.56	
EPSILON	1.062	1.659	3.006	4.063	5.798	11.548	23.687	49.169	103.096	217.103	453.981	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 F	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.47 F*F	.4632	.4261	.3891	.3530	.3366	.3182	.2849	.2533	.2236	.1962	.1726	.1561	.4394
-133.84 F*F2	.1784	.1631	.1444	.1243	.1150	.1045	.0859	.0690	.0541	.0412	.0298	.0194	.1691
-270.00 F*F3	.1457	.2222	.2580	.3142	.3399	.3688	.4207	.4691	.5138	.5541	.5891	.6160	.1830
114.76 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 F*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 F*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 F3*H6*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.9453	.8128	.6695	.5751	.5246	.4692	.3715	.2815	.1992	.1253	.0619	.0161	.8589
-64.50 F*H	1.2464	1.2892	1.3197	1.3418	1.3501	1.3583	1.3708	1.3807	1.3885	1.3948	1.3997	1.4021	1.2757
58.60 F*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1558	.1226	.0559	.0763	.0688	.0615	.0500	.0409	.0335	.0274	.0222	.0178	.1344
79.20 F*H	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 F2	.0052	.0064	.0045	.0033	.0029	.0025	.0019	.0016	.0013	.0012	.0014	.0024	.0072
40.30 F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0044	.0024	.0013	.0007	.0005	.0004	.0002	.0001	.0001	.0000	.0000	.0000	.0029
.00 N2	.8630	.8640	.8646	.8649	.8650	.8651	.8652	.8652	.8652	.8652	.8652	.8653	.8637

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		DENSITY		HEAT FORM		WT. 0/0	
COMPONENT										TREF FORMULA		GM/CC		(KCAL/FORM.WT.)		90.	
										100 N2/F4		1.500		-2.0		10.	
										248 854W9		0.670		+7.74			
FROZEN EXPANSION																	
C STAR = 6000.0 FT/SEC																	
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC			
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL	LVL			
1.000	1.000	300.000	4563.9	-51.344	2.127	130.9	112.6	4.550	233.9	236.8	242.4	243.4	1.235	1.184			
2.000	1.046	162.527	3956.6	-21.34	2.292	239.3	210.0	1.356	270.4	276.4	280.0	290.3	1.371	1.472			
3.000	1.087	10.188	29.445	2675.3	-64.71	265.8	43.6	1.974	280.4	289.2	306.1	309.4	1.421	1.568			
4.000	1.135	18.357	16.307	2293.6	-77.38	281.9	39.5	2.632	282.7	294.3	316.9	321.4	1.433	1.629			
5.000	1.184	28.441	10.475	2059.7	-85.07	293.1	36.0	3.296	296.0	326.2	329.9		1.472				
6.000	1.234	40.245	7.454	1897.0	-90.38	301.5	34.9	3.950					1.505				
7.000	1.284	53.088	5.651	1774.4	-94.35	308.2	33.5	4.638					1.532				
8.000	1.334	66.350	4.519	1677.5	-97.47	313.8	32.1	5.355					1.559				
9.000	1.384	80.043	3.748	1597.9	-100.02	318.4	30.6	6.099					1.586				
10.000	1.434	95.811	3.131	1530.7	-102.12	322.5	29.1	6.774					1.613				
11.000	1.484	112.246	2.672	1472.9	-103.89	326.1	27.6	7.396					1.640				
12.000	1.534	129.128	2.323	1422.5	-105.59	329.3	26.1	7.964					1.667				
13.000	1.584	146.146	2.053	1378.0	-107.00	332.1	24.6	8.489					1.694				
14.000	1.634	163.121	1.839	1338.3	-108.24	334.6	23.1	8.964					1.721				
15.000	1.684	179.967	1.667	1302.5	-109.36	336.8	21.6	9.396					1.748				
16.000	1.734	196.750	1.509	1270.0	-110.38	338.7	20.1	9.784					1.775				
17.000	1.784	213.921	1.370	1240.1	-111.31	340.4	18.6	10.136					1.802				
18.000	1.834	231.617	1.252	1212.8	-112.16	341.9	17.1	10.454					1.829				
19.000	1.884	249.740	1.151	1187.5	-112.94	343.2	15.6	10.736					1.856				
20.000	1.934	268.151	1.063	1164.0	-113.67	344.4	14.1	11.000					1.883				
21.000	1.984	286.878	0.987	1142.1	-114.34	345.4	12.6	11.244					1.910				
22.000	2.034	305.718	0.921	1121.7	-114.97	346.3	11.1	11.476					1.937				
23.000	2.084	324.625	0.863	1102.5	-115.56	347.1	9.6	11.696					1.964				
24.000	2.134	343.570	0.812	1084.5	-116.11	347.8	8.1	11.900					1.991				
25.000	2.184	362.547	0.766	1067.5	-116.63	348.4	6.6	12.096					2.018				
26.000	2.234	381.545	0.726	1051.4	-117.13	348.9	5.1	12.284					2.045				
27.000	2.284	400.562	0.690	1036.2	-117.59	349.3	3.6	12.464					2.072				
28.000	2.334	419.599	0.659	1021.7	-118.03	349.6	2.1	12.636					2.099				
29.000	2.384	438.656	0.619	1007.9	-118.45	349.8	0.6	12.800					2.126				
30.000	2.434	457.733	0.588	994.7	-118.85	350.0	0.0	12.956					2.153				
31.000	2.484	476.829	0.559	982.2	-119.23	350.1	0.0	13.104					2.180				
32.000	2.534	495.944	0.532	970.2	-119.58	350.2	0.0	13.244					2.207				
33.000	2.584	515.079	0.506	958.7	-119.94	350.2	0.0	13.376					2.234				
34.000	2.634	534.233	0.486	947.6	-120.28	350.2	0.0	13.500					2.261				
35.000	2.684	553.406	0.465	937.0	-120.60	350.2	0.0	13.616					2.288				
36.000	2.734	572.597	0.446	926.9	-120.90	350.1	0.0	13.724					2.315				
37.000	2.784	591.806	0.428	917.1	-121.19	350.1	0.0	13.824					2.342				
38.000	2.834	611.033	0.412	907.6	-121.48	350.1	0.0	13.916					2.369				
39.000	2.884	630.279	0.396	898.5	-121.76	350.0	0.0	14.000					2.396				
40.000	2.934	649.544	0.382	889.8	-122.02	350.0	0.0	14.080					2.423				
41.000	2.984	668.829	0.369	881.3	-122.27	350.0	0.0	14.156					2.450				
42.000	3.034	688.133	0.357	873.1	-122.52	349.9	0.0	14.224					2.477				
43.000	3.084	707.456	0.345	865.2	-122.76	349.9	0.0	14.288					2.504				
44.000	3.134	726.797	0.334	857.5	-122.99	349.8	0.0	14.344					2.531				
45.000	3.184	746.156	0.324	850.0	-123.21	349.8	0.0	14.396					2.558				
46.000	3.234	765.533	0.314	842.8	-123.42	349.7	0.0	14.444					2.585				
47.000	3.284	784.929	0.305	835.8	-123.63	349.6	0.0	14.488					2.612				
48.000	3.334	804.344	0.297	829.0	-123.84	349.5	0.0	14.528					2.639				
49.000	3.384	823.779	0.289	822.4	-124.03	349.4	0.0	14.564					2.666				
50.000	3.434	843.233	0.282	815.9	-124.22	349.3	0.0	14.596					2.693				
51.000	3.484	862.706	0.272	809.7	-124.41	349.2	0.0	14.624					2.720				
52.000	3.534	882.197	0.264	803.3	-124.59	349.1	0.0	14.648					2.747				
53.000	3.584	901.706	0.256	796.7	-124.76	349.0	0.0	14.668					2.774				
54.000	3.634	921.233	0.248	790.0	-124.92	348.9	0.0	14.684					2.801				
55.000	3.684	940.779	0.240	783.1	-125.08	348.8	0.0	14.696					2.828				
56.000	3.734	960.344	0.232	776.1	-125.24	348.7	0.0	14.704					2.855				
57.000	3.784	979.929	0.224	769.0	-125.39	348.6	0.0	14.712					2.882				
58.000	3.834	999.533	0.216	761.9	-125.54	348.5	0.0	14.716					2.909				
59.000	3.884	1019.156	0.208	754.8	-125.68	348.4	0.0	14.712					2.936				
60.000	3.934	1038.797	0.200	747.7	-125.82	348.3	0.0	14.696					2.963				
61.000	3.984	1058.456	0.192	740.6	-125.96	348.2	0.0	14.676					2.990				
62.000	4.034	1078.133	0.184	733.5	-126.09	348.1	0.0	14.648					3.017				
63.000	4.084	1097.829	0.176	726.4	-126.22	348.0	0.0	14.616					3.044				
64.000	4.134	1117.544	0.168	719.3	-126.35	347.9	0.0	14.576					3.071				
65.000	4.184	1137.279	0.160	712.2	-126.48	347.8	0.0	14.536					3.098				
66.000	4.234	1157.033	0.152	705.1	-126.60	347.7	0.0	14.488					3.125				
67.000	4.284	1176.806	0.144	698.0	-126.72	347.6	0.0	14.436					3.152				
68.000	4.334	1196.597	0.136	690.9	-126.84	347.5	0.0	14.376					3.179				
69.000	4.384	1216.370	0.128	683.8	-126.96	347.4	0.0	14.312					3.206				
70.000	4.434	1236.143	0.120	676.7	-127.08	347.3	0.0	14.244					3.233				
71.000	4.484	1255.916	0.112	669.6	-127.20	347.2	0.0	14.176					3.260				
72.000	4.534	1275.689	0.104	662.5	-127.32	347.1	0.0	14.104					3.287				
73.000	4.584	1295.462	0.096	655.4	-127.44	347.0	0.0	14.032					3.314				
74.000	4.634	1315.235	0.088	648.3	-127.56	346.9	0.0	13.960					3.341				
75.000	4.684	1335.008	0.080	641.2	-127.68	346.8	0.0	13.888					3.368				
76.000	4.734	1354.781	0.072	634.1	-127.80	346.7	0.0	13.816					3.395				
77.000	4.784	1374.554	0.064	627.0	-127.92	346.6	0.0	13.744					3.422				
78.000	4.834	1394.327	0.056	620.0	-128.04	346.5	0.0	13.672					3.449				
79.000	4.884	1414.100	0.048	612.9	-128.16	346.4	0.0	13.600					3.476				
80.000	4.934	1433.873	0.040	605.8	-128.28	346.3	0.0	13.528					3.503				
81.000	4.984	1453.646	0.032	598.7	-128.40	346.2	0.0	13.456					3.530				
82.000	5.034	1473.419	0.024	591.6	-128.52	346.1	0.0	13.384					3.557				
83.000	5.084	1493.192	0.016	584.5	-128.64	346.0	0.0	13.312					3.584				
84.000	5.134	1512.965	0.008	577.4	-128.76	345.9	0.0	13.240					3.611				
85.000	5.184	1532.738	0.000	570.3	-128.88	345.8	0.0	13.168					3.638				
86.000	5.234	1552.511	0.000	563.2	-129.00	345.7	0.0	13.096					3.665				
87.000	5.284	1572.284	0.000	556.1	-129.12	345.6	0.0	13.024					3.692				
88.000</																	

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N_2H_4 - B_5H_9 SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT MC 1000 PSIA PE 0.1 PSIA
 COMPONENT REF FORMULA DENSITY HEAT FORM WT. %
 LEU K
 298 N2O4 1.004 +17.05 54.
 298 H5FH 0.620 +1.74 45.

G/LK DENSITY = .771 GM/CC
 MIXTURE RATIO = 1.174 LB OXIDIZER / LB OF FILL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 552.22 EU/100GMS

CHAMBER THRUST

	1000	598.1	158.5	64.10	25.12	14.70	10.00	5.291	1.585	.631	.251	.100	571.5
PRESSURE, PSIA	1000	598.1	158.5	64.10	25.12	14.70	10.00	5.291	1.585	.631	.251	.100	571.5
TEMP, DEG K	2732.5	2423.1	2152.7	1896.1	1666.0	1543.3	1459.2	1275.2	1107.2	962.4	831.0	714.1	2543.5
ENTHALPY (-)	-25.74	5.70	33.74	58.56	87.38	116.27	145.94	176.27	208.70	243.57	280.58	319.05	-6.27
CP	1.0076	.9924	.9753	.9571	.9385	.9200	.9015	.8834	.8654	.8474	.8293	.8112	.7937
IMPUL OPT	155.90	277.26	271.12	264.12	257.08	250.08	243.15	236.27	229.43	222.63	215.87	209.14	150.82
IMPUL VAC	250.54	272.61	311.65	335.87	348.02	355.22	357.60	359.17	359.87	359.56	358.23	356.87	243.46
EPSILON	1.077	1.752	3.258	6.411	9.645	12.990	16.269	19.573	22.803	25.965	29.063	32.100	1.000

	1000	598.1	158.5	64.10	25.12	14.70	10.00	5.291	1.585	.631	.251	.100	575.2
PRESSURE, PSIA	1000	598.1	158.5	64.10	25.12	14.70	10.00	5.291	1.585	.631	.251	.100	575.2
TEMP, DEG K	2732.5	2421.0	2224.9	1989.9	1756.2	1610.7	1525.1	1335.4	1165.3	1013.2	877.4	756.4	2586.2
ENTHALPY (-)	-25.74	5.99	34.83	60.14	87.65	116.50	147.48	179.25	212.05	246.28	282.75	320.67	-6.40
X HAK	6.703	6.684	6.651	6.647	6.647	6.647	6.647	6.647	6.647	6.647	6.647	6.647	6.675
N	10.308	10.287	10.264	10.245	10.226	10.207	10.187	10.167	10.147	10.127	10.107	10.087	10.293
CP	1.0049	1.1998	1.0414	.9824	.9212	.8567	.7911	.7257	.6603	.5957	.5313	.4664	1.3270
IMPUL OPT	166.67	229.55	273.65	307.37	329.68	346.23	356.13	364.23	369.50	373.45	376.13	377.36	130.36
IMPUL VAC	252.43	275.78	315.02	337.22	352.28	360.45	367.60	372.12	374.26	374.87	374.07	372.07	244.88
EPSILON	1.083	1.769	3.228	6.492	9.746	13.167	16.222	19.269	22.269	25.151	27.943	30.640	1.000

	1000	598.1	158.5	64.10	25.12	14.70	10.00	5.291	1.585	.631	.251	.100	575.2
PRESSURE, PSIA	1000	598.1	158.5	64.10	25.12	14.70	10.00	5.291	1.585	.631	.251	.100	575.2
TEMP, DEG K	2732.5	2421.0	2224.9	1989.9	1756.2	1610.7	1525.1	1335.4	1165.3	1013.2	877.4	756.4	2586.2
ENTHALPY (-)	-25.74	5.99	34.83	60.14	87.65	116.50	147.48	179.25	212.05	246.28	282.75	320.67	-6.40
X HAK	6.703	6.684	6.651	6.647	6.647	6.647	6.647	6.647	6.647	6.647	6.647	6.647	6.675
N	10.308	10.287	10.264	10.245	10.226	10.207	10.187	10.167	10.147	10.127	10.107	10.087	10.293
CP	1.0049	1.1998	1.0414	.9824	.9212	.8567	.7911	.7257	.6603	.5957	.5313	.4664	1.3270
IMPUL OPT	166.67	229.55	273.65	307.37	329.68	346.23	356.13	364.23	369.50	373.45	376.13	377.36	130.36
IMPUL VAC	252.43	275.78	315.02	337.22	352.28	360.45	367.60	372.12	374.26	374.87	374.07	372.07	244.88
EPSILON	1.083	1.769	3.228	6.492	9.746	13.167	16.222	19.269	22.269	25.151	27.943	30.640	1.000

COMPOSITION SHIFTING (G/LK GM)

	1000	598.1	158.5	64.10	25.12	14.70	10.00	5.291	1.585	.631	.251	.100	575.2
122.60 H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 H+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 H+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 H+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.20 H3+H4+N3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
79.20 H+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 H3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 B/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-60.30 H+N/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA PL 0.1 PSIA
COMPONENT TRF FORMULA DENSITY HEAT FLOW WT. 0/0
LEG K CM/CC (KCAL/FHMM.WT.)
298 N2+H4 1.004 +12.05 56.
298 H5+H9 0.620 +7.74 44.

FULK DENSITY = .774 GM/CC
MIXTURE RATIO = 1.275 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 354.71 EU/100GMS

CHAMBER

THRUST

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.4
PRESSURE, PSIA	2801.7	2475.7	2187.3	1924.4	1689.1	1563.8	1478.6	1290.2	1121.9	971.8	838.2	717.5	2599.4
TEMP, DEG K	-26.45	5.98	34.62	59.89	82.09	93.72	101.53	118.55	133.37	146.22	157.34	166.91	-6.26
ENTHALPY (-)	1.0074	.9873	.9698	.9520	.9337	.9233	.9141	.8911	.8683	.8444	.8193	.7914	.9929
CP	167.95	230.49	274.05	307.27	323.52	333.08	335.16	372.86	387.57	399.05	410.13	420.32	132.52
IMPUL OPT	253.60	245.63	214.85	189.21	151.42	119.43	97.26	390.34	402.14	412.63	420.32	246.40	
IMPUL VAC	1.079	1.744	3.242	6.375	9.587	12.908	20.582	35.302	115.760	243.167	511.007	1.000	
EPSILON													

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
PRESSURE, PSIA	2801.7	2552.3	2249.1	2028.7	1788.5	1659.1	1571.1	1375.7	1200.4	1043.9	904.2	779.8	2659.5
TEMP, DEG K	-26.45	6.37	35.91	62.14	85.30	97.48	105.67	123.55	139.17	152.78	164.59	174.80	-6.47
ENTHALPY (-)	6.721	6.662	6.645	6.638	6.636	6.635	6.635	6.635	6.635	6.635	6.635	6.635	6.681
X BAR	10.163	10.125	10.122	10.120	10.118	10.118	10.118	10.118	10.118	10.118	10.118	10.118	10.137
N	1.0233	1.3512	1.0070	.9878	.9509	.9334	.9207	.9026	.8804	.8573	.8331	.8071	1.5471
CP	169.02	232.71	277.60	311.78	328.34	339.02	341.22	372.57	394.86	407.66	418.42	429.11	131.84
IMPUL OPT	256.20	249.47	219.54	184.69	157.32	119.60	97.07	397.71	410.02	420.59	429.11	248.36	
IMPUL VAC	1.085	1.766	3.295	6.493	9.776	13.176	27.198	56.733	119.126	251.035	529.831	1.000	
EPSILON													

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
PRESSURE, PSIA	2801.7	2552.3	2249.1	2028.7	1788.5	1659.1	1571.1	1375.7	1200.4	1043.9	904.2	779.8	2659.5
TEMP, DEG K	-26.45	6.37	35.91	62.14	85.30	97.48	105.67	123.55	139.17	152.78	164.59	174.80	-6.47
ENTHALPY (-)	6.721	6.662	6.645	6.638	6.636	6.635	6.635	6.635	6.635	6.635	6.635	6.635	6.681
X BAR	10.163	10.125	10.122	10.120	10.118	10.118	10.118	10.118	10.118	10.118	10.118	10.118	10.137
N	1.0233	1.3512	1.0070	.9878	.9509	.9334	.9207	.9026	.8804	.8573	.8331	.8071	1.5471
CP	169.02	232.71	277.60	311.78	328.34	339.02	341.22	372.57	394.86	407.66	418.42	429.11	131.84
IMPUL OPT	256.20	249.47	219.54	184.69	157.32	119.60	97.07	397.71	410.02	420.59	429.11	248.36	
IMPUL VAC	1.085	1.766	3.295	6.493	9.776	13.176	27.198	56.733	119.126	251.035	529.831	1.000	
EPSILON													

COMPOSITION SHIFTING (MOL/100 GPM)

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
PRESSURE, PSIA	2801.7	2552.3	2249.1	2028.7	1788.5	1659.1	1571.1	1375.7	1200.4	1043.9	904.2	779.8	2659.5
TEMP, DEG K	-26.45	6.37	35.91	62.14	85.30	97.48	105.67	123.55	139.17	152.78	164.59	174.80	-6.47
ENTHALPY (-)	6.721	6.662	6.645	6.638	6.636	6.635	6.635	6.635	6.635	6.635	6.635	6.635	6.681
X BAR	10.163	10.125	10.122	10.120	10.118	10.118	10.118	10.118	10.118	10.118	10.118	10.118	10.137
N	1.0233	1.3512	1.0070	.9878	.9509	.9334	.9207	.9026	.8804	.8573	.8331	.8071	1.5471
CP	169.02	232.71	277.60	311.78	328.34	339.02	341.22	372.57	394.86	407.66	418.42	429.11	131.84
IMPUL OPT	256.20	249.47	219.54	184.69	157.32	119.60	97.07	397.71	410.02	420.59	429.11	248.36	
IMPUL VAC	1.085	1.766	3.295	6.493	9.776	13.176	27.198	56.733	119.126	251.035	529.831	1.000	
EPSILON													

SYSTEM LELUO BIPROPELLANT										PC 1000. PSIA		PE 0.1 PSIA	
COMPONENT										DENSITY		PLAT FORM	
REF FORMULA										W/CC		W/CC	
LEW K										1.004		+17.05	
298 N2H4										0.670		+17.74	
298 B5H9												44.	
FROZEN EXPANSION													
C STAR + 6N17.1 FT/SEC													
CP CAL / I OPT DELVAC LELVAC										I SEA I AT		I VAC	
LVL										I AT		CF SEA CF VAC	
10000										50000		LVL	
EPSILON													
P/CP													
P PSIA													
LEW K													
1000.000													
1.750													
1.225													
1.125													
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PRESSURE PROFILE DATA
 SYSTEM LIQUID HIPROPELLANT PC 1000, PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FCKR WT. C/O
 CEG K GM/CC (KCAL/FORM.WT.)
 29H N2*H4 1.004 +12.05 5H.
 29H H5*H9 0.620 +7.74 42.

FULK DENSITY = .797 GM/CC
 MIXTURE RATIO = 1.381 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 556.37 ENT/100GMS

CHAMBER

THROAT

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.7
PRESSURE, PSIA	2799.0	2467.4	2170.4	1904.6	1667.1	1540.9	1455.2	1265.9	1097.2	947.2	814.1	696.1	2592.7
TEMP, DEG K	-26.95	5.77	34.54	59.91	82.09	93.70	101.49	118.59	133.06	145.76	156.70	166.08	-6.53
ENTHALPY (-)	.9946	.9792	.9612	.9431	.9245	.9159	.9045	.8913	.8753	.8581	.8407	.8225	.9847
CP	168.72	231.37	274.88	307.99	325.97	334.27	335.58	333.10	327.62	319.70	309.79	297.79	133.29
IMPUL OPT	254.65	286.49	315.54	339.40	351.92	359.85	366.50	370.38	371.98	371.67	369.77	367.58	247.58
IMPUL VAC	1.078	1.737	3.222	6.322	9.495	12.772	16.236	20.440	25.628	31.795	38.947	47.000	1.000
EPSILON													

SHIFTING EXPANSION

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	573.5
PRESSURE, PSIA	2799.0	2503.6	2216.0	1953.6	1713.7	1585.5	1498.5	1305.5	1133.3	980.1	844.0	724.2	2620.4
TEMP, DEG K	-26.95	5.97	35.21	61.01	85.68	95.54	103.52	120.84	135.90	148.96	160.22	169.91	-6.61
ENTHALPY (-)	6.797	6.776	6.765	6.761	6.759	6.759	6.757	6.759	6.759	6.759	6.759	6.759	6.783
X BAR	10.095	10.095	10.089	10.085	10.084	10.083	10.083	10.083	10.083	10.083	10.083	10.083	10.097
N	1.7610	1.0889	1.0066	.9619	.9341	.9149	.9102	.8860	.8635	.8394	.8150	.7875	1.1419
CP	169.24	232.55	276.63	310.22	328.43	336.90	338.56	336.39	331.19	323.52	313.83	302.02	133.02
IMPUL OPT	255.90	288.34	317.91	342.51	354.82	362.89	369.14	373.99	376.83	376.74	374.04	370.53	248.53
IMPUL VAC	1.081	1.747	3.248	6.340	9.508	12.902	16.552	20.515	25.199	30.561	36.700	43.700	1.000
EPSILON													

COMPOSITION SHIFTING (MOL/100 GM)

	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
132.6C B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
66.00 P*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
199.3C B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-124.2C B3*H6*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.1C F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
79.20 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.0C F2	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441	6.5441
40.3C F2*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-11.04 F3*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.0C H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.0C H2	.1604	.1500	.1479	.1477	.1476	.1476	.1476	.1476	.1476	.1476	.1476	.1476	.1523
-60.3C B*H/C	3.2983	3.3193	3.3236	3.3242	3.3243	3.3243	3.3243	3.3243	3.3243	3.3243	3.3243	3.3243	3.3143

SYSTEM LIQUID RHOPPELLANT										PC 1000, PSIA		PE 0.1 PSIA	
COMPONENT										DENSITY		HEAT FORM	
										G/CC		(KCAL/GRAM, BT.)	
										1.000		+12.05	
										0.020		+1.74	
										59.		59.	
										W2.		W2.	
										FROZEN EXPANSION			
										C STAR = 0.00012 FT/SEC			
										CP CAL/ I OPT UELVAC LELVAC		I SEA	
										I AT		I AT	
										10000		10000	
										I VAC		CF SEA	
										CF VAC		CF VAC	
										LVL		LVL	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPHOPPELLANT PC 1000. PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/D
 DEG K (M/CC) (KCAL/FORM.WT.)
 29H N2OH4 1.604 +12.05 60.
 29H H5OH9 0.620 +1.74 40.

BULK DENSITY = .805 GM/CC
 MIXTURE RATIO = 1.500 LH OXIDIZER / LH OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 357.77 EU/100GMS

CHAMBER

THROAT

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.4
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.4
TEMP, DEG K	2742.8	2409.3	2111.5	1845.6	1608.9	1483.3	1328.2	1210.6	1044.1	896.6	766.3	651.3	2334.5
ENTHALPY (-)	-27.46	5.10	33.65	58.65	80.47	71.85	99.47	115.95	130.14	142.44	152.75	161.70	-7.06
CP	.9842	.9681	.9498	.9108	.9117	.8998	.8896	.8667	.8432	.8188	.7923	.7636	.9738
IMPUL OPT	168.29	230.56	273.69	306.41	322.17	332.22	353.20	370.32	384.45	396.16	405.17	413.21	246.90
IMPUL VAC	253.84	285.29	313.99	337.79	349.68	357.43	373.64	387.17	394.59	407.71	415.45	424.90	246.90
EPSILON	1.076	1.729	3.199	6.256	9.376	12.593	25.765	53.239	110.621	230.469	440.250	1.000	

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
TEMP, DEG K	2742.8	2435.4	2145.6	1880.5	1641.4	1514.7	1428.5	1248.3	1067.3	919.4	787.0	669.9	2354.0
ENTHALPY (-)	-27.46	5.24	34.10	59.45	81.61	73.18	100.92	117.70	132.21	144.72	155.45	164.61	-7.13
X BAR	6.912	6.895	6.887	6.884	6.883	6.883	6.883	6.883	6.883	6.883	6.883	6.883	6.900
N	10.064	10.059	10.053	10.050	10.047	10.044	10.044	10.044	10.044	10.044	10.044	10.044	10.061
CP	1.1621	1.0444	.9807	.9426	.9167	.9041	.8936	.8701	.8464	.8224	.7967	.7686	1.0413
IMPUL OPT	168.67	231.42	274.96	307.02	323.95	334.17	355.35	372.67	387.02	394.89	405.77	413.97	247.59
IMPUL VAC	254.74	286.62	315.66	339.74	351.78	359.63	376.09	389.76	401.15	410.63	418.12	427.59	247.59
EPSILON	1.078	1.737	3.217	6.293	9.442	12.666	25.977	53.725	111.745	233.100	446.345	1.000	

	132.60 B	114.76 B+F	66.00 B+F2	18.00 B+F3	199.30 B2	-124.20 B3+F6+N3	52.10 F	79.20 F+N	.00 F2	40.30 F2+N	-11.04 F3+N	113.00 N	.00 N2	-60.30 B+N/C
COMPOSITION, SHIFTING (MOL/100 GM)	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0047	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0090	.0018	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0541	.0242	.0084	.0022	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	6.5475	6.5780	6.5849	6.5924	6.5934	6.5936	6.5936	6.5936	6.5936	6.5936	6.5936	6.5936	6.5936	6.5936
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.0006	.0003	.0002	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001
	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
	.2958	.2902	.2892	.2892	.2892	.2892	.2892	.2892	.2892	.2892	.2892	.2892	.2892	.2892
	3.1521	3.1637	3.1657	3.1659	3.1660	3.1660	3.1660	3.1660	3.1660	3.1660	3.1660	3.1660	3.1660	3.1660

SYSTEM LIQUID BIHOPPELLANT										PC 1000, PSIA		PE U-1 PSIA	
COMPONENT										DENSITY		HEAT FPNH	
LEG K										W/CC		(KCAL/POUN.WT.)	
200 H20H4										1.004		41.05	
200 H20H0										0.020		41.05	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I AT		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	
200 H20H0										I SEI		I VAC	
FROZEN EXPANSION										C STAR = 0.423.7 FT/SEC		I AT	
C STAR = 0.423.7 FT/SEC										I SEI		I VAC	
Epsilon										I SEI		I VAC	
PC/P										I SEI		I VAC	
P PSIA										I SEI		I VAC	
TEMP										I SEI		I VAC	
ENTHALPY										I SEI		I VAC	
CP CAL/ I OPT DELVAC										I SEI		I VAC	
LEG K										I SEI		I VAC	
200 H20H4										I SEI		I VAC	

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Ford Motor Company,
AERONUTRONIC DIVISION

N_2O_4 - N_2H_4 SYSTEM

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. O/F
29H	N2*O4	1.43	-5.4	40.
29B	N2*H4	1.004	12.05	60.

BULK DENSITY = 1.140 GM/CC
MIXTURE RATIO = .627 LB OXIDIZER / LB OF FUEL

PROF. PROFILE DATA

CHAMBER ENTROPY 316.55 EU/100GMS

	CHAMBER												THROAT
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	551.6
TEMP, DEG K	2564.1	2125.5	1750.4	1430.1	1157.3	1018.5	927.2	735.6	578.7	452.4	352.8	273.2	2273.0
ENTHALPY (-)	-20.21	5.73	27.17	44.76	59.06	66.08	70.58	79.77	87.03	92.73	97.15	100.65	-2.91
CP	.6000	.5819	.5606	.5366	.5120	.4985	.4890	.4700	.4558	.4469	.4412	.4374	.5884
IMPUL OPT		150.23	203.03	237.74	262.62	273.99	281.06	294.93	305.45	313.46	319.54	324.27	122.70
IMPUL VAC		224.34	248.19	269.25	285.70	293.46	298.34	308.00	315.38	321.02	325.33	328.68	219.74
EPSILON		1.058	1.620	2.839	5.224	7.532	9.823	18.655	35.598	64.118	130.873	250.867	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	552.8
TEMP, DEG K	2564.1	2138.2	1764.0	1442.3	1167.9	1028.2	936.3	743.5	586.1	463.6	384.7	339.1	2284.5
ENTHALPY (-)	-20.21	5.80	27.36	45.07	59.49	66.56	71.10	80.37	87.70	93.47	98.07	101.92	-2.93
X BAR	6.059	6.052	6.051	6.051	6.051	6.051	6.051	6.050	6.047	6.026	5.931	5.765	6.054
N	6.059	6.052	6.051	6.051	6.051	6.051	6.051	6.050	6.047	6.026	5.931	5.765	6.054
CP	.6439	.5928	.5628	.5376	.5130	.4995	.4901	.4721	.4651	.4526	.4421	1.5653	.6070
IMPUL OPT		150.44	203.44	238.32	263.32	274.75	281.85	295.81	306.40	314.49	320.79	325.96	122.63
IMPUL VAC		224.81	248.81	269.98	286.52	294.33	299.23	308.96	316.40	322.17	326.93	331.15	220.13
EPSILON		1.059	1.623	2.845	5.237	7.552	9.852	18.720	35.769	69.009	138.773	293.987	1.000

COMPOSITION SHIFTING (MOL/100 GM)													
52.10	H	.0139	.0026	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0050
79.20	H=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00	H=N=O	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
9.33	H=O	.0028	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007
.00	H2	1.9998	2.0040	2.0051	2.0052	2.0052	2.0051	2.0049	2.0040	1.9994	1.9682	1.8254	2.0030
40.30	H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80	H2=O	1.7355	1.7385	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7380
-11.04	H3=N	.0004	.0003	.0002	.0002	.0002	.0003	.0004	.0010	.0249	.1201	.2860	.0003
113.00	N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65	N=O	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
8.06	N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00	N2	2.3064	2.3067	2.3068	2.3068	2.3068	2.3067	2.3067	2.3064	2.2945	2.2469	2.1639	2.3067
19.50	N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56	O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00	O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.5 PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FURN	WT. Q/D										
					DEG K	GA/CC	TREAL/FORN.WT.1							
298 N2+OH		1.43	-5.4	40.										
298 N2+NH		1.004	12.05	60.										
FROZEN EXPANSION														
C STAR = 5440.2 FT/SEC														
EPILION	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GN DEG		/P	/P	LVL	10000	50000		LVL	
1.000	1.000	1000.000	2544.1	20.21	.000									
2.000	9.779	102.259	1613.0	-34.83	.551	219.4	37.8	.370	217.2	217.9	219.4	219.7	1.234	1.249
3.000	17.378	57.586	1602.4	-46.23	.536	240.4	30.5	.531	263.2	265.5	270.1	271.0	1.498	1.580
4.000	27.445	36.411	1246.9	-53.29	.522	252.9	26.2	.720	268.6	271.8	277.9	279.2	1.527	1.587
5.000	37.581	26.409	1174.9	-60.16	.516	261.1	23.4	.885	271.7	275.6	283.2	284.7	1.544	1.618
6.000	48.983	20.415	1102.8	-61.84	.507	267.2	21.6	1.059	273.2	277.9	287.0	288.6	1.553	1.642
7.000	61.301	16.313	1045.0	-64.75	.501	271.9	20.1	1.234	273.9	279.3	289.9	292.0	1.557	1.660
8.000	74.344	13.451	997.1	-67.14	.498	275.7	18.9	1.409		280.2	292.2	294.6	1.561	1.675
9.000	88.232	11.334	956.4	-69.15	.492	278.8	18.0	1.585		280.5	294.7	296.8	1.567	1.687
10.000	102.663	9.741	921.3	-70.87	.488	281.5	17.1	1.760			295.6	298.6	1.569	1.698
11.000	118.194	8.461	890.5	-72.37	.485	283.8	16.4	1.942			296.9	300.2	1.570	1.707
12.000	134.619	7.439	863.2	-73.70	.482	285.8	15.8	2.126			298.0	301.7	1.571	1.715
13.000	151.708	6.613	839.7	-74.88	.480	287.6	15.3	2.308			299.0	303.0	1.572	1.722
14.000	168.451	5.937	816.5	-75.94	.478	289.2	14.8	2.490			299.7	304.0	1.574	1.728
15.000	185.867	5.377	794.4	-76.90	.476	290.7	14.3	2.666			300.5	305.0	1.574	1.734
16.000	203.707	4.909	774.0	-77.77	.474	292.0	14.0	2.844			301.1	305.9	1.574	1.739
17.000	221.559	4.513	761.0	-78.58	.472	293.3	13.6	3.012			301.6	306.8	1.574	1.744
18.000	239.458	4.176	745.3	-79.32	.471	294.5	13.3	3.177			302.1	307.5	1.574	1.746
19.000	256.200	3.873	730.7	-80.00	.470	295.3	13.0	3.347			302.5	308.2	1.572	1.752
20.000	274.900	3.586	717.0	-80.64	.468	296.2	12.7	3.516			302.9	308.9	1.570	1.756
21.000	300.097	3.332	704.3	-81.24	.467	297.1	12.4	3.678			303.2	309.5	1.570	1.759
22.000	321.313	3.108	692.3	-81.80	.466	297.9	12.2	3.834			303.4	310.1	1.568	1.763
23.000	343.739	2.909	681.0	-82.32	.465	298.7	11.9	4.005			303.6	310.6	1.566	1.766
24.000	366.041	2.732	670.4	-82.82	.464	299.4	11.7	4.293			303.8	311.1	1.564	1.769
25.000	388.635	2.573	660.3	-83.29	.463	300.1	11.5	4.679			304.0	311.6	1.562	1.771
26.000	411.402	2.431	650.8	-83.73	.462	300.7	11.3	5.065			304.1	312.0	1.560	1.774
27.000	434.308	2.303	641.7	-84.15	.461	301.3	11.2	5.451			304.2	312.5	1.558	1.776
28.000	457.301	2.187	633.1	-84.54	.460	301.9	11.0	5.822			304.3	312.9	1.556	1.778
29.000	480.334	2.082	624.9	-84.92	.460	302.4	10.8	6.198			304.4	313.3	1.554	1.781
30.000	503.366	1.987	617.0	-85.28	.459	303.0	10.7	6.569			304.5	313.6	1.552	1.783
31.000	526.360	1.900	609.5	-85.63	.458	303.5	10.5	6.937			304.5	314.0	1.550	1.785
32.000	549.289	1.821	602.3	-85.94	.458	303.9	10.4	7.302			304.6	314.3	1.548	1.787
33.000	572.129	1.748	595.4	-86.27	.457	304.4	10.2	7.666			304.6	314.6	1.546	1.788
34.000	594.864	1.681	588.8	-86.57	.457	304.8	10.1	8.019			304.9	314.9	1.544	1.790
35.000	617.484	1.619	582.4	-86.84	.456	305.2	10.0	8.372			305.0	315.2	1.542	1.792
36.000	641.025	1.559	576.3	-87.14	.456	305.6	9.9	8.738			305.1	315.5	1.540	1.793
37.000	664.432	1.496	570.4	-87.41	.455	306.0	9.8	9.107			305.2	315.8	1.538	1.795
38.000	688.601	1.438	564.7	-87.67	.455	306.4	9.7	9.476			305.3	316.0	1.536	1.796
39.000	723.111	1.383	559.2	-87.92	.454	306.7	9.5	9.805			305.3	316.3	1.534	1.798
40.000	750.962	1.332	553.9	-88.17	.454	307.1	9.4	10.095			305.4	316.5	1.532	1.799
41.000	779.071	1.284	548.7	-88.40	.453	307.4	9.3	10.384			305.4	316.7	1.530	1.800
42.000	807.478	1.238	543.7	-88.62	.453	307.7	9.3	10.673			305.5	317.0	1.528	1.802
43.000	836.182	1.194	538.9	-88.84	.453	308.0	9.2	10.962			305.5	317.2	1.526	1.803
44.000	865.038	1.152	534.3	-89.05	.452	308.3	9.1	11.251			305.6	317.4	1.524	1.804
45.000	894.150	1.118	529.7	-89.26	.452	308.6	9.0	11.539			305.6	317.6	1.522	1.805
46.000	923.452	1.083	525.3	-89.44	.452	308.9	8.9	11.826			305.7	317.8	1.520	1.806
47.000	952.926	1.049	521.1	-89.65	.451	309.2	8.8	12.112			305.7	318.0	1.518	1.808
48.000	982.564	1.018	516.8	-89.84	.451	309.5	8.7	12.397			305.8	318.2	1.516	1.809
49.000	1012.298	.988	512.9	-89.99	.451	309.7	8.7	12.681			305.8	318.4	1.514	1.810
50.000	1042.141	.960	509.0	-90.20	.451	309.9	8.6	12.964			305.9	318.5	1.512	1.811
7.532	68.046	14.696	1018.5	-66.08	.498	274.0	19.5	1.325	274.0	279.9	291.2	293.5	1.557	1.668

SHIFTING EXPANSION

C STAR = 5475.4 FT/SEC														
EPILION	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GN DEG		/P	/P	LVL	10000	50000		LVL	
1.000	1.809	1000.000	2504.1	2.93	.644									
1.000	1.809	552.754	2284.5	2.01	.607	122.4	87.5	.176	217.5	218.3	219.8	220.1	1.248	1.233
2.000	9.740	102.644	1627.4	-35.01	.552	219.8	38.0	.370	252.3	254.0	257.2	257.8	1.431	1.461
3.000	17.319	57.742	1615.7	-46.50	.535	240.9	30.7	.532	263.8	266.2	270.7	271.6	1.498	1.580
4.000	27.373	36.532	1281.3	-53.62	.526	251.5	26.9	.722	269.3	272.5	278.6	279.7	1.527	1.587
5.000	37.442	26.404	1184.4	-58.53	.515	261.7	23.7	.888	272.4	276.3	283.9	285.4	1.544	1.618
6.000	48.801	20.491	1114.0	-62.23	.508	267.8	21.8	1.062	274.0	278.7	287.8	289.4	1.553	1.642
7.000	61.071	16.374	1055.8	-65.17	.502	272.4	20.3	1.237	274.6	280.1	290.7	292.8	1.557	1.660
8.000	74.047	13.505	1007.6	-67.58	.497	275.8	19.1	1.412		280.3	293.0	295.8		1.675
9.000	87.874	11.380	964.7	-69.41	.493	279.5	18.1	1.590		283.1	294.9	297.4		1.687
10.000	102.225	9.782	931.4	-71.34	.490	282.2	17.3	1.765			296.5	299.5		1.698
11.000	117.675	8.498	900.3	-72.86	.488	284.6	16.5	1.947			297.8	301.1		1.701
12.000	133.817	7.473	872.8	-74.19	.486	286.4	15.9	2.131			298.9	302.5		1.712
13.000	150.521	6.644	848.2	-75.38	.484	288.5	15.4	2.315			299.8	303.8		1.722
14.000	167.640	5.944	825.9	-76.45	.479	290.0	14.9	2.497			300.6	304.9		1.728
15.000	185.111	5.402	805.6	-77.42	.477	291.5	14.5	2.678			301.3	305.9		1.734
16.000	202.767	4.932	787.0	-78.31	.476	292.8	14.1	2.851			302.0	306.8		1.739
17.000	220.536	4.534	769.9	-79.12	.474	294.0	13.7	3.021			302.5	307.7		1.744
18.000	238.352	4.195	754.1	-79.87	.473	295.1	13.4	3.186			303.0	308.4		1.749
19.000	256.045	3.903	739.4	-80.54	.472	296.1	13.1	3.355			303.4	309.2		1.752
20.000	277.420	3.605	725.7	-81.20	.470	297.0	12.8	3.525			303.8	309.8		1.756
21.000	298.691	3.350	712.8	-81.81	.468	297.9	12.5	3.695			304.1	310.4		1.760
22.000	319.997	3.125	700.8	-82.37	.467	298.7	12.3	3.825			304.3	311.0		1.763
23.000	341.876	2.925	689.4	-82.90	.466	299.5	12.0	4.015			304.5	311.6		1.766
24.000	364.008	2.747	678.7	-83.40	.465	300.2	11.8	4.203			304.7	312.1		1.768
25.000	386.512	2.567	668.4	-83.87	.464	300.9	11.6	4.400			304.9	312.5		1.772
26.000	409.187	2.444	659.0	-84.32	.463	301.6	11.4	4.675			305.0	313.0		1.774
27.000	431.919	2.315	649.8	-84.74	.463	302.2	11.2	4.957			305.1	313.4		1.777
28.000	454.674	2.174	641.1	-85.18	.463	302.8	11.0	5.219			305.2	313.8		1.780
29.000	477.444	2.094	633.0	-85.52	.463	303.3	10.9	5.212			305.3	314.2		1.781
30.000	500.551	1.998	625.2	-85.89	.463	303.8	10.8	5.385			305.4	314.6		1.783
31.000	523.392	1.911	617.7	-86.23	.463	304.3	10.6	5.556			305.5	314.9		1.785
32.000	546.151	1.831	610.5	-86.57	.463	304.8	10.5	5.720			305.6	315.3		1.788
33.000	568.927	1.755	603.7	-86.89	.463	305.2	10.3	5.881			305.7	315.8		1.789
34.000	591.379	1.691	597.1	-87.19	.464	305.7	10.2	6.039			305.9	315.9		1.791
35.000	613.802	1.629	590.8	-87.48	.465	306.1	10.1	6.193			306.1	316.2		1.792
36.000	637.033	1.570	584.7	-87.76	.465	306.5	10.0	6.353			306.3	316.5		1.794
37.000	659.577	1.515	578.8	-88.05	.466	306.9	9.9	6.516			306.5	316.7		1.796
38.000	690.472	1.468	573.1	-88.30	.466	307.2	9.7	6.732			306.7	317.0		1.797
39.000	717.898	1.393	567.6	-88.55	.465	307.6	9.6	6.922			306.9	317.3		1.799
40.000	745.233	1.342	562.4	-88.79	.465	307.9	9.5	7.112			307.1	317.5		1.800
41.000	773.054	1.293	557.3	-89.02	.465	308.2	9.4	7.303			307.3	317.7		1.801
42.000	801.140	1.248	552.3	-89.25	.465	308.6	9.4	7.493			307.5	318.0		1.802
43.000	829.487	1.206	547.4	-89.47	.466	309.0	9.3	7.683			307.8	318.2		1.804
44.000	858.012	1.165	543.0	-89.69	.467	309.2	9.2	7.872			307.9	318.4		1.805
45.000	886.792	1.125	538.7	-89.90	.467	309.5	9.1	8.062			308.1	318.6		1.806
46.000	915.645	1.092	534.3	-90.09	.469	309.6	9.0	8.250			308.2	318.8		1.807
47.000	944.729	1.059	530.1	-90.27	.470	310.1	8.9	8.437			308.3	319.0		1.808
48.000	973.920	1.027	526.1	-90.47	.471	310.3	8.9	8.624			308.4	319.2		1.809
49.000	1003.317	9.94	522.2	-90.66	.471	310.6	8.8	8.809			308.5	319.4		1.810
50.000	1032.599	9.68	518.3	-90.83	.472	310.8	8.7	8.993			308.6	319.5		1.811
1.552	88.044	14.096	1022.2	-64.54	.500	274.7	19.0	1.332	274.7	280.6	292.1	294.3	1.558	1.641

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. 070
298 N2O4		1.43	-5.4	48.
298 N2H4		1.004	12.05	52.

BULK DENSITY = 1.172 GM/CC
MIXTURE RATIO = .923 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 302.75 EU/100GMS

CHAMBER	THROAT													
	FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	554.9	
TEMP, DEG K	2959.7	2480.7	2068.7	1714.2	1409.4	1252.2	1147.8	925.4	738.4	584.0	458.5	358.8	2645.1	
ENTHALPY (-)	-16.73	10.21	32.75	51.49	66.96	74.64	79.62	89.89	98.12	104.66	109.82	113.84	1.04	
CP	.5694	.5554	.5381	.5183	.4957	.4818	.4724	.4494	.4309	.4162	.4065	.4006	.5605	
IMPUL OPT	153.11	207.49	243.63	269.83	281.95	289.53	304.56	316.10	324.98	331.81	337.04	342.35	124.35	
IMPUL VAC	229.10	254.25	276.63	294.33	302.78	308.12	318.81	327.06	333.41	338.29	342.04	342.12	224.12	
EPSILON	1.062	1.041	1.002	.9425	.8684	.8043	.7491	.68454	.61302	.54519	.47726	1.000		
	SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	559.4	
TEMP, DEG K	2959.7	2535.2	2134.4	1775.9	1464.3	1303.3	1196.2	967.3	774.2	614.0	473.9	375.0	2690.4	
ENTHALPY (-)	-16.73	10.46	33.48	52.73	68.64	76.62	81.77	92.41	100.97	107.79	113.14	117.42	.92	
X BAR	5.425	5.399	5.391	5.390	5.389	5.389	5.389	5.389	5.389	5.389	5.387	5.365	5.406	
N	5.425	5.399	5.391	5.390	5.389	5.389	5.389	5.389	5.389	5.389	5.387	5.365	5.406	
CP	.7334	.6150	.5545	.5236	.4994	.4859	.4761	.4552	.4437	.4187	.4156	.5054	.6513	
IMPUL OPT	153.81	209.02	245.84	272.59	284.98	292.73	308.14	320.00	329.14	346.19	341.63	123.94		
IMPUL VAC	230.75	256.61	279.49	297.62	306.29	311.77	322.77	331.27	337.83	342.89	346.86	225.40		
EPSILON	1.066	1.056	1.041	.9494	.8694	.8049	.7497	.68216	.6159	.54718	.478148	1.000		
	COMPOSITION SHIFTING (MOLE/100 GM)													
52.10 H	.0421	.0140	.0029	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0021	
79.20 H+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-10.00 H+N+O	.0018	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
9.33 H+O	.0251	.0056	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0105	
.00 H2	1.1554	1.1551	1.1574	1.1583	1.1585	1.1585	1.1584	1.1583	1.1578	1.1543	1.1218	1.1544		
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-57.80 H2+N	2.0551	2.0799	2.0858	2.0865	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0739	
-11.04 H3+N	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0001	.0001	.0005	.0028	.0245	.0001	
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
21.65 N+O	.0033	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011	
8.06 N+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 N2	2.1416	2.1437	2.1441	2.1442	2.1442	2.1442	2.1442	2.1442	2.1441	2.1440	2.1428	2.1320	2.1432	
19.50 N2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
59.56 O	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	
.00 O2	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	

SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I OPT	STAR = 5786.5 FT/SEC	DELTA VAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC
1.000	1.002	1000.000	2959.7	16.73	569	124.4	90.8	180	221.5	322.3	223.8	224.1	1.232
2.000	1.455	105.760	1920.5	-1.27	551	225.2	90.8	377	257.5	359.2	262.4	263.1	1.433
3.000	14.685	86.004	1497.5	-52.30	517	245.2	32.5	541	269.7	372.1	276.7	277.4	1.500
4.000	26.207	38.158	1550.1	-59.91	507	258.3	28.1	736	275.6	378.0	285.1	286.4	1.553
5.000	35.819	27.918	1645.7	-65.15	499	266.9	25.4	900	278.9	383.0	290.8	292.3	1.552
6.000	46.165	21.641	1685.3	-69.13	492	273.3	23.4	1081	280.9	385.6	294.9	296.7	1.562
7.000	57.407	17.359	1700.4	-72.31	486	278.3	21.9	1262	281.7	387.5	298.1	300.2	1.567
8.000	69.488	14.191	1726.4	-74.92	481	282.4	20.7	1439	283.5	390.6	303.1	305.1	1.568
9.000	82.262	12.159	1750.3	-77.13	477	285.8	19.7	1620	284.8	392.7	305.5	307.7	1.569
10.000	95.410	10.481	1760.4	-79.03	474	288.6	18.9	1799	286.0	394.6	307.5	309.4	1.570
11.000	108.298	9.149	1765.2	-80.49	470	291.1	18.1	1981	287.0	395.9	309.3	311.2	1.570
12.000	123.970	8.066	1769.9	-82.16	467	293.3	17.5	2168	287.9	397.1	310.8	312.9	1.571
13.000	139.174	7.185	1765.7	-83.87	464	295.3	16.9	2356	288.6	398.2	312.2	314.2	1.573
14.000	156.806	6.460	1760.1	-84.65	462	297.0	16.4	2542	289.1	399.1	313.4	315.4	1.573
15.000	170.744	5.856	1752.7	-85.73	459	298.8	15.9	2727	289.4	399.9	314.5	316.5	1.575
16.000	186.960	5.349	1745.1	-86.71	457	300.0	15.4	2909	290.0	400.6	315.6	317.5	1.575
17.000	203.305	4.919	1735.5	-87.62	455	301.3	15.2	3087	290.7	401.2	316.5	318.5	1.576
18.000	219.733	4.551	1724.1	-88.45	453	302.5	14.8	3260	291.0	401.7	317.3	319.3	1.576
19.000	236.191	4.234	1710.0	-89.23	451	303.6	14.5	3429	291.3	402.1	318.1	320.0	1.577
20.000	252.856	3.955	1694.0	-89.95	450	304.4	14.2	3597	291.5	402.4	318.9	320.7	1.577
21.000	271.679	3.681	1676.9	-90.62	448	305.6	13.9	3760	291.7	402.6	319.4	321.2	1.577
22.000	290.941	3.437	1658.8	-91.26	447	306.5	13.7	3918	291.8	402.7	320.2	321.8	1.578
23.000	310.578	3.220	1639.4	-91.85	445	307.4	13.4	4077	291.9	402.8	320.8	322.4	1.578
24.000	330.542	3.025	1618.7	-92.42	444	308.2	13.2	4230	292.0	402.9	321.4	322.9	1.578
25.000	350.787	2.851	1596.8	-92.95	443	308.9	13.0	4378	292.1	402.9	321.9	323.4	1.579
26.000	371.267	2.693	1573.4	-93.45	442	309.6	12.8	4523	292.1	402.9	322.4	323.9	1.579
27.000	391.936	2.551	1548.5	-93.93	441	310.3	12.6	4665	292.1	402.9	322.9	324.4	1.579
28.000	412.752	2.423	1522.2	-94.39	440	310.9	12.4	4804	292.1	402.9	323.4	324.9	1.579
29.000	433.672	2.306	1494.3	-94.82	439	311.5	12.3	4941	292.1	402.9	323.9	325.4	1.580
30.000	454.659	2.199	1464.9	-95.23	438	312.1	12.1	5076	292.1	402.9	324.4	325.9	1.580
31.000	475.678	2.102	1434.8	-95.63	437	312.7	11.9	5209	292.1	402.9	324.9	326.4	1.580
32.000	496.699	2.013	1404.1	-96.01	436	313.2	11.8	5341	292.1	402.9	325.4	326.9	1.580
33.000	517.693	1.932	1372.8	-96.37	435	313.7	11.7	5472	292.1	402.9	325.9	327.4	1.580
34.000	538.638	1.857	1340.8	-96.72	434	314.2	11.5	5602	292.1	402.9	326.4	327.9	1.581
35.000	559.516	1.787	1308.0	-97.05	433	314.6	11.4	5730	292.1	402.9	326.9	328.4	1.581
36.000	580.313	1.721	1274.6	-97.36	433	315.1	11.2	5857	292.1	402.9	327.4	328.9	1.581
37.000	601.018	1.664	1240.4	-97.69	432	315.5	11.1	5983	292.1	402.9	327.9	329.4	1.581
38.000	621.627	1.609	1205.5	-97.99	431	315.9	11.0	6108	292.1	402.9	328.4	329.9	1.581
39.000	642.138	1.552	1170.8	-98.28	431	316.3	10.9	6232	292.1	402.9	328.9	330.4	1.582
40.000	662.524	1.496	1135.3	-98.56	430	316.7	10.8	6355	292.1	402.9	329.4	330.9	1.582
41.000	682.801	1.443	1100.0	-98.83	429	317.1	10.7	6478	292.1	402.9	329.9	331.4	1.582
42.000	702.959	1.392	1064.9	-99.09	429	317.5	10.6	6599	292.1	402.9	330.4	331.9	1.582
43.000	722.994	1.345	1029.0	-99.34	428	317.8	10.5	6719	292.1	402.9	330.9	332.4	1.582
44.000	742.823	1.301	993.3	-99.59	428	318.1	10.4	6838	292.1	402.9	331.4	332.9	1.582
45.000	762.458	1.259	957.7	-99.82	427	318.4	10.3	6956	292.1	402.9	331.9	333.4	1.582
46.000	781.907	1.219	922.3	-100.05	426	318.7	10.2	7073	292.1	402.9	332.4	333.9	1.582
47.000	801.167	1.181	887.1	-100.28	426	319.1	10.1	7189	292.1	402.9	332.9	334.4	1.583
48.000	820.239	1.146	852.0	-100.50	425	319.4	10.0	7304	292.1	402.9	333.4	334.9	1.583
49.000	839.122	1.112	817.0	-100.71	425	319.6	9.9	7418	292.1	402.9	333.9	335.4	1.583
50.000	857.815	1.080	782.1	-100.91	425	319.9	9.9	7531	292.1	402.9	334.4	335.9	1.583
7.999	68.046	14.696	1252.2	-74.64	462	282.0	20.8	1417	282.0	388.2	302.8	302.8	1.568

SHIFTING EXPANSION

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	C STAR = 5855.5 FT/SEC		DELTA VAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC
					CP CAL/ I OPT	DELTA VAC							
1.000	1.788	559.422	2690.4	-92	651	123.9	101.5	181	222.7	323.5	225.4	225.4	1.228
2.000	9.262	107.973	2001.0	-40.83	540	228.1	40.9	379	259.7	361.3	265.2	265.2	1.462
3.000	78.369	81.083	1735.0	-35.31	525	240.3	35.5	545	272.1	374.6	276.2	276.2	1.500
4.000	25.747	38.840	1614.3	-61.10	511	240.3	28.8	742	278.2	381.5	287.9	289.1	1.554
5.000	35.236	28.380	1507.3	-64.53	503	249.2	26.1	918	281.7	385.8	293.7	295.2	1.553
6.000	45.306	22.072	1426.9	-70.44	494	275.7	24.1	1091	283.8	388.6	297.9	299.4	1.564
7.000	56.525	17.691	1356.4	-73.93	491	280.8	22.5	1276	284.7	390.3	301.2	303.4	1.567
8.000	68.136	14.681	1303.0	-76.65	486	285.0	21.1	1462	285.4	391.4	302.4	304.6	1.568
9.000	80.592	12.408	1255.7	-78.92	482	288.5	20.3	1634	286.0	392.0	303.0	305.7	1.569
10.000	93.482	10.697	1214.7	-80.88	478	291.4	19.4	1815	286.2	392.7	303.6	306.4	1.570
11.000	106.966	9.349	1178.5	-82.61	474	294.0	18.7	1998	286.3	393.2	304.2	307.1	1.571
12.000	121.270	8.246	1146.3	-84.13	471	296.4	18.0	2186	286.4	393.7	304.8	307.7	1.572
13.000	136.099	7.348	1117.5	-85.49	468	298.2	17.5	2375	286.5	394.1	305.3	308.2	1.573
14.000	151.354	6.607	1091.0	-86.72	464	300.0	16.9	2564	286.6	394.5	305.8	308.7	1.574
15.000	166.940	5.990	1067.0	-87.84	463	301.6	16.5	2751	286.6	394.8	306.3	309.2	1.575
16.000	182.747	5.471	1044.9	-88.86	461	303.1	16.1	2935	286.7	395.1	306.8	309.7	1.575
17.000	198.753	5.031	1024.5	-89.80	459	304.4	15.7	3115	286.7	395.4	307.3	310.2	1.576
18.000	214.829	4.655	1005.5	-90.67	457	305.7	15.3	3292	286.8	395.7	307.8	310.7	1.577
19.000	230.943	4.330	987.9	-91.47	455	306.8	15.0	3464	286.8	395.9	308.3	311.2	1.577
20.000	247.058	4.048	971.4	-92.22	454	307.9	14.7	3632	286.9	396.1	308.8	311.7	1.578
21.000	264.834	3.776	955.9	-92.93	452	308.9	14.4	3798	286.9	396.3	309.3	312.2	1.579
22.000	283.540	3.527	941.2	-93.59	451	309.8	14.2	3961	287.0	396.5	309.8	312.7	1.579
23.000	302.631	3.304	927.4	-94.21	449	310.7	13.9	4121	287.0	396.7	310.3	313.2	1.580
24.000	322.045	3.105	914.4	-94.79	448	311.5	13.7	4278	287.1	396.9	310.8	313.7	1.580
25.000	341.744	2.926	902.0	-95.35	447	312.3	13.5	4432	287.1	397.1	311.3	314.2	1.581
26.000	361.688	2.765	890.2	-95.87	445	313.0	13.2	4583	287.2	397.3	311.8	314.7	1.581
27.000	381.822	2.619	879.0	-96.37	444	313.7	13.1	4731	287.2	397.5	312.3	315.2	1.582
28.000	402.118	2.487	868.3	-96.83	443	314.3	13.0	4876	287.3	397.7	312.8	315.7	1.582
29.000	422.551	2.367	858.1	-97.30	442	315.0	12.7	5022	287.3	397.9	313.3	316.2	1.583
30.000	443.024	2.257	848.3	-97.73	441	315.6	12.5	5167	287.4	398.1	313.8	316.7	1.583
31.000	463.546	2.157	839.0	-98.14	440	316.1	12.2	5309	287.4	398.3	314.3	317.2	1.584
32.000	484.119	2.065	830.0	-98.51	439	316.7	12.2	5450	287.5	398.5	314.8	317.7	1.584
33.000	504.842	1.982	821.2	-98.87	438	317.2	12.0	5590	287.5	398.7	315.3	318.2	1.585
34.000	525.169	1.908	813.0	-99.20	438	317.7	11.9	5728	287.6	398.9	315.8	318.6	1.585
35.000	545.620	1.833	805.0	-99.63	437	318.2	11.8	5861	287.6	399.0	316.3	319.1	1.586
36.000	566.000	1.767	797.3	-99.97	436	318.6	11.7	5990	287.7	399.1	316.8	319.6	1.586
37.000	586.297	1.704	790.1	-100.29	435	319.1	11.5	6117	287.7	399.2	317.3	320.1	1.587
38.000	606.503	1.649	782.7	-100.60	435	319.5	11.4	6242	287.8	399.3	317.8	320.6	1.587
39.000	626.616	1.596	775.1	-100.90	434	319.9	11.3	6367	287.8	399.4	318.3	321.1	1.588
40.000	646.471	1.540	769.0	-101.20	433	320.1	11.2	6494	287.9	399.5	318.8	321.6	1.588
41.000	666.155	1.483	763.5	-101.49	432	320.5	11.1	6619	287.9	399.6	319.3	322.1	1.589
42.000	677.511	1.436	756.1	-101.75	432	321.1	11.0	6743	288.0	399.7	319.8	322.6	1.589
43.000	721.924	1.385	750.0	-102.02	431	321.4	10.9	6858	288.0	399.8	320.3	323.1	1.590
44.000	766.285	1.339	744.1	-102.27	431	321.8	10.8	6963	288.1	399.9	320.8	323.6	1.590
45.000	771.773	1.293	738.2	-102.51	430	322.1	10.7	7067	288.1	399.9	321.3	324.1	1.591
46.000	764.577	1.255	732.7	-102.76	429	322.4	10.6	8163	288.2	400.0	321.8	324.6	1.591
47.000	821.680	1.217	727.2	-103.00	429	322.7	10.5	8267	288.2	400.0	322.3	325.1	1.592
48.000	867.369	1.180	721.9	-103.22	428	323.1	10.4	8371	288.3	400.1	322.8	325.6	1.592
49.000	913.029	1.143	716.7	-103.44	428	323.4	10.3	8475	288.3	400.1	323.3	326.1	1.593
50.000	958.085	1.113	711.7	-103.66	427	323.6	10.2	8579	288.4	400.2	323.8	326.6	1.593
7.994	68.046	14.694	1303.3	-76.62	486	285.0	21.3	1470	285.0	391.4	303.4	304.3	1.571

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 52.
 298 N2*H4 1.004 +12.05 48.

PULK DENSITY = 1.188 GM/CC
 MIXTURE RATIO = 1.043 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRUPY 294.97 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	556.6
TEMP, DEG K	3129.7	2635.0	2208.8	1840.9	1523.5	1359.3	1249.8	1015.2	816.0	649.4	512.6	402.2	2806.6
ENTHALPY (-)	-15.00	12.00	34.67	53.63	69.38	77.25	82.36	92.96	101.53	108.38	113.81	118.08	2.71
CP	.5518	.5391	.5240	.5059	.4853	.4724	.4625	.4403	.4199	.4032	.3910	.3834	.5438
IMPUL OPT		153.25	207.87	244.35	270.94	283.28	291.03	306.47	318.39	327.62	334.75	340.26	124.10
IMPUL VAC		229.46	254.97	277.74	295.86	304.55	310.07	321.15	329.75	336.41	341.54	345.50	224.34
EPSILON		1.063	1.650	2.939	5.509	8.036	10.569	20.479	39.798	77.320	150.031	290.924	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	565.7
TEMP, DEG K	3129.7	2735.4	2340.5	1969.2	1639.3	1467.5	1352.8	1105.6	894.3	716.0	568.0	447.7	2886.6
ENTHALPY (-)	-15.00	12.40	35.95	55.89	72.56	80.92	86.38	97.73	106.96	114.39	120.31	125.00	2.41
X BAR	5.127	5.083	5.064	5.059	5.058	5.058	5.058	5.058	5.058	5.058	5.058	5.057	5.096
N	5.127	5.083	5.064	5.059	5.058	5.058	5.058	5.058	5.058	5.058	5.058	5.057	5.096
CP	.8586	.6768	.5674	.5193	.4934	.4801	.4706	.4478	.4261	.4074	.3936	.3892	.7394
IMPUL OPT		154.39	210.53	248.33	275.99	288.87	296.97	313.16	325.73	335.51	343.10	348.99	123.06
IMPUL VAC		232.24	259.20	283.01	301.97	311.09	316.89	328.60	337.73	344.84	350.34	354.60	226.41
EPSILON		1.071	1.681	3.009	5.661	8.276	10.905	21.231	41.472	80.968	157.768	307.006	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
52.10 F	.0551	.0240	.0070	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0343
19.20 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H2O2	.0036	.0012	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019
9.33 H2O	.0063	.0200	.0038	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0324
.00 H2	.7587	.7377	.7340	.7346	.7350	.7350	.7350	.7350	.7350	.7349	.7347	.7326	.7430
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-37.80 H2+O	2.1772	2.2351	2.2560	2.2601	2.2605	2.2605	2.2605	2.2605	2.2605	2.2605	2.2605	2.2605	2.2182
-11.04 H3+N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0002	.0016	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N+O	.0109	.0027	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0050
8.06 N+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	2.0556	2.0609	2.0626	2.0628	2.0629	2.0629	2.0629	2.0629	2.0629	2.0628	2.0628	2.0621	2.0594
19.50 N2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
39.56 O	.0026	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0009
.00 O2	.0030	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011

SYSTEM LIQUID RIPOPELLANT										PC 1000. PSIA		DENSITY		HEAT FORM		WT. 0/0	
COMPONENT										TREF FORMULA		GM/CC		(KCAL/FORM.WT.)			
DEG K										298 29804		1.43		-5.4		52.	
										298 29804		1.004		+12.05		68.	

PRESSURE PROFILE DATA
 SYSTEM LIQUID R1PROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 57.
 298 N2*H4 1.004 +12.05 43.

PULK DENSITY = 1.209 GM/CC
 MIXTURE RATIO = 1.326 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 284.38 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	556.3
TEMP, DEG K	3252.7	2743.1	2314.1	1937.9	1612.4	1443.5	1330.8	1087.9	880.2	704.7	559.0	440.2	2923.6
ENTHALPY (-)	-12.82	13.46	35.62	54.24	64.78	77.58	82.67	93.25	101.86	108.79	114.32	118.69	4.42
CP	.5272	.5159	.5022	.4863	.4676	.4555	.4467	.4249	.4040	.3863	.3725	.3634	.5202
IMPUL OPT		151.20	205.30	241.55	268.08	280.44	288.22	303.78	315.87	325.27	332.58	338.25	122.47
IMPUL VAC		226.56	252.02	274.80	293.01	301.78	307.36	318.62	327.42	334.25	339.55	343.64	221.41
EPSILON		1.064	1.658	2.963	5.580	8.163	10.761	20.965	40.974	80.026	155.943	303.299	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.2
TEMP, DEG K	3252.7	2922.1	2592.1	2244.8	1900.1	1714.4	1589.4	1317.8	1082.2	879.4	707.2	563.2	3050.4
ENTHALPY (-)	-12.82	14.06	37.77	58.40	76.02	84.95	90.82	103.15	113.33	121.64	128.37	133.75	3.91
X BAR	4.794	4.723	4.673	4.650	4.645	4.645	4.645	4.645	4.645	4.645	4.645	4.645	4.749
N	4.794	4.723	4.673	4.650	4.645	4.645	4.645	4.645	4.645	4.645	4.645	4.645	4.749
CP	1.0893	.9178	.7124	.5513	.4903	.4742	.4647	.4429	.4208	.3994	.3815	.3670	.9908
IMPUL OPT		152.93	209.77	248.93	278.01	291.66	300.28	317.64	331.28	342.03	350.48	357.09	120.66
IMPUL VAC		230.95	259.71	285.18	305.46	315.26	321.53	334.30	344.40	352.35	358.58	363.43	224.45
EPSILON		1.079	1.733	3.162	6.014	8.839	11.697	23.028	45.546	90.048	177.505	348.537	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0509	.0273	.0117	.0034	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0356
19.20 H*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H*N*O	.0070	.0035	.0014	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0047
9.33 H*O	.1331	.0738	.0294	.0063	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0956
.00 H2	.3544	.2823	.2304	.2089	.2057	.2056	.2056	.2056	.2056	.2056	.2056	.2056	.3088
40.30 H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	2.2335	2.3489	2.4318	2.4696	2.4771	2.4777	2.4778	2.4778	2.4778	2.4778	2.4778	2.4778	2.3067
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N*O	.0372	.0184	.0061	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0250
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.9390	1.9502	1.9575	1.9606	1.9611	1.9612	1.9612	1.9612	1.9612	1.9612	1.9612	1.9612	1.9463
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0111	.0043	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0065
.00 O2	.0279	.0145	.0041	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0196

SYSTEM LIQUID RIPOPELLANT										PC 1000. PSIA		DENSITY		HEAT FORM		WT. O/O	
COMPONENT										TREF FORMULA		GM/CC		(KCAL/FORM.WT.)			
DEF K										298 N240N		1.43		-5.4		57.	
298 N240N										1.0004		-0.004		+12.05		43.	
FROZEN EXPANSION										C STAR = 5722.1 FT/SEC							
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP	CAL/1	OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
			DEG K	KCAL/100GM	GM	DEG	/F	LVL	LVL	10000	50000	50000	LVL				
1.000	1.000	1000.000	3252.7	-4.42	-520	127.5	98.9	-178	218.8	219.6	221.1	221.4	1.230	1.245			
2.000	9.224	108.408	2174.4	-42.42	-497	220.2	40.3	-372	255.0	256.6	259.8	260.4	1.434	1.464			
3.000	16.167	61.854	1910.8	-54.59	-486	242.2	33.0	-534	267.4	269.7	274.3	275.2	1.503	1.547			
4.000	25.326	39.485	1774.9	-62.11	-478	255.4	28.7	-728	273.4	276.7	282.9	284.1	1.537	1.598			
5.000	34.587	28.912	1664.1	-67.36	-471	264.1	24.1	-907	277.0	281.0	286.7	290.2	1.557	1.632			
6.000	44.221	22.613	1578.8	-71.35	-465	270.6	24.2	-1069	279.1	283.8	293.0	294.8	1.569	1.658			
7.000	55.048	18.166	1509.7	-74.55	-460	275.7	22.7	-1249	280.0	285.6	296.3	298.4	1.575	1.678			
8.000	66.199	15.106	1452.0	-77.19	-456	279.8	21.5	-1424	280.4	286.7	298.9	301.3	1.577	1.694			
9.000	78.084	12.407	1402.8	-79.43	-452	283.3	20.5	-1602									
10.000	90.428	11.054	1359.9	-81.36	-449	286.2	19.7	-1781									
11.000	103.148	9.693	1322.1	-83.05	-446	288.8	19.0	-1957									
12.000	116.745	8.566	1288.3	-84.55	-443	291.1	18.3	-2142									
13.000	130.816	7.644	1257.4	-85.90	-441	293.1	17.6	-2327									
14.000	145.246	6.883	1230.2	-87.11	-438	294.9	17.3	-2512									
15.000	160.058	6.246	1204.9	-88.22	-436	296.5	16.8	-2696									
16.000	175.140	5.710	1181.6	-89.23	-434	298.0	16.4	-2878									
17.000	190.348	5.254	1160.1	-90.14	-432	299.3	16.1	-3057									
18.000	205.656	4.862	1140.0	-91.03	-430	300.6	15.7	-3232									
19.000	221.012	4.525	1121.3	-91.83	-428	301.7	15.4	-3404									
20.000	236.314	4.231	1103.8	-92.58	-426	302.8	15.1	-3571									
21.000	251.587	3.972	1087.4	-93.28	-425	303.8	14.8	-3735									
22.000	266.814	3.713	1071.8	-93.93	-423	304.8	14.6	-3896									
23.000	281.956	3.482	1057.1	-94.56	-422	305.6	14.3	-4051									
24.000	305.357	3.274	1043.2	-95.14	-421	306.5	14.1	-4208									
25.000	323.878	3.088	1030.0	-95.70	-419	307.3	13.9	-4359									
26.000	342.463	2.919	1017.4	-96.22	-418	308.0	13.7	-4504									
27.000	361.534	2.766	1005.5	-96.72	-417	308.7	13.5	-4647									
28.000	380.634	2.627	994.0	-97.20	-416	309.4	13.3	-4787									
29.000	399.868	2.501	983.1	-97.65	-415	310.0	13.1	-4924									
30.000	419.273	2.385	972.2	-98.08	-414	310.6	12.9	-5058									
31.000	438.667	2.280	962.5	-98.50	-412	311.2	12.8	-5189									
32.000	458.051	2.183	952.8	-98.90	-411	311.8	12.7	-5318									
33.000	477.519	2.094	943.6	-99.28	-411	312.3	12.5	-5445									
34.000	496.955	2.012	934.6	-99.65	-410	312.8	12.4	-5570									
35.000	516.371	1.937	926.0	-100.00	-409	313.3	12.2	-5694									
36.000	535.737	1.867	917.7	-100.34	-408	313.8	12.1	-5816									
37.000	555.040	1.802	909.6	-100.67	-407	314.2	12.0	-5937									
38.000	574.288	1.741	901.8	-100.98	-406	314.7	11.9	-6057									
39.000	593.414	1.685	894.3	-101.28	-405	315.1	11.8	-6176									
40.000	612.472	1.633	887.0	-101.58	-405	315.5	11.7	-6293									
41.000	631.525	1.583	880.0	-101.87	-404	315.9	11.5	-6409									
42.000	650.552	1.529	873.1	-102.15	-403	316.3	11.4	-6524									
43.000	669.625	1.478	866.5	-102.42	-403	316.6	11.3	-6637									
44.000	688.712	1.430	860.0	-102.68	-402	317.0	11.2	-6749									
45.000	707.763	1.385	853.7	-102.93	-401	317.3	11.1	-6860									
46.000	726.804	1.341	847.6	-103.17	-401	317.7	11.1	-6969									
47.000	745.846	1.300	841.7	-103.41	-400	318.0	11.0	-7077									
48.000	764.810	1.262	835.9	-103.64	-400	318.3	10.9	-7184									
49.000	783.711	1.225	830.3	-103.87	-399	318.6	10.8	-7290									
50.000	802.534	1.190	824.8	-104.09	-398	318.9	10.7	-7396									
8.163	68.046	14.696	1443.5	-77.58	-456	280.4	21.3	-1.452	280.4	286.9	299.3	301.8	1.577	1.697			

SHIFTING EXPANSION																
C STAR = 5846.4 FT/SEC																
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP	CAL/1	OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/100GM	GM	DEG	/F	LVL		LVL	10000	50000	LVL			
1.000	1.000	1000.000	3252.7	-4.42	-520	127.5	98.9	-178	218.8	219.6	221.1	221.4	1.230	1.245		
2.000	8.307	120.383	2594.1	-43.42	-484	221.6	45.1	-374	261.2	262.8	266.0	266.7	1.437	1.468		
3.000	15.081	68.310	2273.3	-54.86	-481	244.4	36.9	-537	275.1	277.6	282.3	283.9	1.514	1.559		
4.000	22.757	43.942	2114.6	-65.31	-470	260.8	32.5	-740	282.4	285.7	292.0	293.3	1.556	1.614		
5.000	31.306	31.943	1995.2	-71.35	-450	270.7	29.6	-925	286.6	290.7	298.6	300.2	1.577	1.652		
6.000	39.638	25.190	1901.2	-75.96	-440	277.9	27.5	-1091	289.4	294.2	303.5	305.4	1.592	1.681		
7.000	49.402	20.242	1825.0	-79.67	-433	283.7	25.8	-1276	290.8	296.4	307.3	309.5	1.600	1.703		
8.000	59.436	16.402	1761.0	-82.74	-428	288.3	24.5	-1457	291.4	297.9	310.4	312.9	1.604	1.722		
9.000	69.780	14.331	1706.1	-85.35	-424	292.2	23.4	-1636								
10.000	80.747	12.381	1658.4	-87.60	-420	295.6	22.5	-1820								
11.000	92.033	10.466	1616.1	-89.58	-417	298.5	21.7	-2001								
12.000	103.619	9.449	1578.4	-91.33	-414	301.0	21.1	-2182								
13.000	115.949	8.446	1544.3	-92.91	-411	303.3	20.4	-2370								
14.000	128.827	7.774	1513.1	-94.28	-408	305.7	19.9	-2569								
15.000	141.646	7.200	1484.9	-95.64	-407	307.2	19.4	-2769								
16.000	154.928	6.655	1458.7	-96.83	-406	308.9	19.0	-2937								
17.000	168.412	6.138	1434.4	-97.93	-405	310.4	18.6	-3124								
18.000	182.039	5.645	1411.9	-98.95	-404	311.9	18.2	-3309								
19.000	195.759	5.168	1390.8	-99.90	-403	313.2	17.8	-3490								
20.000	209.526	4.773	1371.0	-100.79	-402	314.4	17.5	-3680								
21.000	223.365	4.367	1352.4	-101.62	-400	315.5	17.2	-3833								
22.000	237.069	4.018	1334.8	-102.40	-400	316.6	16.9	-4013								
23.000	250.802	3.700	1318.1	-103.14	-399	317.6	16.7	-4199								
24.000	264.469	3.354	1302.5	-103.83	-398	318.6	16.4	-4373								
25.000	278.146	3.052	1287.5	-104.49	-398	319.5	16.2	-4569								
26.000	291.934	2.790	1273.2	-105.12	-397	320.3	16.0	-4768								
27.000	305.745	2.564	1259.6	-105.71	-396	321.1	15.7	-4970								
28.000	319.552	2.316	1246.6	-106.28	-395	321.9	15.5	-5155								
29.000	334.329	2.071	1234.1	-106.83	-395	322.6	15.4	-5349								
30.000	349.248	1.838	1222.2	-107.34	-394	323.3	15.2	-5546								
31.000	364.284	1.624	1210.7	-107.84	-393	324.0	15.0	-5735								
32.000	379.441	1.426	1199.7	-108.32	-393	324.7	14.8	-5925								
33.000	394.672	1.240	1189.1	-108.78	-391	325.3	14.7	-6114								
34.000	410.048	2.105	1178.9	-109.22	-390	325.8	14.5	-6301								
35.000	425.514	2.217	1169.0	-109.64	-429	326.4	14.4	-6486								
36.000	441.085	2.135	1159.5	-110.05	-428	327.0	14.2	-6672								
37.000	456.844	2.059	1150.2	-110.44	-428	327.5	14.1	-6848								
38.000	502.875	1.989	1141.3	-110.82	-427	328.0	14.0	-7025								
39.000	520.066	1.923	1132.7	-111.19	-426	328.5	13.8	-7200								
40.000	537.263	1.861	1124.3	-111.55	-425	328.9	13.7	-7372								
41.000	554.478	1.801	1116.2	-111.89	-424	329.3	13.6	-7541								
42.000	571.704	1.750	1108.4	-112.23	-423	329.8	13.5	-7708								
43.000	588.214	1.700	1100.7	-112.55	-423	330.3	13.4	-7871								
44.000	605.066	1.653	1093.3	-112.86	-422	330.7	13.3	-8032								
45.000	622.136	1.611	1086.2	-113.17	-421	331.2	13.2	-8191								
46.000	639.886	1.563	1079.0	-113.46	-420	331.5	13.1	-8344								
47.000	659.681	1.516	1072.1	-113.75	-420	331.8	13.0	-8500								
48.000	679.657	1.471	1065.4	-114.03	-419	332.2	12.9	-8652								
49.000	699.867	1.428	1058.9	-114.31	-418	332.6	12.8	-8807								
50.000	720.233	1.387	1052.6	-114.58	-417	333.0	12.7	-8953								
8.039	68.046	14.694	1714.4	-84.95	-474	291.7	23.6	1.608	291.7	298.0	312.5	315.3	1.605	1.731		

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2O4 1.43 -5.4 64.
 298 N2H4 1.004 +12.05 36.

BULK DENSITY = 1.241 GM/CC
 MIXTURE RATIO = 1.778 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 267.97 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	557.9
TEMP, DEG K	3163.5	2673.4	2250.2	1883.9	1567.2	1402.9	1293.2	1057.1	855.2	684.8	543.3	427.9	2844.7
ENTHALPY (-)	-9.78	13.91	33.89	50.67	64.67	71.69	76.28	85.81	93.57	99.81	104.79	108.72	5.69
CP	.4885	.4779	.4653	.4502	.4329	.4219	.4135	.3938	.3746	.3582	.3455	.3370	.4819
IMPUL OPT	143.57	194.91	229.33	254.50	266.23	273.62	288.38	299.85	308.77	315.71	321.09	321.09	116.01
IMPUL VAC	215.11	239.26	260.49	278.16	286.48	291.78	302.46	310.81	317.29	322.32	326.21	326.21	210.22
EPSILON	1.064	1.657	2.962	5.577	8.157	10.752	20.948	40.941	79.969	155.853	303.179	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.3
TEMP, DEG K	3163.5	2822.4	2486.1	2151.6	1829.2	1653.1	1533.3	1271.0	1042.6	846.2	679.7	540.8	2954.3
ENTHALPY (-)	-9.78	14.41	35.65	54.11	69.89	77.93	83.21	94.31	103.46	110.93	116.97	121.79	5.33
X BAR	4.444	4.392	4.358	4.341	4.335	4.334	4.333	4.333	4.333	4.333	4.333	4.333	4.410
N	4.444	4.392	4.358	4.341	4.335	4.334	4.333	4.333	4.333	4.333	4.333	4.333	4.410
CP	.8995	.7574	.6243	.5263	.4684	.4474	.4352	.4112	.3903	.3708	.3540	.3409	.8133
IMPUL OPT	145.06	198.81	235.76	263.28	276.24	284.43	300.92	313.88	324.06	332.06	338.32	344.31	114.66
IMPUL VAC	218.93	245.93	270.01	289.31	298.66	304.62	316.75	326.32	333.85	339.73	344.31	344.31	212.90
EPSILON	1.077	1.726	3.151	6.018	8.858	11.725	23.075	45.585	90.014	177.236	347.663	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
52.10 H	.0191	.0074	.0019	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0111
19.20 H2N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H2O	.0100	.0057	.0030	.0013	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0072
4.33 H2O	.1760	.1088	.0553	.0209	.0054	.0020	.0009	.0001	.0000	.0000	.0000	.0000	.1337
.00 H2	.0873	.0434	.0159	.0037	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0587
40.30 H2N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2O	2.0568	2.1422	2.2006	2.2317	2.2437	2.2454	2.2461	2.2466	2.2466	2.2466	2.2466	2.2466	2.1119
-11.04 H2N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N2O	.0894	.0611	.0376	.0196	.0081	.0043	.0026	.0006	.0001	.0000	.0000	.0000	.0716
.00 N2	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
1.7690	1.7854	1.7986	1.8084	1.8145	1.8166	1.8175	1.8185	1.8188	1.8188	1.8188	1.8188	1.8188	1.7794
19.50 N2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0226	.0113	.0042	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0152
.00 O2	.2135	.2264	.2407	.2538	.2674	.2651	.2662	.2674	.2677	.2677	.2677	.2677	.2212

PRESSURE PROFILE DATA
 SYSTEM LIQUID HYDROFILLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 H2O4 1.43 -5.4 40.
 298 H2O4 1.004 +12.05 60.

BULK DENSITY = 1.140 GM/CC
 MIXTURE RATIO = .667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 331.05 EU/100GMS

CHAMBER													THROAT
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.8
TEMP, DEG K	2552.2	2168.2	1833.2	1541.0	1342.7	1286.6	1066.1	876.7	715.8	580.9	469.0	377.9	2262.9
ENTHALPY (-)	-20.21	2.52	21.80	38.05	48.71	51.66	62.99	72.34	80.01	86.75	91.30	95.36	-3.02
CP	.5997	.5840	.5656	.5459	.5292	.5240	.5035	.4844	.4684	.4562	.4481	.4427	.5880
IMPUL 3PT	140.64	191.17	225.13	244.87	250.06	269.04	283.76	295.28	304.33	311.47	317.09	322.79	
IMPUL VAC	221.49	241.46	261.03	273.67	277.04	289.82	299.96	307.99	314.34	319.37	323.34	329.33	
EPSILON	1.025	1.420	2.258	3.343	3.780	6.483	11.256	19.669	34.485	60.591	106.782	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.47	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.9
TEMP, DEG K	2552.2	2188.9	1857.0	1563.2	1363.0	1306.4	1083.6	892.0	729.0	592.2	479.7	394.2	2280.9
ENTHALPY (-)	-20.21	2.62	22.04	38.51	49.30	52.79	63.77	73.26	81.04	87.38	92.52	96.69	-2.98
X BAR	6.066	6.055	6.052	6.051	6.051	6.051	6.051	6.051	6.051	6.050	6.045	6.015	6.056
N	6.066	6.055	6.052	6.051	6.051	6.051	6.051	6.051	6.051	6.050	6.045	6.015	6.056
CP	.6759	.6078	.5716	.5479	.5307	.5256	.5049	.4857	.4697	.4590	.4661	.5942	.6213
IMPUL OPT	140.94	191.81	226.02	245.92	251.15	270.31	285.16	296.80	305.95	313.17	318.91	322.44	
IMPUL VAC	222.23	242.46	262.20	274.91	278.37	291.28	301.53	309.65	316.07	321.18	325.33	329.98	
EPSILON	1.026	1.424	2.266	3.356	3.795	6.513	11.316	19.788	34.726	61.152	109.326	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0241	.0061	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0090
79.20 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H2O	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
9.33 H2O	.0044	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013
.00 H2	1.9963	2.0028	2.0050	2.0054	2.0055	2.0055	2.0054	2.0053	2.0050	2.0038	1.9968	1.9508	2.0017
40.30 H2N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2O	1.7333	1.7380	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7388	1.7374
-11.04 H3N	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0001	.0003	.0012	.0058	.0365	.0001
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N2O	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
8.06 N2O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	2.3065	2.3068	2.3069	2.3069	2.3069	2.3069	2.3069	2.3068	2.3067	2.3063	2.3040	2.2886	2.3068
19.50 N2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		HEAT FORM		WT. O/D	
COMPONENT										DENSITY		(KCAL/FORM.WT.)			
										UM/CC					
										1.43		5.4		40.	
										1.004		+12.05		60.	
										FROZEN EXPANSION					
										C STAR = 5649.1 FT/SEC					
										DEL VAC					
										DEL VAC					
										I SEA					
										I AT					
										I AT					
										I VAC					
										CF SEA					
										CF VAC					
												</			

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 48.
 298 N2*H4 1.004 +12.05 52.

PULK DENSITY = 1.172 GM/CC
 MIXTURE RATIO = .923 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 315.75 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	167.0
TEMP, DEG K	2915.2	2498.9	2133.8	1913.8	1595.1	1533.0	1287.2	1072.7	887.0	727.8	593.3	480.9	2605.1
ENTHALPY (-)	-16.73	6.68	26.72	43.79	55.11	58.27	70.46	80.67	89.14	96.12	101.82	106.47	.75
CP	.5683	.5562	.5416	.5245	.5105	.5060	.4854	.4657	.4467	.4305	.4177	.4088	.5595
IMPUL OPT		142.72	194.43	229.47	250.01	255.44	275.43	291.09	303.49	313.33	321.16	327.39	123.35
IMPUL VAC		225.16	246.11	266.69	280.05	283.70	297.43	308.45	317.25	324.27	329.86	334.30	222.79
EPSILON		1.028	1.434	2.300	3.432	3.890	6.745	11.845	20.920	37.029	65.577	116.122	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	168.3
TEMP, DEG K	2915.2	2574.4	2234.6	1913.8	1689.0	1624.9	1369.8	1146.3	951.9	784.3	641.6	521.9	2669.5
ENTHALPY (-)	-16.73	6.97	27.62	45.40	57.24	60.55	73.36	84.13	93.11	100.53	106.63	111.60	.70
X BAR	5.446	5.410	5.395	5.390	5.390	5.389	5.389	5.389	5.389	5.389	5.389	5.389	5.418
N	5.446	5.410	5.395	5.390	5.390	5.389	5.389	5.389	5.389	5.389	5.389	5.389	5.418
CP	.6341	.6760	.5828	.5378	.5180	.5128	.4918	.4714	.4516	.4346	.4207	.4111	.7133
IMPUL OPT		143.59	196.44	232.50	253.69	259.29	279.97	296.22	309.13	319.40	327.60	334.14	123.17
IMPUL VAC		227.45	249.49	270.86	284.71	288.49	302.76	314.25	323.47	330.84	336.73	341.42	224.69
EPSILON		1.032	1.454	2.340	3.498	3.967	6.898	12.149	21.529	38.234	67.912	120.594	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0667	.0284	.0084	.0016	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0372
79.20 H+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H+N+O	.0015	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007
9.33 H+O	.0381	.0119	.0023	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0172
.00 H2	1.1531	1.1521	1.1557	1.1579	1.1584	1.1584	1.1585	1.1585	1.1585	1.1585	1.1584	1.1579	1.1515
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2+O	2.0388	2.0726	2.0840	2.0863	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0866	2.0660
-11.04 H3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0004	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N+O	.0049	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018
8.06 N+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	2.1410	2.1434	2.1441	2.1442	2.1442	2.1442	2.1442	2.1442	2.1442	2.1442	2.1442	2.1440	2.1429
19.50 N2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0013	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 O2	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003

SYSTEM LIQUID DIPROPELLANT										PC 100, PSIA		DENSITY		HEAT FORM		WT. 0/0	
COMPONENT										REF. FORMULA		GM/CC		(KCAL/FORM.WT.)			
										DEG K		1.43		-5.4		48.	
										298 N2H4		1.004		+12.05		52.	
										FROZEN EXPANSION		C STAR + 5748.9 FT/SEC					
										DEG K		I DELVAC		I SEA		I AT	
										LVL		10000		50000		CF VAC	
										LVL		LVL		LVL		LVL	
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC			
			DEG K	KCAL/100GM	GM DEG		/P	/P									
1.000	1.000	300.000	2915.2	16.73	.568				214.0	216.7	221.8	227.8	1.198	1.247			
2.000	9.181	31.947	1833.9	-39.58	.529	221.9	39.5	1.737	243.2	248.7	250.3	261.4	1.361	1.403			
3.000	16.753	17.407	1864.8	-51.54	.515	243.7	32.1	1.795	249.5	257.4	272.8	275.9	1.396	1.544			
4.000	25.643	11.699	1519.9	-55.95	.505	256.6	27.9	2.183	260.0	280.4	284.5			1.592			
5.000	35.751	8.191	1415.7	-64.15	.497	265.3	25.1	2.993			285.3	290.4		1.625			
6.000	46.539	6.446	1316.1	-68.08	.490	271.6	23.2	3.592			288.7	294.8		1.650			
7.000	57.888	5.183	1272.0	-71.77	.484	276.6	21.7	4.178			291.1	298.2		1.669			
8.000	70.550	4.252	1218.6	-75.77	.479	280.6	20.4	4.807			292.9	301.1		1.685			
9.000	83.719	3.584	1171.1	-79.94	.475	284.0	19.4	5.426			294.2	303.4		1.698			
10.000	97.149	3.087	1131.7	-84.31	.471	286.8	18.6	6.023			295.1	305.4		1.709			
11.000	110.608	2.712	1094.0	-88.84	.468	289.3	17.9	6.594			295.9	307.1		1.719			
12.000	124.121	2.413	1068.1	-93.48	.465	291.4	17.3	7.152			296.5	308.7		1.727			
13.000	139.759	2.171	1040.3	-98.17	.462	293.3	16.7	7.778			296.8	310.0		1.735			
14.000	155.671	1.927	1015.1	-103.13	.460	295.1	16.2	8.404			296.9	311.3		1.742			
15.000	171.953	1.745	992.0	-108.39	.458	296.6	15.7	9.024			297.0	312.4		1.748			
16.000	188.511	1.591	970.9	-113.95	.455	298.0	15.3	9.635			297.0	313.4		1.754			
17.000	205.259	1.462	951.4	-119.84	.453	299.3	15.0	10.237			297.0	314.3		1.759			
18.000	222.127	1.351	933.2	-126.06	.452	300.5	14.6	10.825			297.0	315.1		1.764			
19.000	239.080	1.256	916.4	-132.62	.450	301.6	14.3	11.400			297.0	315.9		1.768			
20.000	256.021	1.172	900.6	-139.53	.448	302.6	14.0	11.958			297.0	316.6		1.772			
21.000	273.144	1.098	885.8	-146.79	.447	303.6	13.7	12.510			297.0	317.3		1.776			
22.000	292.241	1.037	871.9	-154.41	.445	304.5	13.5	13.134			297.0	317.9		1.779			
23.000	311.692	.982	858.7	-162.39	.444	305.3	13.2	13.757			297.0	318.5		1.783			
24.000	331.689	.935	846.1	-170.75	.443	306.1	13.0	14.368			297.0	319.1		1.786			
25.000	351.982	.895	834.5	-179.47	.441	306.8	12.8	14.967			297.0	319.6		1.789			
26.000	371.934	.862	823.3	-188.56	.440	307.5	12.6	15.562			297.0	320.2		1.792			
27.000	392.554	.836	812.6	-198.03	.439	308.2	12.4	16.147			297.0	320.6		1.794			
28.000	413.829	.815	802.5	-207.87	.438	308.8	12.2	16.725			297.0	321.0		1.797			
29.000	435.195	.791	792.8	-218.10	.437	309.4	12.1	17.295			297.0	321.5		1.799			
30.000	455.227	.769	783.5	-228.73	.436	310.0	11.9	17.857			297.0	321.9		1.801			
31.000	476.369	.746	774.6	-239.76	.435	310.5	11.7	18.409			297.0	322.3		1.804			
32.000	497.568	.723	766.1	-251.19	.434	311.0	11.6	18.953			297.0	322.6		1.806			
33.000	518.862	.700	757.9	-263.02	.434	311.5	11.5	19.489			297.0	322.9		1.808			
34.000	540.190	.679	750.7	-275.16	.433	312.0	11.3	20.017			297.0	323.1		1.809			
35.000	561.524	.658	743.4	-287.60	.432	312.5	11.2	20.539			297.0	323.3		1.811			
36.000	582.862	.639	736.1	-300.35	.431	312.9	11.1	21.052			297.0	323.4		1.813			
37.000	604.229	.620	729.2	-313.41	.431	313.3	10.9	21.557			297.0	323.5		1.815			
38.000	625.617	.601	721.2	-326.80	.430	313.7	10.8	22.060			297.0	323.6		1.816			
39.000	647.029	.582	714.6	-340.52	.429	314.1	10.7	22.564			297.0	323.7		1.818			
40.000	668.417	.564	708.3	-354.66	.429	314.5	10.6	23.068			297.0	323.8		1.819			
41.000	689.820	.546	702.1	-369.22	.428	314.9	10.5	23.563			297.0	323.9		1.821			
42.000	711.249	.529	696.1	-384.21	.427	315.2	10.4	24.057			297.0	324.0		1.822			
43.000	732.695	.512	690.3	-399.63	.427	315.6	10.3	24.543			297.0	324.1		1.824			
44.000	754.157	.496	684.7	-415.48	.426	315.9	10.2	25.027			297.0	324.2		1.825			
45.000	775.634	.480	679.3	-431.76	.426	316.2	10.1	25.507			297.0	324.3		1.826			
46.000	797.127	.464	674.1	-448.48	.425	316.5	10.0	25.983			297.0	324.4		1.827			
47.000	818.617	.449	669.0	-465.64	.425	316.8	9.9	26.457			297.0	324.5		1.829			
48.000	839.915	.434	664.0	-483.25	.424	317.1	9.8	26.927			297.0	324.6		1.830			
49.000	861.213	.419	659.2	-501.31	.424	317.4	9.7	27.393			297.0	324.7		1.831			
50.000	882.511	.404	654.5	-519.82	.423	317.7	9.6	27.857			297.0	324.8		1.832			
51.000	903.809	.389	649.9	-538.78	.423	318.0	9.5	28.319			297.0	324.9		1.833			
52.000	925.107	.374	645.4	-558.19	.422	318.3	9.4	28.779			297.0	325.0		1.834			
53.000	946.405	.359	640.9	-578.05	.422	318.6	9.3	29.237			297.0	325.1		1.835			
54.000	967.703	.344	636.4	-598.36	.421	318.9	9.2	29.693			297.0	325.2		1.836			
55.000	989.001	.329	632.0	-619.12	.421	319.2	9.1	30.147			297.0	325.3		1.837			
56.000	1010.299	.314	627.6	-640.33	.420	319.5	9.0	30.600			297.0	325.4		1.838			
57.000	1031.597	.299	623.2	-661.99	.420	319.8	8.9	31.052			297.0	325.5		1.839			
58.000	1052.895	.284	618.8	-684.10	.419	320.1	8.8	31.503			297.0	325.6		1.840			
59.000	1074.193	.269	614.4	-706.66	.419	320.4	8.7	31.953			297.0	325.7		1.841			
60.000	1095.491	.254	610.0	-729.67	.418	320.7	8.6	32.402			297.0	325.8		1.842			

PRESSURE PROFILE DATA
 SYSTEM LIQUID R/PROPELLANT PC 300. PSIA
 COMPONENT TRFF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 H2O4 1.43 -5.4 52.
 298 H2O4 1.004 +12.05 48.

BULK DENSITY = 1.188 GM/CC
 MIXTURE RATIO = 1.043 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 307.27 FU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	166.9
TEMP, DEG K	3057.2	2627.6	2254.1	1924.1	1638.3	1634.1	1379.3	1155.8	961.1	792.9	649.3	528.4	2738.6
ENTHALPY (-)	-15.00	8.31	28.32	45.44	56.84	60.02	72.36	82.75	91.42	98.60	104.51	109.33	2.41
CP	.5502	.5192	.5261	.5108	.4979	.4937	.4746	.4548	.4353	.4184	.4043	.3934	.5423
IMPUL OPT	142.38	194.12	229.30	249.98	255.46	275.68	291.61	304.27	314.37	322.43	328.87	328.87	123.06
IMPUL VAC	224.76	245.91	266.73	280.29	283.99	297.99	309.29	318.36	325.62	331.42	336.04	336.04	222.32
EPSILON	1.028	1.440	2.317	3.467	3.933	6.851	12.086	21.451	38.144	67.820	120.502	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	170.1
TEMP, DEG K	3057.2	2752.9	2435.4	2114.7	1880.6	1812.9	1541.7	1301.9	1091.2	907.5	748.8	613.5	2842.5
ENTHALPY (-)	-15.00	8.73	29.73	48.77	60.40	63.86	77.34	88.76	98.37	106.40	113.05	118.51	2.12
X BAR	5.159	5.105	5.074	5.062	5.059	5.059	5.058	5.058	5.058	5.058	5.058	5.058	5.118
N	5.159	5.105	5.074	5.062	5.059	5.059	5.058	5.058	5.058	5.058	5.058	5.058	5.118
CP	1.0181	.7981	.6330	.5470	.5152	.5087	.4862	.4660	.4464	.4270	.4107	.3977	.8588
IMPUL OPT	143.65	197.26	234.23	256.11	261.92	283.42	300.44	314.05	324.97	333.76	340.81	340.81	122.03
IMPUL VAC	228.22	251.42	273.74	288.23	292.19	307.21	319.39	329.24	337.19	343.57	348.68	348.68	225.09
EPSILON	1.036	1.477	2.400	3.606	4.096	7.167	12.714	22.704	40.633	72.699	129.897	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.0823	.0443	.0178	.0048	.0013	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0543
79.20 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H2N2O	.0029	.0012	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0016
9.33 H2O	.0830	.0370	.0109	.0019	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0485
.00 H2	.7682	.7417	.7335	.7338	.7346	.7347	.7350	.7350	.7350	.7350	.7350	.7350	.7473
40.30 H2N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-7.80 H2O	2.1432	2.2125	2.2475	2.2584	2.2601	2.2603	2.2605	2.2605	2.2605	2.2605	2.2605	2.2605	2.1960
-11.04 H3N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N2O	.0142	.0051	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0072
8.06 N2O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	2.0543	2.0597	2.0621	2.0628	2.0629	2.0629	2.0629	2.0629	2.0629	2.0629	2.0629	2.0629	2.0585
19.50 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0053	.0014	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0021
.00 O2	.0059	.0017	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 57.
 298 N2*H4 1.004 +12.05 43.

BULK DENSITY = 1.209 GM/CC
 MIXTURE RATIO = 1.326 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 295.91 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	166.7
TEMP, DEG K	3148.7	2715.6	2334.9	1999.6	1769.9	1704.4	1444.6	1215.9	1015.8	841.8	692.3	565.4	2825.5
ENTHALPY (-)	-12.82	9.72	29.13	45.79	56.91	60.02	72.12	82.35	90.92	98.06	103.95	108.78	4.04
CP	.5254	.5153	.5033	.4898	.4779	.4741	.4563	.4374	.4189	.4015	.3865	.3747	.5180
IMPUL OPT		140.04	191.04	225.81	246.30	251.74	271.85	287.74	300.42	310.58	318.73	325.25	121.13
IMPUL VAC		221.16	242.17	262.86	276.36	280.07	294.08	305.42	314.57	321.92	327.81	332.52	218.71
EPSILON		1.029	1.444	2.330	3.494	3.967	6.933	12.279	21.879	39.057	69.702	124.220	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	172.8
TEMP, DEG K	3148.7	2892.4	2635.7	2375.3	2156.6	2088.6	1802.7	1541.2	1308.5	1102.9	922.2	765.0	2971.2
ENTHALPY (-)	-12.82	10.25	31.09	49.79	62.68	66.34	80.71	93.05	103.56	112.46	119.52	126.15	3.32
X BAR	4.839	4.765	4.706	4.666	4.651	4.649	4.645	4.645	4.645	4.645	4.645	4.645	4.787
N	4.839	4.765	4.706	4.666	4.651	4.649	4.645	4.645	4.645	4.645	4.645	4.645	4.787
CP	1.2769	1.1092	.9038	.6832	.5603	.5368	.4844	.4613	.4420	.4229	.4038	.3871	1.1650
IMPUL OPT		141.68	195.46	233.40	256.30	262.43	285.25	303.49	318.20	330.13	339.83	347.71	118.50
IMPUL VAC		225.79	250.41	274.45	290.13	294.42	310.63	323.88	334.71	343.55	350.73	356.54	222.27
EPSILON		1.040	1.513	2.517	3.835	4.368	7.718	13.810	24.903	45.053	81.504	147.149	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
52.10 H	.0737	.0455	.0245	.0105	.0043	.0031	.0006	.0001	.0000	.0000	.0000	.0000	.0535
79.20 H*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H*N*O	.0051	.0029	.0015	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0035
9.33 H*O	.1596	.1032	.0559	.0214	.0069	.0045	.0005	.0000	.0000	.0000	.0000	.0000	.1199
.00 H2	.3886	.3200	.2613	.2218	.2090	.2075	.2056	.2056	.2056	.2056	.2056	.2056	.3405
40.30 H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	2.1756	2.2877	2.3812	2.4454	2.4688	2.4721	2.4773	2.4778	2.4778	2.4778	2.4778	2.4778	2.2545
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N*O	.0398	.0236	.0114	.0036	.0009	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0282
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.9387	1.9479	1.9548	1.9591	1.9606	1.9609	1.9612	1.9612	1.9612	1.9612	1.9612	1.9612	1.9453
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0178	.0089	.0033	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0113
.00 O2	.0359	.0257	.0123	.0031	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0302

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA									
COMPONENT										DENSITY									
TREF FORMULA										HEAT FORM									
DEG K										(KCAL/FORM.WT.)									
298 N2=04										57.									
298 N2=44										43.									
PROZEN EXPANSION										C STAR = 5650.4 FT/SEC									
C STAR = 5650.4 FT/SEC										I AT 10000									
PSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I	DELTAC	DELTAC	DELTAC	DELTAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	LVL	LVL	LVL	LVL
			DEG K	KCAL/100GM	DEG														
1.000	1.000	100.000	184.87	12.82	1.277														
1.000	1.000	100.000	202.55	-4.04	.518	171.1	91.6	.585	210.1	212.7	217.7	218.7	1.136	1.245					
2.000	9.242	32.462	2090.8	-41.32	.494	217.6	34.5	1.218	234.2	244.6	255.0	257.1	1.362	1.464					
3.000	16.359	18.338	1852.1	-52.96	.487	239.3	32.4	1.764	245.7	251.5	268.6	271.6	1.399	1.547					
4.000	24.499	12.049	1700.2	-60.72	.474	252.1	28.2	2.362		256.3	276.3	280.3		1.596					
5.000	34.753	8.677	1531.5	-65.34	.467	260.8	24.5	3.041			281.3	286.3		1.630					
6.000	44.456	6.682	1507.8	-69.22	.461	267.2	23.6	3.532			284.7	290.8		1.656					
7.000	55.548	5.401	1440.4	-72.31	.456	272.1	22.1	4.103			287.3	294.3		1.676					
8.000	67.546	4.441	1384.1	-74.87	.452	276.2	21.0	4.718			289.1	297.2		1.692					
9.000	80.314	3.744	1335.9	-77.03	.448	279.6	20.0	5.340			290.5	299.4		1.708					
10.000	92.762	3.233	1294.2	-78.90	.444	282.5	19.2	5.925			291.5	301.6		1.718					
11.000	105.014	2.841	1257.4	-80.53	.441	285.0	18.5	6.496			292.4	303.4		1.728					
12.000	118.419	2.533	1224.5	-81.97	.438	287.2	17.8	7.041			293.0	305.0		1.737					
13.000	132.439	2.265	1194.8	-83.27	.436	289.1	17.3	7.531			293.4	306.4		1.745					
14.000	147.326	2.036	1167.9	-84.44	.433	290.9	16.8	8.047			293.6	307.7		1.752					
15.000	162.575	1.845	1143.3	-85.50	.431	292.5	16.3	8.480			293.7	308.8		1.759					
16.000	178.103	1.684	1120.6	-86.48	.429	293.9	15.9	8.947			309.9			1.764					
17.000	193.832	1.548	1099.7	-87.37	.427	295.2	15.6	9.365			310.8			1.770					
18.000	209.853	1.431	1080.2	-88.10	.425	296.5	15.2	9.732			311.7			1.775					
19.000	226.032	1.332	1062.0	-88.69	.423	297.6	14.9	10.057			312.5			1.780					
20.000	241.607	1.242	1045.0	-89.69	.422	298.6	14.6	10.344			313.3			1.784					
21.000	257.552	1.165	1029.1	-90.77	.420	299.6	14.4	10.596			314.3			1.788					
22.000	273.786	1.105	1014.0	-91.77	.419	300.5	14.1	10.882			314.6			1.792					
23.000	291.758	1.058	999.8	-92.58	.417	301.4	13.9	11.144			315.1			1.795					
24.000	310.343	1.028	986.3	-93.15	.416	302.2	13.7	11.379			315.9			1.797					
25.000	328.621	1.013	973.5	-93.54	.415	303.0	13.6	11.584			316.4			1.802					
26.000	347.455	1.001	961.3	-93.89	.414	303.7	13.2	11.755			316.9			1.805					
27.000	366.715	0.991	949.7	-94.17	.412	304.4	13.1	11.894			317.4			1.807					
28.000	386.769	0.982	938.6	-94.43	.411	305.0	12.9	12.015			317.9			1.810					
29.000	406.749	0.974	928.0	-94.66	.410	305.7	12.7	12.155			318.3			1.813					
30.000	426.748	0.966	917.9	-94.86	.409	306.2	12.5	12.255			318.8			1.815					
31.000	446.420	0.959	908.1	-95.03	.408	306.8	12.4	12.344			319.2			1.817					
32.000	466.169	0.952	898.8	-95.17	.407	307.3	12.2	12.426			319.6			1.820					
33.000	486.019	0.945	889.8	-95.27	.406	307.9	12.1	12.505			320.0			1.822					
34.000	505.948	0.939	881.1	-95.47	.406	308.4	12.0	12.577			320.4			1.824					
35.000	525.937	0.933	872.8	-95.61	.405	308.8	11.8	12.644			320.7			1.826					
36.000	545.754	0.928	864.8	-95.71	.404	309.3	11.7	12.707			321.0			1.828					
37.000	565.772	0.923	857.0	-95.75	.403	309.7	11.6	12.751			321.3			1.830					
38.000	585.764	0.918	849.5	-95.75	.402	310.2	11.5	12.785			321.6			1.831					
39.000	605.770	0.913	842.2	-95.75	.402	310.6	11.3	12.833			321.9			1.833					
40.000	625.860	0.908	835.2	-95.75	.401	311.0	11.2	12.877			322.2			1.835					
41.000	645.910	0.903	828.4	-95.75	.400	311.3	11.1	12.915			322.5			1.836					
42.000	665.967	0.898	821.8	-95.85	.399	311.7	11.0	12.944			322.7			1.838					
43.000	685.978	0.893	815.4	-95.91	.399	312.1	10.9	12.974			323.0			1.839					
44.000	705.977	0.888	809.1	-95.96	.398	312.4	10.8	12.999			323.2			1.841					
45.000	725.956	0.883	803.1	-95.96	.398	312.7	10.7	13.024			323.4			1.842					
46.000	745.910	0.878	797.2	-95.96	.397	313.1	10.7	13.044			323.7			1.843					
47.000	765.845	0.873	791.5	-95.96	.396	313.4	10.6	13.064			323.9			1.845					
48.000	785.765	0.868	785.9	-95.96	.396	313.7	10.5	13.084			324.2			1.846					
49.000	805.655	0.863	780.5	-95.96	.395	314.0	10.4	13.104			324.4			1.847					
50.000	825.517	0.858	775.2	-95.96	.395	314.3	10.3	13.124			324.6			1.848					
3.444	20.414	14.616	1763.4	-56.31	.478	246.3	30.1	2.046	246.3	255.4	272.4	276.4	1.422	1.574					

SHIFTING EXPANSION																	
C STAR = 5795.1 FT/SEC																	
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I DEG	DELTAC I	DELTAC I	DELTAC I	DELTAC I	I SEA LVL	I AT 10000	I AT 56000	I VAC LVL	CF SEA LVL	CF VAC LVL		
1.000	1.000	100.000	184.87	12.82	1.277												
2.000	1.736	172.455	2971.2	-1.32	1.165	118.5	103.8		1.620	213.4	216.1	221.2	222.3	1.234	1.185		
3.000	8.241	35.182	2489.2	-42.24	.774	219.4	45.2	1.240	230.3	231.8	262.5	267.6	1.367	1.409			
4.000	16.365	24.835	2284.3	-55.33	.624	243.6	37.7	1.809	254.8	262.8	276.3	281.4	1.415	1.562			
5.000	24.667	15.810	2114.6	-63.88	.552	258.3	33.2	2.402		266.9				1.613			
6.000	34.753	10.424	2019.9	-69.58	.472	269.9	28.2	3.009						1.698			
7.000	44.456	7.740	1926.4	-74.86	.400	275.9	28.0	3.622						1.687			
8.000	54.214	6.245	1850.1	-78.42	.489	281.7	26.4	4.227						1.711			
9.000	77.686	5.201	1785.6	-81.53	.482	286.5	25.0	4.812						1.730			
10.000	68.315	4.791	1707.6	-84.18	.468	291.2	23.9	5.491						1.759			
11.000	79.253	4.781	1627.4	-86.27	.472	293.9	23.0	6.073						1.750			
12.000	90.465	3.816	1633.7	-88.48	.468	296.3	22.2	6.685						1.771			
13.000	101.765	2.950	1671.5	-90.26	.466	299.5	21.5	7.277						1.782			
14.000	112.928	2.657	1586.9	-91.87	.463	301.8	20.8	7.847						1.793			
15.000	124.461	2.415	1515.5	-93.31	.461	304.1	20.3	8.404						1.800			
16.000	137.105	2.168	1506.7	-94.64	.458	305.8	19.8	9.042						1.807			
17.000	150.149	1.998	1480.2	-95.85	.456	307.5	19.3	9.673						1.814			
18.000	163.436	1.836	1455.7	-96.97	.454	309.1	18.9	10.301						1.821			
19.000	176.910	1.680	1432.9	-98.00	.452	310.6	18.4	10.924						1.828			
20.000	190.517	1.535	1411.5	-98.97	.451	313.9	18.2	11.539						1.832			
20.030	204.214	1.489	1391.5	-99.87	.449	313.1	17.8	12.145						1.837			
21.000	217.962	1.376	1372.7	-100.71	.447	313.4	17.5	12.740						1.842			
22.000	231.729	1.295	1355.0	-101.50	.446	315.4	17.2	13.323						1.846			
23.000	245.492	1.232	1338.2	-102.25	.445	316.4	17.0	13.894						1.850			
24.000	259.219	1.177	1322.2	-102.96	.443	317.4	16.7	14.455						1.855			
25.000	273.115	1.098	1303.1	-103.63	.442	318.3	16.5	15.012						1.859			
26.000	288.510	1.040	1292.7	-104.26	.441	319.2	16.3	15.561						1.862			
27.000	304.371	.986	1281.9	-104.87	.439	320.1	16.0	16.103						1.865			
28.000	320.618	.937	1269.7	-105.45	.438	320.8	15.8	16.600						1.869			
29.000	336.350	.893	1253.1	-106.00	.437	321.5	15.6	17.029						1.872			
30.000	352.246	.852	1241.0	-106.52	.436	322.5	15.4	17.456						1.875			
31.000	368.587	.814	1229.4	-107.03	.435	322.9	15.3	17.881						1.878			
32.000	385.013	.781	1218.3	-107.51	.434	323.4	15.1	18.299						1.881			
33.000	401.627	.747	1207.5	-107.98	.433	324.2	15.0	20.021						1.883			
34.000	418.290	.717	1197.2	-108.43	.432	324.8	14.8	20.634						1.885			
35.000	435.029	.686	1187.2	-108.86	.431	325.4	14.6	21.244						1.888			
36.000	451.828	.656	1177.6	-109.27	.430	325.9	14.5	21.848						1.890			
37.000	468.811	.626	1168.3	-109.67	.429	326.4	14.4	22.446						1.892			
38.000	485.850	.596	1159.2	-110.06	.428	327.2	14.2	23.039						1.894			
39.000	502.451	.567	1150.5	-110.43	.428	327.8	14.1	23.626						1.896			
40.000	519.372	.538	1142.0	-110.79	.427	327.9	14.0	24.203						1.899			
41.000	536.600	.510	1133.8	-111.14	.426	328.3	13.9	24.781						1.901			
42.000	553.231	.482	1125.9	-111.48	.425	328.9	13.7	25.350						1.902			
43.000	570.162	.456	1118.1	-111.81	.424	329.3	13.6	25.912						1.904			
44.000	587.091	.431	1110.6	-112.13	.424	329.7	13.5	26.469						1.906			
45.000	604.016	.407	1103.3	-112.44	.423	330.1	13.4	27.019						1.908			
46.000	621.020	.382	1096.1	-112.74	.422	330.5	13.3	27.563						1.910			
47.000	641.683	.358	1089.2	-113.03	.421	330.9	13.2	28.271						1.911			
48.000	660.862	.334	1082.4	-113.32	.421	331.3	13.1	28.899						1.912			
49.000	680.069	.314	1075.8	-113.60	.420	331.6	13.0	29.528						1.914			
50.000	699.497	.294	1069.3	-113.88	.419	331.9	12.9	30.152						1.915			
3.835	20.414	14.928	2150.4	-62.08	.360	256.3	33.0	2.302	256.3	266.5	280.2	290.1	1.423	1.611			

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 298 N2*O4 1.43 -5.4 64.
 298 N2*H4 1.004 +12.05 36.

BULK DENSITY = 1.241 GM/CC
 MIXTURE RATIO = 1.778 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 278.64 EU/100GMS

	CHAMBER										THROAT															
	FROZEN EXPANSION																									
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	167.8													
TEMP, DEG K	3077.3	2654.6	2282.8	1955.3	1730.9	1667.0	1413.1	1189.8	994.4	824.5	678.4	554.3	2765.2													
ENTHALPY (-)	-9.78	10.62	28.18	43.27	53.33	56.15	67.11	76.37	84.14	90.61	95.95	100.33	5.32													
CP	.4869	.4776	.4666	.4539	.4430	.4394	.4232	.4060	.3885	.3727	.3588	.3477	.4803													
IMPUL OPT	133.21	181.73	214.82	234.32	239.50	258.63	273.76	285.84	295.52	303.28	309.51	314.60														
IMPUL VAC	210.39	230.38	250.07	262.93	266.46	279.79	290.60	299.32	306.33	311.95	316.44	308.05														
EPSILON	1.029	1.444	2.330	3.496	3.968	6.938	12.289	21.906	39.124	69.851	124.544	1.000														
	SHIFTING EXPANSION																									
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.4													
TEMP, DEG K	3077.3	2811.6	2547.1	2276.9	2065.8	2001.8	1733.4	1484.1	1259.6	1060.6	885.9	734.0	2891.0													
ENTHALPY (-)	-9.78	11.06	29.93	46.58	58.11	61.37	74.25	85.33	94.77	102.76	109.45	115.03	5.02													
X BAR	4.480	4.423	4.380	4.352	4.341	4.339	4.335	4.333	4.333	4.333	4.333	4.333	4.438													
N	4.480	4.423	4.380	4.352	4.341	4.339	4.335	4.333	4.333	4.333	4.333	4.333	4.438													
CP	1.0527	.8979	.7393	.6040	.5294	.5121	.4609	.4315	.4103	.3919	.3746	.3592	.9457													
IMPUL OPT	134.66	185.63	221.43	243.02	248.80	270.38	287.65	301.60	312.90	322.07	329.51	313.47														
IMPUL VAC	214.49	237.58	260.12	274.92	278.98	294.40	306.98	317.24	325.60	332.38	337.86	211.23														
EPSILON	1.039	1.506	2.497	3.806	4.338	7.630	13.779	24.838	44.891	81.123	146.310	1.000														
	COMPOSITION SHIFTING (MOL/100 GM)																									
52.10 F	.0317	.0156	.0059	.0015	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0197													
79.20 H*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
-10.00 H*N	.0068	.0043	.0025	.0013	.0008	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0049													
9.33 H*O	.2008	.1384	.0842	.0422	.0207	.0161	.0044	.0008	.0001	.0000	.0000	.0000	.1564													
.00 F2	.1165	.0697	.0342	.0124	.0043	.0029	.0004	.0000	.0000	.0000	.0000	.0000	.0828													
40.30 F2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
-57.80 H2*O	2.0105	2.0978	2.1662	2.2118	2.2315	2.2352	2.2439	2.2462	2.2466	2.2466	2.2466	2.2466	2.0733													
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
113.00 N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
21.65 N*O	.0833	.0608	.0416	.0256	.0159	.0135	.0059	.0020	.0006	.0001	.0000	.0000	.0672													
8.06 N*O2	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001													
.00 N2	1.7737	1.7862	1.7968	1.8054	1.8105	1.8118	1.8158	1.8178	1.8186	1.8188	1.8188	1.8188	1.7827													
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000													
59.56 O	.0323	.0188	.0091	.0033	.0011	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0225													
.00 O2	.2241	.2309	.2393	.2490	.2561	.2579	.2638	.2665	.2674	.2677	.2677	.2677	.2288													

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		DENSITY		HEAT FORM		WT. O/D	
COMPONENT										REF FORMULA		GM/CC		(KCAL/FORM.WT.)		%	
										DEG K		1.43		5.4		84.	
										298 N2O4		1.004		412.05		36.	
										298 N2H4							
										FROZEN EXPANSION							
										C STAR = 5375.4 FT/SEC							
										GM DEG							
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OF₂ - B₂H₆ SYSTEM

PRESSURE PROFILE DATA
 SYSTEM C-F2-B2H6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 CEG K GM/CC (KCAL/FORM.WT.)
 OF2 128 O*F2 1.54 3.5 66.0
 B2H6 180 R2*H6 0.445 2.50 34.0

BULK DENSITY = .836 GM/CC
 MIXTURE RATIO = 1.941 LP OXIDIZER / LP OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRCPY 351.46 EU/100GMS

CHAMBER

THROAT

	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	550.1
MP, DEG K	3663.6	3037.4	2508.7	2063.3	1688.5	1498.7	1374.0	1110.9	892.8	713.1	566.0	446.5	3245.3
ENTHALPY (-)	-7.35	31.72	64.06	90.72	112.60	123.43	130.45	144.93	156.60	165.96	173.41	179.31	18.84
X BAR	.6300	.6173	.6052	.5911	.5754	.5660	.5585	.5424	.5278	.5132	.4997	.4869	.6219
PLL OPT	184.36	249.25	292.09	323.03	337.31	346.23	363.97	377.67	388.29	396.55	402.97	409.09	150.93
PLL VAC	275.36	304.84	331.11	351.90	361.85	368.15	380.83	390.72	398.44	404.44	409.09	269.69	
SILCN	1.059	1.625	2.864	5.323	7.734	10.152	19.614	38.158	74.462	145.371	283.433	1.000	

	SHIFTING EXPANSION												
ESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	567.8
MP, DEG K	3663.6	3253.5	2674.2	2512.5	2167.7	1979.6	1851.4	1628.4	1518.6	1421.4	1348.2	1284.7	3407.1
ENTHALPY (-)	-7.35	32.73	67.73	98.17	124.43	137.92	146.84	165.92	183.00	198.57	212.86	226.10	17.91
X BAR	6.389	6.286	6.207	6.153	6.118	6.100	6.086	6.066	6.059	5.718	5.569	5.426	6.323
N	6.389	6.286	6.207	6.153	6.118	6.100	6.086	6.038	5.973	5.905	5.871	5.843	6.323
CP	1.2136	1.1727	1.0085	.8592	.7659	.7420	.7314	2.7605	3.0466	3.2895	6.4023	6.8456	1.2315
IMPLL OPT	186.72	255.57	302.98	338.59	355.49	366.25	388.25	406.94	423.25	437.69	450.65	448.22	
IMPLL VAC	281.41	315.91	347.09	372.45	384.86	392.85	410.03	425.64	439.85	452.52	464.03	273.88	
EPSILCN	1.075	1.721	3.159	6.092	9.030	12.020	24.720	53.894	118.903	266.809	604.322	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 E	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
45.47 E*F	1.2988	1.2839	1.2670	1.2484	1.2261	1.2105	1.1988	1.1929	1.2140	1.2251	1.1039	.9686	1.2899
-143.00 E*F*O	.6856	.7830	.8793	.9690	1.0372	1.0570	1.0586	.9664	.7712	.5732	.4832	.4111	.7453
-133.84 E*F2	.0232	.0171	.0128	.0096	.0068	.0051	.0039	.0021	.0017	.0012	.0008	.0005	.0192
-271.00 E*F3	.0030	.0036	.0052	.0095	.0218	.0349	.0465	.0819	.1371	.1963	.2623	.3272	.0033
174.76 E*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 E*H*O	.2929	.2578	.2148	.1671	.1255	.1109	.1058	.0858	.0496	.0290	.0178	.0111	.2724
-135.32 E*H*O2	.0363	.0340	.0290	.0219	.0148	.0118	.0101	.0058	.0023	.0008	.0004	.0002	.0352
61.00 E*H2	.0018	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010
-45.00 E*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 E*H3	.0003	.0001	.0001	.0001	.0000	.0000	.0001	.0001	.0000	.0000	.0000	.0000	.0002
-238.60 E*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 E*O	.0635	.0474	.0217	.0073	.0017	.0006	.0003	.0001	.0000	.0000	.0000	.0000	.0602
-84.00 E*O2	.0036	.0021	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026
-111.60 E2*O2	.0116	.0112	.0103	.0089	.0082	.0090	.0108	.0128	.0061	.0030	.0015	.0008	.0114
-211.10 E2*O3	.0015	.0019	.0022	.0024	.0028	.0035	.0045	.0057	.0023	.0009	.0005	.0002	.0018
-567.00 E3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0001	.0004	.0069	.0114	.0161	.0212	.0260	.0000
8.86 F	.0011	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
-64.50 F*H	.4035	.3322	.2570	.1794	.1022	.0618	.0366	.0144	.0102	.0066	.0051	.0040	.3603
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.CC F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F*	.4476	.2779	.1457	.0589	.0166	.0066	.0031	.0007	.0003	.0001	.0001	.0000	.3394
9.33 F**	.0038	.0012	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019
.CC F2	3.0411	3.1988	3.3409	3.4608	3.5559	3.5867	3.6042	3.6303	3.6525	3.6722	3.6762	3.6794	
-57.80 F2*O	.0486	.0328	.0193	.0093	.0033	.0016	.0009	.0002	.0001	.0000	.0000	.0000	.0387
59.56 C	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.CC O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 E2*O3/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0316	.1145	.2175	.2398	.0000
.CC E/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0850	.1776	.0000

PRESSURE PROFILE DATA
 SYSTEM C-F2-R2H6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 OF2 126 0*F2 1.53 +3.5 70.0
 B2H6 180 B2H6 0.445 +2.50 30.0

BULK DENSITY = .884 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 340.18 EU/100GMS

CHAMBER

THRUST

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	554.3
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	554.3
TEMP, DEG K	398.1	3303.8	2727.2	2242.6	1835.7	1630.0	1494.7	1209.8	973.2	778.1	618.3	488.3	3536.6
ENTHALPY (-)	-7.25	32.92	66.13	93.50	115.45	127.08	134.29	149.18	161.19	170.63	178.51	184.60	19.35
CP	.5915	.5810	.5706	.5581	.5449	.5364	.5301	.5146	.5005	.4871	.4741	.4621	.5848
IMPLL OPT	186.42	252.65	296.04	327.38	341.84	350.91	368.90	382.40	393.60	402.00	408.53	412.10	152.10
IMPLL VAC	279.13	308.96	335.56	356.63	366.72	373.13	386.00	396.06	403.91	410.02	414.77	273.40	
EPSILON	1.058	1.624	2.862	5.322	7.735	10.155	19.638	38.240	74.690	145.974	284.932	1.000	

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.5
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.5
TEMP, DEG K	398.1	3575.3	3204.0	2859.9	2533.1	2353.5	2233.1	1979.0	1754.0	1537.5	1419.4	1346.4	3730.1
ENTHALPY (-)	-7.25	34.05	70.37	102.33	130.37	145.03	154.86	176.25	194.99	211.33	225.70	238.91	18.63
X BAR	6.034	5.912	5.806	5.720	5.652	5.617	5.591	5.522	5.456	5.403	5.288	5.154	5.958
N	6.034	5.912	5.806	5.720	5.652	5.617	5.591	5.522	5.456	5.403	5.327	5.258	5.958
CP	1.4972	1.3864	1.2416	1.0741	.9422	.9259	.9459	.9976	.8925	.8877	4.7728	4.7811	1.4324
IMPLL OPT	189.55	259.85	308.75	346.01	363.98	375.54	399.54	419.45	436.07	450.17	462.76	150.04	
IMPLL VAC	285.95	321.74	354.55	381.78	395.38	404.28	423.18	439.17	452.54	464.59	475.72	278.09	
EPSILON	1.077	1.737	3.229	6.334	9.502	12.782	26.415	55.355	116.095	255.246	576.569	1.000	

	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
132.60 B	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 B*F	.9822	.9556	.9289	.9013	.8659	.8460	.8247	.7618	.6996	.6588	.6532	.6551	.9659
-143.00 B*F*0	.7898	.8947	.9962	1.0905	1.1703	1.2051	1.2235	1.2487	1.2567	1.2363	1.0795	.8861	.8542
-133.84 B*F2	.0299	.0225	.0174	.0141	.0120	.0110	.0102	.0072	.0040	.0017	.0010	.0007	.0251
-270.00 B*F3	.0040	.0045	.0058	.0093	.0200	.0350	.0521	.1107	.1732	.2162	.2598	.3207	.0042
114.76 B*H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*H*0	.1933	.1676	.1367	.1024	.0683	.0519	.0428	.0297	.0252	.0269	.0215	.0141	.1782
-135.32 B*H*02	.0383	.0362	.0313	.0240	.0157	.0115	.0092	.0059	.0044	.0037	.0022	.0010	.0374
66.00 B*H2	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
-45.00 B*H2*02	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*H3*03	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*0	.1068	.0680	.0374	.0165	.0054	.0024	.0013	.0003	.0001	.0000	.0000	.0000	.0823
-84.00 B*02	.0076	.0050	.0028	.0012	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0060
-111.60 B2*02	.0056	.0049	.0040	.0028	.0017	.0012	.0010	.0007	.0009	.0019	.0019	.0011	.0052
-210.10 B2*03	.0011	.0012	.0012	.0011	.0008	.0007	.0006	.0005	.0008	.0021	.0020	.0010	.0011
-567.00 B3*F3*03	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0051	.0213	.0259	.0000
18.86 F	.0059	.0023	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0034
-64.50 F*H	.7429	.6814	.6145	.5446	.4683	.4142	.3677	.2354	.1082	.0301	.0146	.0103	.7062
-26.10 F*H*0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.7054	.5116	.3375	.1931	.0898	.0517	.0336	.0111	.0030	.0005	.0002	.0001	.5851
9.33 F*0	.0153	.0065	.0023	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0093
.00 F2	2.3197	2.4657	2.6453	2.7910	2.9151	2.9768	3.0175	3.1068	3.1792	3.2196	3.2312	3.2377	2.4215
-57.80 F2*0	.0022	.0028	.0039	.0072	.0143	.0091	.0064	.0026	.0009	.0002	.0001	.0000	.0704
59.56 F	.0026	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 B2*03/0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0390	.1037	.0000

SYSTEM 0-F2-B2H6
COMPONENT C6H K
OF2 120 04F2
B2H6 100 B2H6

PC ICCE PSIA
DENSITY
GW/CC 1.53
0.445
+2.50

HEAT FORM
(KCAL/FORM.WT.)
+3.5
7C.0
30.0

PE 0.1 PSIA
WT. 0/B

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL / I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
1.000	1.000	1000.000	3986.5	7.25	592	152.1	121.3	270.2	271.2	273.0	274.4	1.235	1.249
2.000	9.715	102.932	2521.7	-77.82	560	272.0	47.3	313.5	315.4	319.3	320.1	1.432	1.463
3.000	17.129	58.382	2207.8	-95.44	557	296.9	38.5	327.7	330.6	336.3	337.4	1.498	1.542
4.000	26.949	37.107	2010.4	-106.39	551	318.5	33.3	339.6	343.6	350.2	351.6	1.529	1.589
5.000	38.739	27.216	1812.3	-115.96	548	324.7	30.1	348.0	353.5	361.9	363.6	1.547	1.621
6.000	47.450	21.057	1706.9	-119.99	542	332.3	27.7	354.7	361.5	371.8	373.6	1.557	1.644
7.000	54.205	16.890	1622.4	-124.26	539	336.2	25.9	361.6	369.4	381.6	383.4	1.561	1.664
8.000	59.423	14.003	1612.6	-128.01	536	340.0	24.5	369.4	378.2	391.4	393.2	1.564	1.680
9.000	64.471	11.838	1553.3	-131.16	533	344.0	23.2	378.2	387.9	405.1	406.8	1.567	1.692
10.000	67.900	10.215	1502.0	-133.43	530	348.4	22.0	387.9	398.4	419.1	420.8	1.569	1.703
11.000	71.423	8.913	1453.1	-135.29	528	353.4	21.5	398.4	409.9	434.6	436.3	1.570	1.713
12.000	72.138	7.862	1417.1	-138.35	526	358.0	20.8	409.9	422.4	451.6	453.3	1.571	1.721
13.000	72.700	7.008	1381.3	-140.27	524	363.2	20.1	422.4	435.9	469.1	470.8	1.572	1.729
14.000	73.057	6.305	1348.9	-141.97	522	368.0	19.5	435.9	450.4	487.1	488.8	1.573	1.736
15.000	73.172	5.721	1316.4	-144.51	521	373.4	19.0	450.4	465.9	505.6	507.3	1.574	1.742
16.000	73.159	5.251	1292.3	-146.91	519	378.4	18.5	465.9	482.4	524.6	526.3	1.575	1.747
17.000	72.941	4.816	1267.4	-149.21	518	383.4	18.1	482.4	499.9	544.1	545.8	1.576	1.752
18.000	72.463	4.401	1244.3	-151.40	517	388.4	17.7	499.9	517.9	564.1	565.8	1.577	1.757
19.000	71.685	4.015	1222.8	-153.51	515	393.4	17.3	517.9	536.9	584.1	585.8	1.578	1.761
20.000	70.578	3.676	1202.7	-155.55	514	398.4	17.0	536.9	556.9	604.1	605.8	1.579	1.765
21.000	69.127	3.373	1184.8	-157.52	513	403.4	16.7	556.9	577.9	624.1	625.8	1.580	1.769
22.000	67.341	3.102	1168.1	-159.42	512	408.4	16.4	577.9	599.9	644.1	645.8	1.581	1.773
23.000	65.246	2.856	1152.4	-161.26	511	413.4	16.1	599.9	621.9	664.1	665.8	1.582	1.776
24.000	62.859	2.634	1137.6	-163.05	510	418.4	15.8	621.9	644.9	684.1	685.8	1.583	1.779
25.000	60.179	2.433	1124.6	-164.85	509	423.4	15.6	644.9	667.9	704.1	705.8	1.584	1.782
26.000	57.206	2.250	1113.4	-166.57	508	428.4	15.4	667.9	690.9	724.1	725.8	1.585	1.785
27.000	53.949	2.094	1094.9	-168.26	507	433.4	15.1	690.9	713.9	744.1	745.8	1.586	1.787
28.000	50.405	1.961	1078.0	-169.91	507	438.4	14.9	713.9	736.9	764.1	765.8	1.587	1.790
29.000	46.574	1.846	1062.7	-171.54	506	443.4	14.7	736.9	759.9	784.1	785.8	1.588	1.792
30.000	42.465	1.747	1049.0	-173.12	505	448.4	14.5	759.9	782.9	804.1	805.8	1.589	1.794
31.000	38.105	1.662	1036.7	-174.70	505	453.4	14.4	782.9	805.9	824.1	825.8	1.590	1.797
32.000	33.525	1.590	1025.9	-176.24	504	458.4	14.2	805.9	828.9	844.1	845.8	1.591	1.799
33.000	28.749	1.531	1016.5	-177.77	504	463.4	14.0	828.9	851.9	864.1	865.8	1.592	1.801
34.000	23.781	1.484	1008.6	-179.27	503	468.4	13.9	851.9	874.9	884.1	885.8	1.593	1.803
35.000	18.624	1.447	1002.0	-180.75	502	473.4	13.7	874.9	897.9	904.1	905.8	1.594	1.804
36.000	13.289	1.419	996.7	-182.21	502	478.4	13.6	897.9	920.9	924.1	925.8	1.595	1.806
37.000	7.781	1.401	992.8	-183.64	501	483.4	13.5	920.9	943.9	944.1	945.8	1.596	1.808
38.000	2.105	1.392	989.4	-185.04	501	488.4	13.3	943.9	966.9	964.1	965.8	1.597	1.809
39.000	-4.540	1.390	986.9	-186.41	500	493.4	13.2	966.9	989.9	984.1	985.8	1.598	1.811
40.000	-11.685	1.394	985.8	-187.75	500	498.4	13.0	989.9	1012.9	994.1	995.8	1.599	1.813
41.000	-19.429	1.403	986.0	-189.06	499	503.4	12.9	1012.9	1035.9	994.1	995.8	1.600	1.814
42.000	-27.773	1.416	987.4	-190.34	499	508.4	12.8	1035.9	1058.9	994.1	995.8	1.601	1.815
43.000	-36.717	1.433	990.1	-191.59	498	513.4	12.7	1058.9	1081.9	994.1	995.8	1.602	1.817
44.000	-46.261	1.454	994.4	-192.81	498	518.4	12.6	1081.9	1104.9	994.1	995.8	1.603	1.818
45.000	-56.405	1.479	1000.4	-193.99	497	523.4	12.5	1104.9	1127.9	994.1	995.8	1.604	1.819
46.000	-67.149	1.507	1008.1	-195.14	497	528.4	12.4	1127.9	1150.9	994.1	995.8	1.605	1.820
47.000	-78.493	1.537	1017.6	-196.26	496	533.4	12.3	1150.9	1173.9	994.1	995.8	1.606	1.822
48.000	-90.437	1.569	1029.0	-197.35	496	538.4	12.2	1173.9	1196.9	994.1	995.8	1.607	1.823
49.000	-102.981	1.603	1042.3	-198.42	495	543.4	12.1	1196.9	1219.9	994.1	995.8	1.608	1.824
50.000	-116.125	1.639	1057.6	-199.46	495	548.4	12.0	1219.9	1242.9	994.1	995.8	1.609	1.825
7.755	68.000	14.696	1033.0	-147.00	536	411.8	24.9	341.8	344.3	363.8	366.7	1.562	1.670

SHIFTING EXPANSION

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/ I OPT	C STAR = 7236.2 F/SEC		I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
						CP DEG	DELVAC						
1.000	1.000	1000.000	3986.5	7.25	1.492	152.0	121.0	270.0	271.0	273.0	274.4	1.237	1.222
2.000	1.750	565.504	2521.7	-77.82	1.432	150.0	47.0	313.0	315.0	319.0	320.1	1.439	1.469
3.000	8.250	121.096	2115.6	-97.40	1.201	278.1	36.2	323.5	325.5	329.5	330.3	1.539	1.609
4.000	18.661	57.722	2006.0	-106.39	1.092	304.8	30.8	329.0	331.0	335.0	336.2	1.577	1.562
5.000	31.802	37.151	1812.3	-111.01	1.022	322.0	28.0	335.0	337.0	341.0	342.1	1.559	1.599
6.000	49.657	32.073	2043.1	-121.21	0.977	334.3	26.7	345.0	347.1	351.1	352.2	1.588	1.659
7.000	77.370	26.791	2551.9	-128.31	0.949	343.4	26.4	356.1	358.2	362.2	363.3	1.601	1.689
8.000	95.604	21.926	2681.7	-134.11	0.937	355.7	26.1	367.1	369.2	373.2	374.3	1.611	1.714
9.000	114.475	18.347	2812.6	-139.71	0.930	368.0	25.9	378.2	380.3	384.3	385.4	1.616	1.734
10.000	134.076	15.754	2576.6	-145.16	0.918	381.1	25.7	389.3	391.4	395.4	396.5	1.610	1.751
11.000	154.200	13.739	2332.1	-148.76	0.915	396.1	25.6	400.4	402.5	406.4	407.5	1.600	1.768
12.000	174.845	12.126	2292.9	-149.97	0.912	411.1	25.5	411.5	413.6	417.5	418.6	1.588	1.786
13.000	196.000	10.785	2226.6	-155.40	0.909	426.1	25.4	422.6	424.7	428.6	429.7	1.576	1.776
14.000	217.749	9.796	2108.4	-157.74	0.906	441.1	25.3	433.7	435.8	439.7	440.8	1.564	1.766
15.000	241.443	8.998	2172.7	-159.08	0.903	456.1	25.2	444.8	446.9	450.8	451.9	1.552	1.756
16.000	267.100	8.315	2127.4	-161.81	0.900	471.1	25.1	455.9	458.0	461.9	463.0	1.540	1.746
17.000	294.552	6.871	2127.4	-163.08	0.897	486.1	25.0	467.0	469.1	473.0	474.1	1.528	1.736
18.000	324.742	6.380	2107.2	-165.37	0.894	501.1	24.9	478.1	480.2	484.1	485.2	1.516	1.726
19.000	356.626	5.951	2088.4	-166.97	0.891	516.1	24.8	489.2	491.3	495.2	496.3	1.504	1.716
20.000	390.288	5.576	2070.8	-168.84	0.888	531.1	24.8	500.3	502.4	506.3	507.4	1.492	1.706
21.000	425.737	5.244	2050.1	-169.80	0.885	546.1	24.7	511.4	513.5	517.4	518.5	1.480	1.696
22.000	463.965	4.951	2038.7	-171.18	0.882	561.1	24.6	522.5	524.6	528.5	529.6	1.468	1.686
23.000	504.910	4.689	2029.0	-172.43	0.879	576.1	24.5	533.6	535.7	539.6	540.7	1.456	1.676
24.000	548.584	4.455	2010.0	-173.61	0.876	591.1	24.4	544.7	546.8	550.7	551.8	1.444	1.666
25.000	595.000	4.245	1991.7	-174.75	0.873	606.1	24.3	555.8	557.9	561.8	562.9	1.432	1.656
26.000	644.267	4.055	1984.1	-175.82	0.870	621.1	24.2	566.9	569.0	572.9	574.0	1.420	1.646
27.000	696.570	3.867	1972.0	-176.84	0.867	636.1	24.1	578.0	580.1	584.0	585.1	1.408	1.636
28.000	751.932	3.686	1960.4	-177.83	0.864	651.1	24.0	589.1	591.2	595.1	596.2	1.396	1.626
29.000	810.263	3.515	1949.1	-178.77	0.861	666.1	23.9	600.2	602.3	606.2	607.3	1.384	1.616
30.000	871.584	3.363	1938.6	-179.67	0.858	681.1	23.8	611.3	613.4	617.3	618.4	1.372	1.606
31.000	935.910	3.222	1928.3	-180.54	0.854	696.1	23.7	622.4	624.5	628.4	629.5	1.360	1.596
32.000	1003.251	3.091	1918.4	-181.38	0.851	711.1	22.7	633.5	635.6	639.5	640.6	1.348	1.586
33.000	1073.607	2.976	1909.1	-182.19	0.848	726.1	22.6	644.6	646.7	650.6	651.7	1.336	1.576
34.000	1146.980	2.856	1899.7	-182.97	0.845	741.1	22.5	655.7	657.8	661.7	662.8	1.324	1.566
35.000	1223.373	2.755	1890.8	-183.70	0.842	756.1	22.4	666.8	668.9	672.8	673.9	1.312	1.556
36.000	1302.787	2.652	1882.2	-184.43	0.839	771.1	22.3	677.9	679.9	683.8	684.9	1.300	1.546
37.000	1385.220	2.556	1873.8	-185.13	0.836	786.1	22.2	689.0	691.1	695.0	696.1	1.288	1.536
38.000	1470.672	2.474	1865.7	-185.80	0.833	801.1	22.1	700.1	702.2	706.1	707.2	1.276	1.526
39.000	1559.140	2.396	1857.9	-186.44	0.830	816.1	22.0	711.2	713.3	717.2	718.3	1.264	1.516
40.000	1650.617	2.321	1850.2	-187.10	0.827	831.1	21.9	722.3	724.4	728.3	729.4	1.252	1.506
41.000	1745.100	2.251	1842.7	-187.71	0.824	846.1	21.8	733.4	735.5	739.4	740.5	1.240	1.496
42.000	1842.587	2.186	1835.4	-188.28	0.821	861.1	21.7	744.5	746.6	750.5	751.6	1.228	1.486
43.000	1943.070	2.123	1828.6	-188.80	0.818	876.1	21.6	755.6	757.7	761.6	762.7	1.216	1.476
44.000	2046.553	2.068	1821.7	-189.24	0.815	891.1	21.5	766.7	768.8	772.7	773.8	1.204	1.466
45.000	2153.036	2.009	1815.0	-190.01	0.812	906.1	21.4	777.8	779.9	783.8	784.9	1.192	1.456
46.000	2262.519	1.956	1808.5	-190.75	0.809	921.1	21.3	788.9	791.0	794.9	796.0	1.180	1.446
47.000	2374.992	1.908	1802.1	-191.07	0.806	936.1	21.2	799.9	802.0	805.9	807.0	1.168	1.436
48.000	2490.465	1.862	1795.9	-191.50	0.803	951.1	21.1	811.0	813.1	817.0	818.1	1.156	1.426
49.000	2608.940	1.818	1789.8	-192.08	0.800	966.1	21.0	822.1	824.2	828.1	829.2	1.144	1.416
50.000	2730.417	1.776	1783.9	-192.61	0.797	981.1	20.9	833.2	835.3	839.2	840.3	1.132	1.406
51.000	2854.894	1.736	1783.5	-193.01	0.794	996.1	20.8	844.3	846.4	850.3	851.4	1.120	1.396
52.000	2982.371	1.696	1783.5	-193.03	0.792	1011.1	20.7	855.4	857.5	861.4	862.5	1.108	1.386

PRESSURE PROFILE DATA
 SYSTEM C-F2-B2+6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/O
 DEG K GM/CC (KCAL/FORM.WT.)
 CF2 128 0*F2 1.53 +3.5 74.0
 B2+6 180 B2+H6 0.445 +2.50 26.0

BULK DENSITY = .936 GM/CC
 MIXTURE RATIO = 2.846 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 327.11 EU/100GMS

CHAMBER

INLET

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	.051
PRESSURE, PSIA	4296.4	3550.8	2425.4	2401.7	1963.6	1742.5	1597.5	1292.2	1038.8	830.1	659.2	520.7	379.9
TEMP, DEG K	-7.14	33.62	67.25	94.92	117.59	128.81	136.07	151.08	163.18	172.68	180.61	186.75	20.11
ENTHALPY (-)	.5510	.5421	.5332	.5230	.5113	.5037	.4984	.4841	.4709	.4582	.4460	.4345	.4244
CF	128.31	254.40	297.98	329.41	343.91	352.98	371.01	384.93	395.74	408.15	416.08	424.44	433.44
IMPLL OPT	281.09	310.98	337.64	358.74	368.84	375.25	388.15	398.21	406.06	412.17	416.12	419.36	422.50
IMPLL VAC	1.058	1.620	2.853	5.259	7.699	10.107	15.537	36.026	74.236	145.010	282.931	1.00	
EPSILON													

	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	.051
PRESSURE, PSIA	4296.4	3873.4	3494.7	3159.6	2844.4	2668.1	2544.4	2268.4	2040.2	1855.3	1695.3	1545.8	1431.9
TEMP, DEG K	-7.14	34.87	71.93	104.72	133.75	149.08	159.41	181.99	201.90	219.61	235.50	249.78	264.79
ENTHALPY (-)	5.692	5.559	5.439	5.332	5.242	5.197	5.167	5.097	5.018	4.934	4.852	4.781	4.719
X BAR	5.692	5.559	5.439	5.332	5.242	5.197	5.167	5.097	5.018	4.934	4.852	4.781	4.719
N	1.6549	1.5705	1.4518	1.3019	1.1280	1.0358	.9877	1.0073	1.1847	1.2995	1.2673	1.1054	1.6002
CP	191.18	262.28	311.95	350.11	368.65	380.65	405.63	426.44	444.15	459.45	472.77	481.15	486.29
IMPLL OPT	286.55	325.00	358.65	386.92	401.17	410.51	430.27	447.20	461.97	474.93	486.29	496.50	505.60
IMPLL VAC	1.078	1.744	3.262	6.460	9.752	13.161	27.285	57.725	124.465	271.613	555.690	1.000	
EPSILON													

	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
132.60 E	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 E+F	.6972	.6556	.6180	.5830	.5493	.5294	.5138	.4657	.3958	.3148	.2354	.1653	.0713
-143.00 E+F+O	.8380	.9448	1.0450	1.1368	1.2169	1.2564	1.2806	1.3216	1.3418	1.3514	1.3562	1.3562	.9038
-133.84 E+F2	.0323	.0237	.0177	.0137	.0111	.0102	.0096	.0084	.0064	.0042	.0023	.0011	.0267
-270.00 E+F3	.0044	.0045	.0049	.0063	.0059	.0147	.0207	.0530	.1164	.1956	.2748	.3451	.0044
114.76 E+H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 E+H+O	.1221	.1073	.0900	.0707	.0508	.0397	.0325	.0191	.0117	.0079	.0057	.0044	.1133
-135.32 E+H+O2	.0375	.0375	.0346	.0291	.0216	.0170	.0139	.0080	.0051	.0037	.0030	.0027	.0378
66.00 E+H2	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-45.00 E+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 E+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 E+H3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 E+O	.1238	.0968	.0548	.0300	.0134	.0074	.0046	.0012	.0003	.0001	.0000	.0000	.1008
-64.00 E+O2	.0142	.0108	.0072	.0040	.0018	.0010	.0006	.0001	.0000	.0000	.0000	.0000	.0122
-111.60 E2+O2	.0028	.0024	.0020	.0014	.0009	.0007	.0005	.0002	.0001	.0001	.0001	.0001	.0026
-210.10 E2+O3	.0008	.0008	.0009	.0008	.0006	.0005	.0004	.0003	.0002	.0002	.0002	.0003	.0008
-567.00 E3+O3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0000
18.86 F	.0228	.0108	.0046	.0017	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0147
-64.50 F+H	1.1049	1.0687	1.0228	.9729	.9219	.8903	.8647	.7778	.6412	.4795	.3200	.1792	1.0843
-26.10 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F+O	.9330	.7519	.5699	.3970	.2445	.1705	.1262	.0546	.0227	.0096	.0038	.0013	.8232
9.33 F+O	.0462	.0246	.0113	.0043	.0013	.0005	.0003	.0000	.0000	.0000	.0000	.0000	.0319
.00 F2	1.5517	1.7253	1.8756	2.0235	2.1598	2.2306	2.2770	2.3765	2.4712	2.5638	2.6492	2.7224	1.6680
-57.80 F2+O	.1132	.0967	.0771	.0566	.0373	.0275	.0213	.0108	.0056	.0030	.0017	.0008	.1036
59.56 O	.0148	.0059	.0020	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0087
.00 O2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002

PRESSURE PROFILE DATA
 SYSTEM C-F2-B2H6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/O
 CEG K GM/CC (KCAL/FORM.WT.)
 OF2 128 O+O2 1.53 +3.5 78.0
 B2H6 180 B2+H6 0.445 +2.50 22.0

BULK DENSITY = .996 GM/CC
 MIXTURE RATIO = 3.545 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRCPY 312.34 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	549.7
TEMP, DEG K	4581.7	3773.6	3099.2	2536.9	2068.7	1833.2	1679.0	1355.2	1087.2	866.8	686.9	541.0	4040.2
ENTHALPY (-)	-7.04	33.75	67.29	94.81	117.29	128.39	135.58	150.38	162.50	171.83	179.41	185.40	20.35
CP	.5011	.4934	.4849	.4747	.4683	.4632	.4508	.4384	.4266	.4155	.4053	.3937	.5037
IMPL OPT	188.38	254.30	297.67	328.87	343.25	352.24	370.07	383.87	394.47	402.74	409.16	415.38	154.38
IMPL VAC	291.03	310.66	337.08	357.97	367.95	374.28	387.01	396.91	404.64	410.63	415.28	415.28	275.42
EPSILON	1.057	1.615	2.837	5.260	7.633	10.011	19.320	37.371	73.146	142.615	277.726	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	571.5
TEMP, DEG K	4581.7	4157.0	3780.2	3440.7	3130.2	2959.5	2840.3	2562.7	2294.0	2050.2	1841.7	1639.6	4317.3
ENTHALPY (-)	-7.04	35.15	72.52	105.72	135.27	150.96	161.60	165.02	205.76	224.05	240.23	254.52	19.21
X BAR	5.350	5.212	5.086	4.970	4.866	4.812	4.775	4.700	4.638	4.577	4.513	4.457	5.265
A	5.350	5.212	5.086	4.970	4.866	4.812	4.775	4.700	4.638	4.577	4.513	4.457	5.265
CP	1.6731	1.7884	1.6677	1.5241	1.3612	1.2565	1.1779	.9919	.8810	.7573	.6218	.4733	1.8271
IMPL OPT	191.58	263.09	313.20	351.86	370.75	383.02	408.16	430.26	448.38	463.80	477.02	481.13	151.13
IMPL VAC	289.36	326.26	360.40	399.78	403.95	417.64	434.23	451.64	466.47	479.29	490.26	490.26	281.16
EPSILON	1.079	1.752	3.288	6.346	9.930	13.455	28.123	59.280	126.036	271.054	582.045	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 E	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
-45.47 E+F	.4655	.4066	.3544	.3089	.2683	.2464	.2311	.1952	.1566	.1069	.0495	.0097	.4290
-143.00 E+H+E	.8363	.9425	1.0406	1.1293	1.2088	1.2506	1.2785	1.3373	1.3816	1.4062	1.4132	1.3981	.9018
-133.84 E+H	.0324	.0222	.0152	.0105	.0075	.0062	.0055	.0043	.0034	.0025	.0012	.0003	.0257
-270.00 E+H	.0048	.0042	.0039	.0039	.0044	.0051	.0059	.0101	.0237	.0598	.1149	.1672	.0044
114.76 E+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 E+H+E	.0672	.0596	.0515	.0429	.0338	.0284	.0246	.0161	.0092	.0048	.0024	.0010	.0626
-135.32 E+H+E2	.0318	.0348	.0362	.0353	.0319	.0288	.0262	.0190	.0123	.0082	.0075	.0122	.0338
66.00 E+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 E+H2+E2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 E+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 E+H3+E3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 E+H	.1239	.0949	.0674	.0434	.0247	.0165	.0118	.0044	.0012	.0003	.0000	.0000	.1062
-84.00 E+H2	.0226	.0204	.0167	.0121	.0075	.0053	.0039	.0015	.0004	.0001	.0000	.0000	.0215
-111.60 E+H2	.0013	.0011	.0009	.0007	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0000	.0012
-210.10 E+H2+E3	.0005	.0006	.0007	.0007	.0006	.0006	.0005	.0004	.0003	.0002	.0002	.0003	.0006
-567.00 E+H3+E3+E3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0715	.0463	.0208	.0097	.0040	.0023	.0014	.0004	.0001	.0000	.0000	.0000	.0510
-64.50 F+H	1.4363	1.4424	1.4311	1.4083	1.3796	1.3620	1.3492	1.3170	1.2727	1.1914	1.0790	.9788	1.4424
-26.10 F+H+E	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	1.0338	.9069	.7647	.6102	.4516	.3621	.3008	.1715	.0792	.0309	.0110	.0028	.9586
9.33 F+O	.1073	.0722	.0438	.0233	.0166	.0061	.0039	.0011	.0002	.0000	.0000	.0000	.0853
.00 H2	.9202	1.0040	1.1066	1.2235	1.3472	1.4188	1.4686	1.5786	1.6711	1.7501	1.8205	1.8662	.9687
-57.80 F+H2	.1252	.1217	.1134	.1002	.0827	.0713	.0628	.0428	.0259	.0160	.0133	.0201	.1236
59.56 C	.0648	.0357	.0169	.0067	.0021	.0009	.0005	.0001	.0000	.0000	.0000	.0000	.0458
.00 C2	.0034	.0017	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0023

PRESSURE PROFILE DATA
 SYSTEM C-F2-B2H6 PC 1000 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORP.WT.)
 OF2 128 0*F2 1.53 +3.5 84.0
 B2H6 180 B2H6 0.445 +2.50 16.0

BULK DENSITY = 1.101 GM/CC
 MIXTURE RATIO = 5.250 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRCPY 286.90 EU/100GMS

CHAMBER

THROAT

	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	551.4
PRESSURE, PSIA	4876.7	3986.1	3249.4	2640.5	2137.7	1886.4	1722.5	1380.4	1099.4	870.2	684.8	535.8	4282.1
TEMP, DEG K	-6.89	32.25	64.20	90.21	111.30	121.67	128.35	142.04	152.99	161.68	168.54	173.92	19.30
ENTHALPY (-)	4421	4365	4305	4233	4152	4097	4053	3949	3841	3743	3654	3574	4386
CP	184.52	248.64	290.63	320.65	334.42	343.00	359.95	372.94	382.94	390.66	396.61	396.61	150.94
IMPLL OPT	274.93	303.36	328.66	348.55	358.03	364.01	375.99	385.27	392.45	397.99	402.26	402.26	269.66
IMPLL VAC	1.055	1.602	2.799	5.159	7.460	9.761	18.723	36.153	70.003	135.638	262.590	1.000	
EPSILON													

	1000	398.1	156.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	573.1
PRESSURE, PSIA	4876.7	4462.9	4099.0	3773.1	3477.5	3317.3	3206.8	2955.9	2717.2	2479.1	2224.5	1942.7	4619.8
TEMP, DEG K	-6.89	33.84	70.13	102.59	131.69	147.25	157.84	181.36	202.53	221.54	238.47	253.31	18.30
ENTHALPY (-)	4.841	4.700	4.569	4.446	4.331	4.267	4.223	4.123	4.034	3.959	3.904	3.874	4.755
X BAR	4.841	4.700	4.569	4.446	4.331	4.267	4.223	4.123	4.034	3.959	3.904	3.874	4.755
N	2.1796	2.1631	2.0836	1.9714	1.8363	1.7545	1.6876	1.6471	1.6279	1.6205	1.6195	1.6195	2.1767
CP	188.24	258.84	308.61	347.21	366.18	378.56	404.68	426.83	445.78	462.01	475.77	488.03	
IMPLL OPT	284.56	321.40	355.61	384.72	399.60	409.49	430.72	449.03	464.81	478.26	489.45	496.32	
IMPLL VAC	1.081	1.763	3.328	6.670	10.160	13.817	29.217	62.579	134.770	289.048	610.984	1.000	
EPSILON													

COMPOSITION SHIFTING (MOL/100 GM)

132.60 B	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-45.47 B*F	.2336	.1756	.1239	.0813	.0495	.0358	.0260	.0150	.0077	.0037	.0016	.0005	.1979
-143.00 B*F*O	.7438	.8312	.9056	.9644	1.0061	1.0231	1.0324	1.0471	1.0556	1.0625	1.0697	1.0740	.7980
-133.84 B*F*O	.0336	.0209	.0121	.0064	.0032	.0021	.0015	.0007	.0003	.0001	.0001	.0000	.0254
-270.00 B*F*O	.0077	.0060	.0044	.0031	.0021	.0017	.0014	.0010	.0008	.0008	.0011	.0026	.0067
114.76 B*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.12 B*H*O	.0173	.0139	.0111	.0087	.0066	.0056	.0049	.0034	.0022	.0014	.0007	.0003	.0152
-135.32 B*H*O	.0148	.0172	.0203	.0246	.0306	.0348	.0382	.0471	.0566	.0653	.0714	.0743	.0162
66.00 B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
16.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*O	.0773	.0612	.0464	.0332	.0221	.0168	.0145	.0075	.0036	.0014	.0003	.0000	.0675
-64.00 B*O2	.0263	.0287	.0310	.0331	.0346	.0349	.0348	.0327	.0276	.0191	.0094	.0026	.0278
-111.60 B2*O2	.0003	.0002	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-210.10 B2*O2	.0002	.0002	.0003	.0003	.0004	.0004	.0005	.0005	.0006	.0007	.0007	.0007	.0002
-567.00 B3*F2*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.2763	.1958	.1313	.0823	.0481	.0339	.0259	.0127	.0054	.0018	.0004	.0000	.2258
-64.50 F*H	1.7669	1.8487	1.9129	1.9608	1.9947	2.0090	2.0173	2.0317	2.0393	2.0404	2.0361	2.0286	1.8185
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.7715	.7058	.6364	.5604	.4763	.4244	.3863	.2945	.2057	.1241	.0563	.0153	.7320
9.32 F*O	.1926	.1688	.1475	.1280	.1090	.0976	.0890	.0674	.0446	.0233	.0078	.0013	.1779
.00 F2	.2709	.2687	.2715	.2782	.2926	.2962	.2962	.3037	.3104	.3203	.3358	.3497	.2691
-57.80 F2*O	.0811	.0676	.0480	.1142	.1378	.1553	.1696	.2079	.2490	.2861	.3116	.3240	.0847
59.56 O	.2521	.2392	.1897	.1440	.1031	.0818	.0678	.0392	.0183	.0058	.0009	.0000	.2598
.00 O2	.0339	.0303	.0267	.0233	.0196	.0173	.0155	.0109	.0060	.0021	.0003	.0000	.0317

SYSTEM G-F2-P2M6										PC 1000 PSIA										PE C.I. PSIA									
COMPONENT										DENSITY										WT. O/D									
REF. FORMULA										CP/CL										HEAT FORM.									
CEG K										+3.5										+3.5									
OF2										0.445										0.445									
P2M6										0.445										0.445									
FROZEN EXPANSION										C STAR = 0.0216 FT/SEC										C STAR = 0.0216 FT/SEC									
EPSILON										I SEA										I SEA									
PC/P										I AT										I AT									
P PSIA										I VAC										I VAC									
TEMP										CF SEA										CF SEA									
ENTHALPY										CF VAC										CF VAC									
CP CAL/ I OPT										DEL VAC										DEL VAC									
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SYSTEM 0-F2-B2H6
 COMPONENT TREF FORMULA PC 300 PSIA PE 0.1 PSIA
 DEG K DENSITY GM/CC HEAT FORM (KCAL/FORM.WT.) WT. O/O
 OF2 120 0*F2 1.53 +3.5 74.0
 B2H6 180 B2*H6 0.445 +2.50 26.0

BULK DENSITY = .936 GM/CC
 MIXTURE RATIO = 2.846 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 340.88 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	165.2
TEMP, DEG K	4061.8	3377.0	2799.5	2313.2	2113.3	1906.1	1560.4	1272.1	1031.4	831.8	667.1	532.1	3579.6
ENTHALPY (-)	-7.14	30.19	61.19	86.86	97.26	108.02	125.41	139.62	151.18	160.53	168.04	174.06	19.21
CP	.5492	.5407	.5324	.5226	.5178	.5117	.4997	.4862	.4740	.4622	.4507	.4401	.5435
IMPUL OPT	180.23	243.82	285.97	301.37	316.53	339.58	357.32	371.12	381.92	390.39	397.03	397.03	151.40
IMPUL VAC	274.54	301.62	326.68	336.67	346.81	362.71	375.24	385.11	392.88	398.99	403.78	403.78	270.41
EPSILON	1.042	1.523	2.562	3.334	4.547	8.289	15.329	28.563	53.422	100.050	187.291	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	171.5
TEMP, DEG K	4061.8	3709.4	3394.2	3107.8	2981.5	2841.5	2586.0	2334.6	2098.4	1905.2	1749.6	1614.5	3830.6
ENTHALPY (-)	-7.14	31.46	65.91	96.77	110.06	124.43	149.23	171.36	191.02	208.51	224.25	238.50	18.16
X BAR	5.822	5.681	5.551	5.434	5.384	5.330	5.242	5.169	5.102	5.026	4.944	4.866	5.730
N	5.822	5.681	5.551	5.434	5.384	5.330	5.242	5.169	5.102	5.026	4.944	4.866	5.730
CP	1.9735	1.8871	1.7665	1.6061	1.5170	1.4042	1.1797	1.0018	1.0329	1.2544	1.3971	1.3771	1.9224
IMPUL OPT	183.26	252.11	300.66	319.32	338.33	368.83	394.07	415.20	433.14	448.66	462.27	468.36	
IMPUL VAC	282.67	316.72	349.22	362.78	377.03	400.60	420.54	437.50	452.26	465.33	476.97	476.97	276.27
EPSILON	1.060	1.645	2.951	3.965	5.613	10.999	21.875	43.964	89.963	187.278	393.982	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
132.60 B	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
-45.47 B*F	.6874	.6477	.6136	.5839	.5711	.5573	.5327	.5066	.4658	.4003	.3231	.2468	.6611
-143.00 B*F*O	.8760	.9737	1.0637	1.1448	1.1792	1.2155	1.2739	1.3172	1.3429	1.3545	1.3598	1.3626	.9397
-133.84 B*F2	.0205	.0151	.0114	.0088	.0079	.0071	.0061	.0056	.0052	.0041	.0028	.0016	.0168
-270.00 B*F3	.0024	.0024	.0025	.0029	.0033	.0040	.0069	.0163	.0471	.1090	.1854	.2618	.0024
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*H*O	.1000	.0893	.0767	.0625	.0556	.0476	.0329	.0201	.0114	.0069	.0047	.0034	.0933
-135.32 B*H*O2	.0317	.0317	.0296	.0255	.0231	.0200	.0137	.0081	.0044	.0027	.0019	.0014	.0320
66.00 B*H2	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*O	.1375	.1001	.0671	.0405	.0305	.0212	.0089	.0028	.0007	.0002	.0001	.0000	.1131
-84.00 B*O2	.0159	.0124	.0087	.0053	.0040	.0027	.0011	.0003	.0001	.0000	.0000	.0000	.0137
-111.60 B2*O2	.0022	.0019	.0016	.0012	.0010	.0008	.0005	.0002	.0001	.0001	.0000	.0000	.0020
-210.10 B2*O3	.0007	.0007	.0007	.0007	.0006	.0006	.0004	.0002	.0001	.0001	.0001	.0001	.0007
567.00 B3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0239	.0121	.0057	.0024	.0016	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0156
-64.50 F*H	1.1052	1.0699	1.0275	.9833	.9631	.9409	.9010	.8567	.7802	.6506	.4959	.3426	1.0836
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	1.1562	.9624	.7658	.5738	.4880	.3949	.2389	.1194	.0498	.0208	.0091	.0039	1.0326
9.33 H*O	.0443	.0250	.0126	.0055	.0036	.0020	.0006	.0001	.0000	.0000	.0000	.0000	.0311
.00 H2	1.5069	1.6484	1.7959	1.9419	2.0076	2.0793	2.2014	2.3028	2.3884	2.4736	2.5594	2.6405	1.5967
-57.80 H2*O	.0914	.0795	.0651	.0499	.0429	.0351	.0221	.0120	.0058	.0030	.0016	.0009	.0840
59.56 O	.0187	.0082	.0031	.0010	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0112
.00 O2	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002

SYSTEM 8-72-B2M4 PC 800 PSIA PE 0.1 PSIA
 COMPONENT THEF FORMULA DENSITY HEAT FORM WT. B/S
 B2M4 120 B0P2 1.53 23.5 74.0
 B2M4 180 B2M4 0.449 22.50 26.0

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	C STAR = 4953.4 FT/SEC		I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
					CP CAL/ I OPT	DELVAC DELVAC						
			DEG K	KCAL/100GM	GH DEG	/P	LVL	10000	50000		LVL	
1.000	1.000	300.000	5001.8	7.14	549	151.4	119.0	229.8	263.0	269.2	270.4	1.231
2.000	0.753	30.761	2517.0	-76.17	527	269.8	44.2	1.501	293.9	300.6	313.4	1.360
3.000	17.433	17.209	2190.4	-93.26	520	295.6	37.3	2.167	301.0	310.6	329.2	1.393
4.000	26.908	11.149	1987.4	-103.75	514	310.6	32.2	2.888	313.2	317.9	342.8	1.586
5.000	37.478	8.005	1854.7	-111.06	510	320.7	28.9	3.618		343.5	349.6	1.618
6.000	49.248	6.092	1736.3	-116.37	506	326.1	26.4	4.370		347.2	354.7	1.641
7.000	61.528	4.876	1644.9	-120.92	503	333.0	24.9	5.100		350.0	358.7	1.660
8.000	73.898	4.060	1578.8	-124.49	500	338.4	23.5	5.784		352.0	361.9	1.674
9.000	87.617	3.424	1518.4	-127.50	498	342.3	22.3	6.420		353.5	364.6	1.687
10.000	102.471	2.928	1466.2	-130.09	496	346.3	21.3	7.022		354.4	366.9	1.698
11.000	117.778	2.547	1420.5	-132.35	493	348.6	20.5	7.604		355.1	368.9	1.707
12.000	133.326	2.250	1380.1	-134.34	492	350.9	19.8	8.169		355.6	370.4	1.715
13.000	148.936	2.014	1343.8	-136.12	490	353.0	19.2	8.708		356.0	372.2	1.722
14.000	164.473	1.824	1311.1	-137.72	488	355.0	18.6	9.218		356.2	373.6	1.729
15.000	179.858	1.668	1281.3	-139.17	487	356.6	18.1	9.707			374.3	1.734
16.000	196.889	1.524	1254.0	-140.50	485	358.4	17.6	11.158			376.0	1.740
17.000	215.200	1.394	1228.8	-141.72	484	359.9	17.2	12.327			377.1	1.745
18.000	235.939	1.282	1205.4	-142.85	483	361.2	16.8	13.095			378.0	1.749
19.000	255.031	1.186	1183.7	-143.90	482	362.5	16.4	13.868			378.9	1.753
20.000	272.402	1.101	1163.5	-144.88	481	363.7	16.1	14.646			379.8	1.757
21.000	291.980	1.027	1144.5	-145.79	480	364.8	15.8	15.368			380.5	1.761
22.000	311.700	0.962	1126.7	-146.64	479	365.8	15.5	16.105			381.3	1.764
23.000	331.503	0.905	1109.9	-147.46	478	366.7	15.2	16.830			382.0	1.767
24.000	351.336	0.851	1094.1	-148.25	477	367.4	15.0	17.548			382.4	1.770
25.000	371.135	0.804	1079.1	-148.91	477	368.5	14.7	18.234			383.2	1.773
26.000	390.935	0.767	1064.9	-149.59	476	369.3	14.5	18.912			383.8	1.776
27.000	410.643	0.731	1051.3	-150.23	475	370.0	14.3	19.574			384.3	1.778
28.000	430.269	0.697	1038.4	-150.85	474	370.7	14.1	20.230			384.8	1.781
29.000	451.129	0.665	1026.1	-151.43	474	371.6	13.9	20.911			385.3	1.783
30.000	473.916	0.633	1014.3	-151.99	473	372.1	13.7	21.676			385.8	1.785
31.000	497.037	0.604	1003.1	-152.52	472	372.7	13.5	22.443			386.2	1.787
32.000	520.465	0.576	992.3	-153.03	472	373.3	13.4	23.210			386.7	1.789
33.000	544.170	0.551	981.9	-153.52	471	373.9	13.2	23.978			387.1	1.791
34.000	568.141	0.528	971.9	-153.99	471	374.4	13.1	24.741			387.5	1.793
35.000	592.336	0.506	962.3	-154.44	470	374.9	12.9	25.504			387.8	1.795
36.000	616.735	0.486	953.1	-154.88	470	375.4	12.8	26.264			388.2	1.796
37.000	641.313	0.468	944.2	-155.29	469	375.9	12.6	27.021			388.6	1.798
38.000	666.064	0.450	935.4	-155.70	468	376.4	12.5	27.772			388.9	1.799
39.000	690.907	0.434	927.2	-156.09	468	376.8	12.4	28.519			389.2	1.801
40.000	715.877	0.419	919.2	-156.46	468	377.3	12.3	29.260			389.5	1.802
41.000	740.935	0.405	911.4	-156.82	467	377.7	12.1	29.995			389.8	1.804
42.000	766.059	0.392	903.9	-157.18	467	378.1	12.0	30.723			390.1	1.805
43.000	791.232	0.379	896.6	-157.52	466	378.5	11.9	31.444			390.4	1.806
44.000	816.436	0.367	889.5	-157.85	466	378.9	11.8	32.158			390.7	1.808
45.000	841.656	0.356	882.7	-158.17	465	379.2	11.7	32.864			390.9	1.809
46.000	866.879	0.346	876.0	-158.48	465	379.6	11.6	33.562			391.2	1.810
47.000	892.093	0.336	869.5	-158.78	465	379.9	11.5	34.254			391.4	1.811
48.000	917.283	0.327	863.2	-159.07	464	380.3	11.4	34.933			391.7	1.812
49.000	942.446	0.318	857.1	-159.36	464	380.6	11.3	35.606			391.9	1.813
50.000	967.573	0.310	851.1	-159.63	463	380.9	11.2	36.271			392.2	1.814
53.334	20.414	14.696	2113.3	-97.26	518	301.4	35.3	2.402	301.4	312.0	332.6	1.394

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GEM	SHIFTING EXPANSION C STAR = 7196.6 FT/SEC		I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA	CF VAC
					CP CAL/ I OPT	DELVAC DELVAC						
1.000	1.000	300.000	5001.8	7.14	1.973	148.4	127.9	265.3	268.6	275.0	276.3	1.235
2.000	0.753	30.761	2517.0	-76.17	1.922	148.4	44.2	1.501	293.9	300.6	313.4	1.360
3.000	13.923	21.947	3100.5	-97.54	1.901	301.0	46.2	2.239	317.1	327.0	358.2	1.504
4.000	20.662	14.519	2977.8	-105.45	1.914	319.8	43.3	2.984	332.5	358.1	383.2	1.623
5.000	27.400	10.746	2887.2	-110.91	1.942	342.6	40.2	3.737	344.1	366.1	394.1	1.665
6.000	35.513	8.005	2816.4	-127.05	1.982	361.7	37.9	4.500	356.7	371.9	375.6	1.696
7.000	43.704	6.094	2755.8	-132.97	1.929	349.2	36.1	5.265	356.7	379.3	383.3	1.722
8.000	52.142	5.736	2705.0	-137.94	1.924	355.3	34.7	6.039	356.7	379.7	390.0	1.743
9.000	60.657	4.946	2660.7	-142.20	1.925	360.5	33.6	6.791	356.7	382.5	394.1	1.761
10.000	69.123	4.289	2622.6	-145.93	1.924	364.9	32.4	7.524	356.7	384.7	397.5	1.777
11.000	77.467	3.673	2586.0	-149.23	1.923	368.8	31.8	8.204	356.6	386.6	400.6	1.790
12.000	87.034	3.447	2553.0	-152.20	1.923	372.3	31.0	8.988	356.0	388.0	403.3	1.803
13.000	96.825	3.096	2523.7	-154.89	1.923	375.9	30.3	9.793	355.9	389.1	405.8	1.814
14.000	106.772	2.810	2496.9	-157.33	1.924	378.3	30.0	10.584	355.0	390.0	408.0	1.824
15.000	116.816	2.561	2471.9	-159.59	1.924	380.7	29.2	11.368	354.9	390.7	410.1	1.833
16.000	126.894	2.364	2447.2	-161.66	1.924	383.2	28.7	12.139	354.2	391.2	411.9	1.841
17.000	136.944	2.190	2425.1	-163.59	1.924	385.4	28.2	12.896	354.0	391.7	413.7	1.849
18.000	146.998	2.041	2406.4	-165.39	1.924	387.4	27.8	13.635	353.8	392.0	415.3	1.856
19.000	156.922	1.912	2389.9	-167.07	1.924	389.3	27.4	14.353	353.3	392.3	416.8	1.863
20.000	166.757	1.799	2366.5	-168.64	1.924	391.1	27.1	15.054	352.9	392.5	418.1	1.869
21.000	176.477	1.700	2349.1	-170.13	1.924	392.7	26.7	15.735	352.6	392.5	419.5	1.875
22.000	186.279	1.611	2332.4	-171.53	1.924	394.3	26.4	16.413	352.6	392.7	420.7	1.880
23.000	196.036	1.537	2316.3	-172.86	1.924	395.7	26.1	17.084	352.5	392.8	421.9	1.885
24.000	206.815	1.437	2301.5	-174.13	1.924	397.1	25.9	17.744	352.4	392.9	423.0	1.890
25.000	220.279	1.362	2287.1	-175.33	1.924	398.4	25.6	18.385	352.3	393.0	424.0	1.895
26.000	231.849	1.294	2273.9	-176.48	1.924	399.7	25.3	19.017	352.2	393.1	425.0	1.900
27.000	243.528	1.232	2260.1	-177.59	1.924	400.9	25.1	20.364	352.1	393.2	426.0	1.904
28.000	255.269	1.175	2247.3	-178.63	1.924	402.0	24.9	21.333	352.0	393.3	426.9	1.908
29.000	267.011	1.126	2235.3	-179.63	1.924	403.1	24.6	22.136	351.9	393.4	427.9	1.912
30.000	278.826	1.076	2223.7	-180.59	1.924	404.1	24.4	22.715	351.8	393.5	428.6	1.915
31.000	290.663	1.032	2212.5	-181.52	1.924	405.1	24.2	23.288	351.7	393.6	429.4	1.919
32.000	302.508	0.992	2201.7	-182.41	1.924	406.1	24.1	23.845	351.6	393.7	430.1	1.922
33.000	314.347	0.954	2191.4	-183.27	1.924	407.0	23.9	24.015	351.5	393.8	430.9	1.926
34.000	326.169	0.920	2181.4	-184.09	1.924	407.9	23.7	25.767	351.4	393.9	431.6	1.929
35.000	337.962	0.888	2171.2	-184.89	1.924	408.7	23.5	26.511	351.3	394.0	432.3	1.932
36.000	349.717	0.858	2162.4	-185.67	1.924	409.6	23.4	27.241	351.2	394.1	432.9	1.935
37.000	361.427	0.829	2153.9	-186.43	1.924	410.4	23.2	27.957	351.1	394.2	433.6	1.938
38.000	373.083	0.804	2146.8	-187.14	1.924	411.1	23.1	28.693	351.0	394.3	434.2	1.941
39.000	384.681	0.780	2136.4	-187.84	1.924	411.9	22.9	29.402	350.9	394.4	434.8	1.944
40.000	396.214	0.757	2128.2	-188.52	1.924	412.6	22.8	30.102	350.8	394.5	435.4	1.946
41.000	407.684	0.736	2120.3	-189.17	1.924	413.3	22.7	30.795	350.7	394.6	436.0	1.949
42.000	419.094	0.716	2112.7	-189.81	1.924	413.9	22.5	31.475	350.6	394.7	436.5	1.951
43.000	430.414	0.697	2105.3	-190.44	1.924	414.6	22.4	32.148	350.5	394.8	437.0	1.953
44.000	441.738	0.679	2098.1	-191.04	1.924	415.2	22.3	32.818	350.4	394.9	437.5	1.955
45.000	453.060	0.660	2091.4	-191.63	1.924	415.8	22.2	33.486	350.3	395.0	438.0	1.957
46.000	464.382	0.642	2084.8	-192.20	1.924	416.4	22.1	34.146	350.2	395.1	438.5	1.959
47.000	475.704	0.626	2078.4	-192.76	1.924	417.0	22.0	34.796	350.1	395.2	439.0	1.962
48.000	487.026	0.607	2072.2	-193.30	1.924	417.6	21.9	35.488	350.0	395.3	439.5	1.964
49.000	498.348	0.591	2066.1	-193.83	1.924	418.1	21.7	36.782	350.0	395.4	440.0	1.966
50.000	509.670	0.576	2060.0	-194.36	1.924	418.7	21.6	37.465	350.0	395.5	440.5	1.968
51.000	520.993	0.561	2054.0	-194.88	1.924	419.2	21.5	38.141	350.0	395.6	441.0	1.970
52.000	532.315	0.546	2048.1	-195.39	1.924	419.7	21.4	38.817	350.0	395.7	441.5	1.972
53.000	543.638	0.531	2042.3	-195.89	1.924	420.2	21.3	39.492	350.0	395.8	442.0	1.974
54.000	554.960	0.516	2036.5	-196.39	1.924	420.7	21.2	40.167	350.0	395.9	442.5	1.976
55.000	566.283	0.501	2030.8	-196.89	1.924	421.2	21.1	40.842	350.0	396.0	443.0	1.978
56.000	577.605	0.486	2025.1	-197.39	1.924	421.7	21.0	41.517	350.0	396.1	443.5	1.980
57.000	588.928	0.471	2019.4	-197.89	1.924	422.2	20.9	42.192	350.0	396.2	444.0	1.982
58.000	600.250	0.456	2013.7	-198.39	1.924	422.7	20.8	42.867	350.0	396.3	444.5	1.984
59.000	611.573	0.441	2008.0	-198.89	1.924	423.2	20.7	43.542	350.0	396.4	445.0	1.986
60.000	622.895	0.426	2002.3	-199.39	1.924	423.7	20.6	44.217	350.0	396.5	445.5	1.988
61.000	634.218	0.411	1996.6	-199.89	1.924	424.2	20.5	44.892	350.0	396.6	446.0	1.990
62.000	645.540	0.396	1990.9	-200.39	1.924	424.7	20.4	45.567	350.0	396.7	446.5	1.992
63.000	656.863	0.381	1985.2	-200.89	1.924	425.2	20.3	46.242	350.0	396.8	447.0	1.994
64.000	668.185	0.366	1979.5	-201.39	1.924	425.7	20.2	46.917	350.0	396.9	447.5	1.996
65.000	679.508	0.351	1973.8	-201.89	1.924	426.2	20.1	47.592	350.0	397.0	448.0	1.998
66.000	690.830	0.336	1968.1	-202.39	1.924	426.7	20.0	48.267	350.0	397.1	448.5	1.999
67.000	702.153	0.321	1962.4	-202.89	1.924	427.2	19.9	48.942	350.0	397.2	449.0	2.001
68.000	713.475	0.306	1956.7	-203.39	1.924	427.7	19.8	49.617	350.0	397.3	449.5	2.003
69.000	724.798	0.291	1951.0	-203.89	1.924	428.2	19.7	50.292	350.0	397.4	450.0	2.005
70.000	736.120	0.276	1945.3	-204.39	1.924	428.7	19.6	50.967	350.0	397.5	450.5	2.007
71.000	747.443	0.261	1939.6	-204.89	1.924	429.2	19.5	51.642	350.0	397.6	451.0	2.009
72.000	758.765	0.246	1933.9	-205.39	1.924	429.7	19.4	52.317	350.0	397.7	451.5	2.011
73.000	770.088	0.231	1928.2	-205.89	1.924	430.2	19.3	52.992	350.0	397.8	452.0	2.013
74.000	781.410	0.216	1922.5	-206.39	1.924	430.7	19.2	53.667	350.0	397.9	452.5	2.015
75.000	792.733	0.201	1916.8	-206.89	1.924	431.2	19.1	54.342	350.0	398.0	453.0	2.017
76.000	804.055	0.186	1911.1	-207.39	1.924	431.7	19.0	55.017	350.0	398.1	453.5	2.019
77.000	815.378	0.171	1905.4	-207.89	1.924	432.2	18.9	55.692	350.0	398.2	454.0	2.021
78.000	826.700	0.156	1899.7	-208.39	1.924	432.7	18.8	56.367	350.0	398.3	454.5	2.023
79.000	838.023	0.141	1894.0	-208.89	1.924	433.2	18.7	57.042	350.0	398.4	455.0	2.025
80.000	849.345	0.126	1888.3	-209.39	1.924	433.7	18.6	57.717	350.0	398.5	455.5	2.027

PRESSURE PROFILE DATA
 SYSTEM 0-F2-B2H6 PC 300 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 OF2 128 0*F2 1.53 +3.5 78.0
 B2H6 180 B2*H6 0.445 +2.50 22.0

BULK DENSITY = .996 GM/CC
 MIXTURE RATIO = 3.545 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 325.30 EU/100GMS

	CHAMBER										THROAT															
	FROZEN										EXPANSION															
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	164.0													
TEMP, DEG K	4309.7	3569.6	2949.0	2428.8	2215.8	1993.3	1828.9	1324.5	1071.2	861.5	689.2	548.4	3782.6													
ENTHALPY (-)	-7.04	30.22	61.04	86.47	96.75	107.38	124.50	138.46	149.79	158.92	166.25	172.10	19.55													
CP	.5070	.5000	.4928	.4846	.4802	.4751	.4642	.4526	.4412	.4303	.4198	.4103	.5022													
IMPUL OPT	180.05	243.36	285.22	300.49	315.50	338.28	355.78	369.37	379.97	388.27	394.77	394.77	152.09													
IMPUL VAC	274.07	300.83	325.61	335.46	345.46	361.12	373.44	383.12	390.73	396.69	401.35	270.04														
EPSILON	1.040	1.518	2.546	3.310	4.508	8.201	15.133	28.136	52.506	98.116	183.253	1.000														

	SHIFTING EXPANSION																								
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	171.8												
TEMP, DEG K	4309.7	3569.6	3639.5	3351.9	3226.0	3088.1	2842.6	2609.3	2380.6	2151.3	1936.6	1755.0	4078.8												
ENTHALPY (-)	-7.04	31.62	66.24	97.35	110.79	125.35	150.58	173.35	193.82	212.15	228.46	243.00	18.19												
X BAR	5.486	5.343	5.211	5.089	5.035	4.977	4.875	4.785	4.710	4.649	4.592	4.531	5.394												
N	5.486	5.343	5.211	5.089	5.035	4.977	4.875	4.785	4.710	4.649	4.592	4.531	5.394												
CP	2.2242	2.1333	2.0089	1.8653	1.7905	1.7002	1.5080	1.2885	1.0591	.8960	.9340	.9736	2.1688												
IMPUL OPT	183.40	252.50	301.35	320.17	339.37	370.31	396.14	418.01	436.67	452.63	466.39	468.15													
IMPUL VAC	283.05	317.44	350.29	364.03	378.52	402.66	423.39	441.20	456.47	469.62	481.13	276.53													
EPSILON	1.061	1.650	2.968	3.994	5.667	11.177	22.470	45.642	93.020	190.462	394.428	1.000													

	COMPOSITION SHIFTING (MOL/100 GM)																
132.60 B	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004	
-45.47 B*F	.4561	.3972	.3464	.3033	.2855	.2667	.2348	.2062	.1796	.1516	.1112	.0572	.4176				
-143.00 B*F*O3	.8695	.9689	1.0596	1.1410	1.1758	1.2128	1.2753	1.3286	1.3722	1.4044	1.4221	1.4276	.9341				
-133.84 B*F2	.0208	.0143	.0098	.0068	.0058	.0049	.0036	.0028	.0023	.0020	.0016	.0009	.0163				
-270.00 B*F3	.0027	.0024	.0021	.0020	.0020	.0021	.0024	.0034	.0062	.0157	.0461	.0977	.0025				
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
-47.13 B*H*O3	.0529	.0476	.0420	.0360	.0330	.0295	.0229	.0165	.0107	.0061	.0031	.0016	.0495				
-135.32 B*H*O2	.0258	.0285	.0300	.0299	.0292	.0278	.0240	.0187	.0130	.0078	.0047	.0039	.0276				
66.00 B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
-45.00 B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
-238.60 B*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
5.74 B*O	.1334	.1047	.0774	.0532	.0433	.0333	.0186	.0088	.0033	.0009	.0002	.0000	.1150				
-84.00 B*O2	.0244	.0225	.0191	.0147	.0125	.0101	.0060	.0030	.0011	.0003	.0001	.0000	.0234				
-111.60 B2*O2	.0010	.0009	.0007	.0006	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0000	.0009				
-210.10 B2*O3	.0004	.0005	.0006	.0006	.0006	.0006	.0005	.0004	.0003	.0002	.0001	.0001	.0005				
-567.00 B3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
18.86 F	.0750	.0441	.0242	.0123	.0088	.0058	.0025	.0009	.0003	.0001	.0000	.0000	.0538				
-64.50 F*H	1.4386	1.4430	1.4328	1.4127	1.4013	1.3877	1.3619	1.3375	1.3137	1.2817	1.2143	1.1092	1.4433				
-26.10 F*H*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000				
52.10 H	1.2517	1.1209	.9745	.8141	.7358	.6453	.4771	.3193	.1839	.0849	.0326	.0119	1.1699				
9.33 H*O	.1001	.0705	.0456	.0266	.0198	.0137	.0081	.0022	.0006	.0001	.0000	.0000	.0807				
.00 H2	.8513	.9316	1.0289	1.1400	1.1952	1.2593	1.3795	1.4936	1.5944	1.6772	1.7471	1.8133	.9006				
-57.80 H2*O	.0978	.0968	.0924	.0841	.0790	.0724	.0582	.0430	.0284	.0163	.0092	.0071	.0975				
59.56 O	.0799	.0468	.0243	.0109	.0071	.0042	.0013	.0003	.0000	.0000	.0000	.0000	.0575				
.00 O2	.0036	.0019	.0009	.0003	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0024				

PRESSURE PROFILE DATA
 SYSTEM O-F2-B2H6 PC 300 PSIA PE 0.1 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/G
 DEG K GM/CC (KCAL/FORM.WT.)
 OF2 128 O=F2 1.53 +3.5 84.0
 B2H6 180 B2=H6 0.445 +2.50 16.0

BULK DENSITY = 1.101 GM/CC
 MIXTURE RATIO = 5.250 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 298.64 EU/100GMS

CHAMBER	THROAT											
	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050 163.3
TEMP, DEG K	4568.9	3756.7	3081.1	2519.5	2291.0	2053.1	1665.8	1344.9	1079.9	862.4	685.1	541.6 3985.8
ENTHALPY (-)	-6.89	28.73	57.98	81.94	91.57	101.50	117.40	130.28	140.65	148.95	155.57	160.81 18.72
CP	.4410	.4359	.4298	.4232	.4194	.4149	.4059	.3962	.3863	.3772	.3689	.3615 .4373
IMPUL OPT	176.03	237.55	277.99	292.67	307.07	328.83	345.44	358.26	368.20	375.94	381.96	381.96 149.27
IMPUL VAC	267.61	293.21	316.88	326.26	335.76	350.57	362.15	371.19	378.25	383.76	388.04	388.04 263.86
EPSILON	1.039	1.507	2.513	3.258	4.424	8.001	14.677	27.121	50.298	93.414	173.463	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050 172.2
TEMP, DEG K	4568.9	4225.3	3918.4	3640.2	3518.4	3385.4	3151.0	2934.7	2732.9	2540.1	2347.6	2141.6 4345.1
ENTHALPY (-)	-6.89	30.29	63.76	94.00	107.12	121.37	146.21	168.76	189.28	207.96	224.92	240.26 17.24
X BAR	4.964	4.823	4.692	4.569	4.514	4.452	4.342	4.238	4.142	4.054	3.978	3.919 4.873
N	4.964	4.823	4.692	4.569	4.514	4.452	4.342	4.238	4.142	4.054	3.978	3.919 4.873
CP	2.5622	2.5226	2.4292	2.3045	2.2436	2.1766	2.0489	1.9031	1.7101	1.4432	1.1148	.7855 2.5451
IMPUL OPT	179.83	247.91	296.25	314.93	334.03	364.94	390.90	413.10	432.33	449.07	463.68	444.89
IMPUL VAC	277.81	312.02	344.78	358.52	373.04	397.35	418.41	436.79	452.92	467.05	479.33	271.24
EPSILON	1.062	1.659	2.998	4.043	5.752	11.406	23.104	47.486	98.534	205.358	426.602	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
132.60 B	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-45.47 B=F	.2376	.1798	.1286	.0861	.0696	.0537	.0314	.0175	.0094	.0050	.0025	.0012 .2002
-143.00 B=F=O	.7593	.8406	.9104	.9662	.9871	1.0067	1.0326	1.0468	1.0538	1.0580	1.0626	1.0691 .8123
-133.84 B=F2	.0227	.0143	.0084	.0046	.0034	.0024	.0011	.0005	.0002	.0001	.0001	.0000 .0170
-270.00 B=F3	.0047	.0036	.0027	.0019	.0016	.0013	.0008	.0006	.0004	.0003	.0003	.0004 .0040
114.76 B=H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
-47.13 B=H=O	.0130	.0106	.0086	.0069	.0062	.0055	.0042	.0031	.0022	.0015	.0010	.0006 .0114
-135.32 B=H=O2	.0109	.0126	.0149	.0182	.0202	.0228	.0291	.0367	.0455	.0547	.0632	.0698 .0119
66.00 B=H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
-45.00 B=H2=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
18.00 B=H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
-238.60 B=H3=O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
5.74 B=O	.0807	.0649	.0504	.0373	.0319	.0262	.0172	.0105	.0059	.0030	.0013	.0004 .0705
-84.00 B=O2	.0261	.0286	.0312	.0339	.0352	.0365	.0385	.0390	.0372	.0321	.0235	.0130 .0277
-111.60 B2=O2	.0002	.0001	.0001	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000 .0002
-210.10 B2=O3	.0001	.0002	.0002	.0002	.0002	.0003	.0003	.0004	.0005	.0006	.0006	.0007 .0001
-567.00 B3=F3=O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
18.86 F	.2931	.2128	.1471	.0961	.0772	.0591	.0342	.0186	.0094	.0043	.0016	.0004 .2403
-64.50 F=H	1.7618	1.8384	1.9002	1.9479	1.9658	1.9831	2.0081	2.0254	2.0367	2.0427	2.0434	2.0393 1.8124
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0000
52.10 H	.9159	.8482	.7775	.7003	.6614	.6149	.5220	.4252	.3292	.2374	.1522	.0778 .8730
9.33 H=O	.1668	.1492	.1339	.1203	.1143	.1074	.0939	.0787	.0612	.0424	.0240	.0095 .1553
.00 H2	.2416	.2412	.2451	.2533	.2582	.2644	.2765	.2873	.2959	.3035	.3138	.3295 .2408
-57.80 H2=O	.0579	.0629	.0709	.0835	.0914	.1023	.1285	.1617	.2003	.2408	.2780	.3056 .0608
59.56 O	.3400	.2861	.2351	.1875	.1605	.1436	.1041	.0699	.0420	.0210	.0076	.0015 .3053
.00 O2	.0316	.0291	.0267	.0244	.0233	.0221	.0194	.0159	.0116	.0069	.0028	.0006 .0300

SYSTEM 0-F2-02M6										PC 300 PSIA		PE 0.1 PSIA	
COMPONENT										DENSITY		HEAT FORM	
REF FORMULA										GAL/CC		BTU/FORM.WT.	
DEG K										1.53		84.0	
0F2										0.445		16.0	
02M6										0.445		16.0	
PROZEN EXPANSION										C STAR = 0771.7 FT/SEC			
										I SEA		I AT	
										10000		50000	
										I VAC		CF SEA	
										LVL		CF VAC	

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OF₂ - B₅H₉ SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 100C PSIA
 COMPOENAT TREF FORMULA DENSITY HEAT FURN WT. C/O
 DEG K GP/CC (KCAL/FORM.WT.)
 12H C*F2 1.53 +3.5 66.
 29H B5*H7 0.620 +7.74 54.

BULK DENSITY = 1.021 GM/CC
 MIXTURE RATIO = 1.941 LH OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA													
CHAMBER ENTROPY 509.95 EU/100GMS													
CHAMBER													
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	151.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	555.1
TEMP, DEG K	3944.5	3273.1	2708.0	2233.1	1834.5	1632.8	1500.3	1220.6	987.4	794.1	634.4	503.3	3502.3
ENTHALPY (-)	-8.44	26.73	55.87	79.95	99.77	109.62	116.02	129.27	140.02	148.70	155.66	161.19	14.78
CP	.5277	.5196	.5116	.5019	.4917	.4850	.4801	.4673	.4549	.4420	.4286	.4156	.5226
IMPUL OPT	174.93	236.54	277.31	306.42	320.48	327.06	346.13	359.39	369.74	377.84	384.16	384.16	142.15
IMPL VAC	261.30	289.48	314.48	334.42	344.00	350.10	362.41	372.07	379.66	385.59	390.20	392.58	255.88
EPSILON	1.059	1.027	1.004	0.985	0.963	0.941	0.922	0.906	0.891	0.877	0.864	0.851	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	151.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	568.9
TEMP, DEG K	3944.5	3527.8	3153.4	2804.5	2465.6	2269.2	2125.9	1806.6	1614.2	1501.5	1414.5	1343.3	5683.3
ENTHALPY (-)	-8.44	27.66	59.35	87.17	111.49	124.13	132.54	150.48	165.81	179.67	192.33	204.00	14.23
X BAR	5.339	5.233	5.142	5.070	5.021	5.003	4.995	4.982	4.974	4.968	4.963	4.959	5.273
N	5.339	5.233	5.142	5.070	5.021	5.003	4.995	4.982	4.974	4.968	4.963	4.959	5.273
CP	1.2649	1.1763	1.0480	.8880	.7248	.6453	.6011	.5529	1.9661	2.3315	4.0620	5.4724	1.2158
IMPUL OPT	177.23	242.85	288.41	323.02	339.61	350.22	371.84	389.36	404.54	417.93	429.91	440.44	
IMPL VAC	267.26	300.57	331.03	356.15	368.51	376.47	392.76	406.97	419.97	431.65	442.25	454.99	
EPSILON	1.076	1.733	3.214	6.276	9.358	12.490	25.015	52.879	116.354	259.908	587.271	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
132.60 H	.0026	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014
-45.47 F*F	1.5151	1.5115	1.5063	1.5002	1.4940	1.4882	1.4825	1.4765	1.4703	1.4643	1.4585	1.4532	
-143.00 F*F*O	.6067	.6195	.7487	.8124	.8675	.8935	.9081	.9232	.9371	.9500	.9633	.9761	
-133.64 F*F*2	.0211	.0144	.0097	.0065	.0042	.0032	.0026	.0021	.0017	.0014	.0011	.0008	.0168
-270.00 F*F*3	.0014	.0013	.0013	.0014	.0018	.0024	.0032	.0048	.0075	.0119	.0184	.0273	
114.76 F*F	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-47.13 F*F*O	.3017	.2905	.2740	.2518	.2237	.2050	.1910	.1775	.1637	.1554	.1515	.1515	.0295
-135.32 F*F*O2	.0296	.0299	.0287	.0259	.0215	.0183	.0158	.0131	.0108	.0088	.0070	.0054	.0299
66.00 F*F*2	.0024	.0011	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014
-45.00 F*F*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 F*F*3	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-238.60 F*F*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 F*F	.1655	.1144	.0705	.0365	.0143	.0068	.0036	.0005	.0001	.0000	.0000	.0000	.1335
-84.00 F*F*2	.0058	.0040	.0024	.0012	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0047
199.30 F*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 F*F*O2	.0177	.0194	.0213	.0235	.0264	.0289	.0314	.0341	.0369	.0395	.0423	.0455	.0188
-210.10 F*F*O3	.0017	.0023	.0030	.0040	.0054	.0067	.0079	.0126	.0094	.0055	.0016	.0008	.0020
-567.00 F*F*F*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002	.0016	.0038	.0075	.0115	.0000
-541.69 F*F*F*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0021	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011
-64.50 F*F	.2743	.2200	.1660	.1148	.0692	.0469	.0335	.0220	.0163	.0121	.0084	.0057	.2412
-26.10 F*F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.5424	.3826	.2434	.1319	.0550	.0276	.0152	.0025	.0007	.0003	.0002	.0001	.4424
9.33 F*F	.0055	.0021	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0031
.00 F*F	1.8119	1.9361	2.0506	2.1511	2.2333	2.2708	2.2928	2.3306	2.3641	2.3906	2.4102	2.4102	1.8889
-57.80 F*F*O	.0305	.0220	.0145	.0083	.0039	.0022	.0013	.0003	.0001	.0000	.0000	.0000	.0253
59.56 O	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
.00 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-305.34 B2*O3/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0529	.1279	.1618	.1862	.0000
.00 F/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1373	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 LEG K
 12H O+P2 1.53 +3.5 72.
 298 B3+P9 0.620 +7.14 24.
 BULK DENSITY = 1.084 GM/CC
 MIXTURE RATIO = 2.571 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRCPY 298.60 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	555.7
TEMP, DEG K	4462.1	3689.4	3042.9	2502.4	2051.4	1824.1	1675.0	1361.5	1100.7	884.9	707.1	561.3	3950.6
ENTHALPY (-)	-7.10	29.19	59.98	85.35	106.18	116.51	123.22	137.10	148.36	157.44	164.72	170.51	16.64
CP	.4855	.4795	.4726	.4657	.4573	.4477	.4372	.4261	.4149	.4032	.3916	.3814	
IMPL OPT	180.11	243.36	285.12	315.30	329.25	337.99	355.41	366.93	379.49	387.74	394.19	400.71	
IMPL VAC	268.88	297.54	323.16	343.49	351.76	359.47	372.01	381.86	389.59	395.64	400.36	405.40	
EPSILON	1.058	1.622	2.860	5.326	7.752	10.191	19.787	38.711	76.002	149.363	292.810	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.4
TEMP, DEG K	4462.1	4023.4	3635.6	3295.7	2983.1	2810.3	2688.8	2404.7	2142.6	1923.8	1735.3	1551.9	4187.7
ENTHALPY (-)	-7.10	30.32	64.21	94.21	120.84	134.94	144.48	165.40	183.82	200.07	214.50	227.31	15.90
X BAR	5.012	4.493	4.782	4.682	4.594	4.549	4.520	4.460	4.404	4.342	4.271	4.233	4.938
A	5.012	4.493	4.782	4.682	4.594	4.549	4.520	4.460	4.404	4.342	4.271	4.233	4.938
CP	1.4945	1.4410	1.3691	1.2638	1.1221	1.0266	.9579	.8313	.6831	.5404	.4092	.2861	1.4652
IMPL OPT	182.82	250.80	298.34	334.91	352.75	364.33	388.50	408.61	425.55	440.60	452.54	464.49	
IMPL VAC	275.91	310.78	343.05	370.29	384.08	393.16	412.37	428.57	442.52	454.65	465.09	468.23	
EPSILON	1.078	1.745	3.267	6.492	9.827	13.293	27.633	58.070	123.989	267.862	578.500	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 H	.0025	.0010	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015
-45.47 B+F	.0038	.0012	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015
-143.00 B+F+O	.0112	.0105	1.0023	1.0262	1.1607	1.1990	1.2258	1.2715	1.2997	1.3123	1.3174	1.3174	.8725
-133.84 B+F2	.0377	.0276	.0203	.0153	.0119	.0106	.0098	.0087	.0077	.0068	.0036	.0018	.0311
-270.00 B+F3	.0035	.0033	.0033	.0037	.0047	.0060	.0077	.0112	.0157	.0214	.0281	.0358	.0443
114.76 B+P	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B+P+O	.1273	.1174	.1044	.0891	.0708	.0593	.0510	.0425	.0346	.0272	.0204	.0141	.0084
-125.32 B+P+O2	.0270	.0274	.0259	.0228	.0182	.0150	.0127	.0076	.0042	.0026	.0016	.0015	.0024
66.00 B+P2	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B+P2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
16.00 B+P3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-236.60 B+P3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B+O	.1849	.1398	.0963	.0597	.0319	.0202	.0137	.0043	.0011	.0003	.0001	.0000	.0000
-84.00 B+O2	.0151	.0112	.0083	.0050	.0026	.0016	.0010	.0003	.0001	.0000	.0000	.0000	.0000
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2+O2	.0045	.0041	.0036	.0030	.0022	.0018	.0015	.0008	.0004	.0003	.0003	.0004	.0004
-210.10 B2+O3	.0006	.0009	.0010	.0010	.0009	.0007	.0007	.0004	.0003	.0002	.0002	.0005	.0009
-567.00 B3+P3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 B3+P3+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0265	.0127	.0056	.0022	.0008	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000
-64.50 F+P	.7492	.7113	.6630	.6104	.5581	.5287	.5079	.4546	.3776	.2669	.1501	.0573	.0277
-26.10 F+P+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.0947	.7476	.5936	.4415	.2996	.2254	.1772	.0836	.0442	.0229	.0094	.0011	.0002
9.33 F+O	.0369	.0200	.0096	.0040	.0014	.0006	.0003	.0001	.0000	.0000	.0000	.0000	.0000
.00 F2	1.0172	1.1337	1.2569	1.3816	1.5002	1.5649	1.6079	1.6981	1.7740	1.8456	1.9107	1.9594	1.0876
-57.80 F2+O	.0572	.0488	.0391	.0291	.0199	.0151	.0120	.0062	.0028	.0012	.0005	.0002	.0002
59.56 O	.0175	.0073	.0026	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TRCF FORMULA	DENSITY GM/CC	HEAT FORM (KCAL/ECRM.WT.)	WT. C/O
12H O+F2		1.53	+3.5	77.
29H H5+H9		0.620	+7.74	23.

BULK DENSITY = 1.144 GM/CC
MIXTURE RATIO = 3.348 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
CHAMBER ENTROPY 246.11 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	392.1	152.5	63.10	25.12	14.70	10.00	5.981	1.585	.651	.251	.100	552.8
TEMP, DEG K	4224.7	3975.5	3265.7	2675.9	2186.0	1940.1	1779.3	1642.0	1462.7	932.4	743.2	588.4	4261.7
ENTHALPY (-)	-7.81	30.18	61.42	87.05	108.02	118.40	125.15	139.02	150.25	159.29	166.51	172.25	17.47
CP		.4475	.4425	.4373	.4314	.4245	.4200	.4162	.4069	.3971	.3870	.3768	.4444
IMPUL OPT		181.79	245.41	277.26	317.44	351.36	380.07	407.40	430.22	448.27	461.43	469.79	148.31
IMPUL VAC		271.19	299.80	325.54	345.59	355.29	361.46	373.49	383.84	391.27	397.23	401.87	265.78
EPSILON		1.057	1.615	2.840	5.274	7.665	10.066	19.497	35.060	74.563	146.174	286.204	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	392.1	152.5	63.10	25.12	14.70	10.00	5.981	1.585	.651	.251	.100	572.2
TEMP, DEG K	4224.7	4494.2	4007.7	3658.7	3340.2	3167.0	3047.4	2774.0	2513.4	2265.9	2050.9	1878.5	4558.7
ENTHALPY (-)	-7.81	31.54	66.47	97.57	125.30	140.05	150.04	172.14	191.91	209.46	225.04	239.00	16.61
X BAR	4.724	4.604	4.489	4.382	4.284	4.230	4.194	4.114	4.044	3.983	3.920	3.851	4.652
N	4.724	4.604	4.489	4.382	4.284	4.230	4.194	4.114	4.044	3.983	3.920	3.851	4.652
CP	1.7149	1.7393	1.6220	1.4945	1.3665	1.2884	1.2305	1.0787	.9291	.8734	1.0067	1.2022	1.7743
IMPUL OPT		185.01	254.20	302.77	340.29	358.65	370.59	395.70	416.85	434.75	450.08	463.37	145.74
IMPUL VAC		279.54	315.38	348.55	376.64	390.75	400.41	420.63	437.91	452.70	465.52	476.87	271.54
EPSILON		1.000	1.756	5.300	6.583	9.975	13.561	28.445	60.504	129.346	279.657	613.930	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
132.60 H	.0019	.0004	.0004	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0012
-45.47 F+O	.6444	.5867	.5360	.4944	.4626	.4472	.4374	.4165	.3966	.3701	.3252	.2842	.6087
-143.00 F+O+O	.F557	.9659	1.0660	1.1556	1.2315	1.2695	1.2940	1.3430	1.3787	1.4012	1.4124	1.4175	.9236
-133.84 F+O2	.C464	.C329	.0241	.0164	.0120	.C101	.C091	.0073	.C062	.0056	.0047	.0034	.0377
-270.00 F+O3	.C056	.C048	.0043	.0040	.0041	.0044	.0048	.0069	.0127	.0300	.0707	.1307	.0051
114.76 F+H	.C001	.C000	.0000	.0000	.C000	.C000	.C000	.0000	.0000	.0000	.0000	.C000	.0000
-47.12 F+H+O	.C524	.C471	.0422	.0371	.0315	.0279	.C252	.C186	.C123	.0074	.0043	.C027	.0492
-135.32 F+H+O2	.C187	.C201	.0207	.C203	.0185	.0164	.0153	.0112	.0072	.0041	.0024	.0016	.0196
26.00 F+H2	.C001	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 F+H2+O2	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.C000	.C000	.0000	.C000	.C000	.0000
18.00 F+H3	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 F+H3+O3	.C000	.C000	.0000	.0000	.0000	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 F+O	.1678	.1366	.1051	.0750	.0484	.0355	.0275	.0132	.0051	.0015	.0004	.0001	.1489
-44.00 F+O2	.C037	.0220	.0187	.0142	.0095	.0069	.0053	.0025	.0009	.0002	.0001	.C000	.0228
199.30 H2	.C000	.C000	.0000	.0000	.0000	.C000	.0000	.0000	.0000	.0000	.0000	.C000	.0000
-111.60 H2+O2	.C015	.C013	.C011	.C009	.C007	.C006	.C005	.0003	.0002	.0001	.0000	.0000	.0013
-210.10 H2+O3	.0004	.0005	.0005	.0005	.0005	.0005	.0004	.0003	.0002	.0001	.0001	.0000	.0004
-567.00 C3H3F+O3	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 C3H3F+O6	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.C000	.C000	.0000
18.86 F	.1208	.0747	.0422	.0216	.0099	.C060	.C041	.0014	.0004	.0001	.0000	.0000	.0911
-64.50 F+H	1.1213	1.1442	1.1477	1.1351	1.1116	1.0956	1.0838	1.0556	1.0256	.9793	.8927	.7713	1.1375
-26.10 F+H+O	.C000	.C000	.0000	.0000	.0000	.C000	.0000	.0000	.0000	.0000	.0000	.C000	.0000
32.40 F+O	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000	.C000	.C000	.0000	.0000	.0000
.00 F2	.C000	.C000	.0000	.0000	.0000	.C000	.C000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.9451	.8716	.7626	.6739	.5877	.4693	.4124	.2799	.1643	.0812	.0372	.0178	.9022
9.33 F+O	.C939	.0666	.0433	.0249	.0123	.0076	.0051	.0017	.0004	.0001	.0000	.0000	.0771
.00 F2	.4662	.5090	.5691	.6472	.7396	.7969	.8384	.9347	1.0212	1.0957	1.1665	1.2396	.4902
-57.80 C2H2+O	.C563	.C544	.0510	.0455	.0379	.0329	.0291	.0201	.0123	.0066	.0035	.0021	.0553
59.56 C	.1015	.0619	.0328	.0186	.0093	.0026	.0015	.0003	.0000	.0000	.0000	.0000	.0763
.00 C2	.C048	.0026	.0011	.0004	.0001	.0000	.C000	.0000	.0000	.0000	.0000	.0000	.0033
34.10 C3	.C000	.C000	.0000	.0000	.C000	.C000	.C000	.C000	.C000	.0000	.0000	.0000	.C000

SYSTEM LIQUID PROPPELLANT										PC 1000, PSIA		HEAT FORM		WT. G/G	
COMPONENT		REF. FORMULA		DEG K		GPM/CC		DEENSITY		(KCAL/FORM.WT.)					
				128 R/F2		1.53		0.55		17.7					
				298 R/F50		0.62C		0.776		21.					
EJECTOR EXPANSION															
C STAR = 6836 R/F1/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/L	1 OPT	DELVAC	DELVAC	1 SEA	1 AT	1 AT	1 VAC	CP SEA	CP VAC	
			DEG K	KCAL/1000G	CP CAL/L	1 OPT	DELVAC	DELVAC	LVL	10000	10000	10000	LVL	LVL	
1.00C	1.00C	552.850	288.2	-17.81	-1.88	128.5	117.5	-212	262.7	263.6	265.4	265.6	1.256	1.251	
2.00C	9.00A	101.583	300.3	-72.7C	-4.32	248.8	95.4	-447	504.2	506.2	510.0	510.0	1.437	1.463	
3.00C	17.352	57.629	2826.9	-109.1E	-4.31	290.5	36.9	-641	518.0	520.4	526.5	527.4	1.497	1.541	
4.00C	27.312	36.827	2388.9	-109.1E	-4.28	205.5	41.9	-871	524.5	526.4	535.9	537.3	1.527	1.588	
5.00C	37.312	26.810	222.5	-109.1E	-4.27	161.5	47.7	-1101	529.3	531.1	541.1	542.6	1.565	1.643	
6.00C	48.121	20.781	2087.5	-111.17	-4.25	122.5	26.4	-1279	530.3	536.0	546.9	549.1	1.555	1.653	
7.00C	59.969	16.765	1996.9	-116.02	-4.21	122.5	26.9	-1491	541.2	537.8	550.5	551.1	1.559	1.662	
8.00C	72.355	13.621	1915.9	-119.5C	-4.19	132.8	23.5	-1701	538.8		556.5	556.3	1.677		
9.00C	85.749	11.515	1835.9	-122.97	-4.18	143.1	20.8	-1911	535.9		557.6	557.4	1.769		
10.00C	99.099	10.091	1763.9	-124.97	-4.16	153.9	19.4	-2125	539.3		557.7	561.3	1.777		
11.00C	113.612	8.802	1729.9	-127.1E	-4.11	162.7	20.8	-2344	539.3		567.3	561.3	1.710		
12.00C	128.710	7.766	1624.7	-129.1E	-4.13	162.7	19.9	-2568	567.3		567.3	567.3	1.738		
13.00C	144.025	6.825	1500.8	-130.8E	-4.12	164.3	18.3	-2787	567.9		567.9	567.9	1.774		
14.00C	160.458	6.232	1402.3	-132.8E	-4.12	164.3	17.3	-3008	567.9		567.9	568.1	1.732		
15.00C	176.765	5.657	1367.5	-135.8V	-4.11	151.1	16.2	-3225	567.9		567.9	567.9	1.748		
16.00C	193.245	5.175	1355.7	-139.1E	-4.10	152.7	17.0	-3450	568.0		568.0	570.5	1.744		
17.00C	209.615	4.766	1362.3	-143.8E	-4.10	152.7	17.4	-3679	568.0		568.0	571.6	1.769		
18.00C	226.867	4.401	1370.2	-147.351	-4.08	150.5	17.0	-3909	568.0		568.0	572.6	1.753		
19.00C	242.972	4.116	1353.9	-150.58	-4.07	150.4	16.7	-4208	568.6		568.6	573.5	1.756		
20.00C	260.481	3.836	1343.4	-153.9C	-4.07	150.4	16.3	-4508	568.7		568.7	574.3	1.762		
21.00C	279.482	3.573	1366.1	-160.4C	-4.08	155.1	16.0	-4806	567.5		567.5	575.1	1.765		
22.00C	299.421	3.339	1387.5	-161.2E	-4.05	160.5	15.8	-5104	567.5		567.5	575.8	1.768		
23.00C	319.359	3.131	1367.7	-162.0A	-4.04	160.1	15.5	-5395	567.5		567.5	576.5	1.772		
24.00C	339.317	2.946	1349.1	-162.79	-4.03	160.0	15.2	-5673	567.4		567.4	577.2	1.777		
25.00C	360.074	2.777	1331.6	-163.5C	-4.03	162.7	14.9	-5951	568.6		568.6	577.8	1.778		
26.00C	380.721	2.626	1314.7	-164.19	-4.03	164.3	14.6	-6229	568.6		568.6	578.5	1.779		
27.00C	401.516	2.491	1299.0	-164.81	-4.02	164.3	14.6	-6509	569.0		569.0	578.9	1.785		
28.00C	422.411	2.367	1283.9	-165.41	-4.02	165.4	14.4	-6771	569.1		569.1	579.5	1.788		
29.00C	443.364	2.255	1269.5	-165.99	-4.01	165.8	14.2	-7028	569.2		569.2	580.0	1.790		
30.00C	464.378	2.153	1256.2	-166.55	-4.01	166.5	14.0	-7280	569.2		569.2	580.7	1.792		
31.00C	485.352	2.061	1243.5	-167.07	-4.00	167.1	13.8	-7533	569.5		569.5	580.9	1.793		
32.00C	506.221	1.975	1229.8	-167.56	-4.00	167.7	13.7	-7790	569.5		569.5	581.3	1.795		
33.00C	527.073	1.897	1217.7	-168.02	-3.99	168.2	13.5	-8043	569.6		569.6	581.7	1.797		
34.00C	547.902	1.826	1206.0	-168.45	-3.99	168.5	13.4	-8292	569.7		569.7	582.2	1.799		
35.00C	568.695	1.759	1194.7	-168.84	-3.98	168.9	13.2	-8537	569.7		569.7	582.7	1.800		
36.00C	589.543	1.696	1183.9	-169.19	-3.98	169.6	13.1	-8777	569.7		569.7	582.9	1.802		
37.00C	609.449	1.641	1173.4	-169.53	-3.97	170.3	13.0	-9014	569.8		569.8	583.1	1.804		
38.00C	629.399	1.588	1163.3	-169.75	-3.97	170.8	12.8	-9246	569.8		569.8	583.6	1.805		
39.00C	649.394	1.536	1153.5	-169.92	-3.97	171.2	12.7	-9473	569.9		569.9	584.0	1.806		
40.00C	669.434	1.485	1144.1	-170.09	-3.96	171.7	12.6	-9699	569.9		569.9	584.5	1.808		
41.00C	689.429	1.434	1134.9	-170.26	-3.96	172.1	12.5	-9923	569.9		569.9	584.6	1.810		
42.00C	709.458	1.385	1126.0	-170.41	-3.96	172.5	12.4	-10146	569.9		569.9	584.9	1.811		
43.00C	729.514	1.337	1117.6	-170.55	-3.95	172.9	12.3	-10367	569.9		569.9	585.1	1.813		
44.00C	749.595	1.290	1109.1	-170.69	-3.95	173.4	12.1	-10586	569.9		569.9	585.4	1.814		
45.00C	769.676	1.245	1101.0	-170.78	-3.95	173.7	12.0	-10801	569.7		569.7	585.7	1.815		
46.00C	789.747	1.202	1093.1	-170.85	-3.94	174.1	11.9	-11014	569.7		569.7	585.7	1.817		
47.00C	809.815	1.160	1085.1	-170.91	-3.94	174.5	11.8	-11225	569.7		569.7	585.7	1.818		
48.00C	829.878	1.118	1077.0	-170.96	-3.94	174.9	11.7	-11434	569.7		569.7	585.7	1.819		
49.00C	849.932	1.103	1070.7	-171.00	-3.93	175.1	11.7	-11640	569.7		569.7	585.7	1.820		
50.00C	869.979	1.072	1063.7	-171.04	-3.93	175.4	11.6	-11845	569.7		569.7	585.7	1.821		
7.06S	68.026	1.692	196.1	-118.0C	-4.20	151.8	23.9	1.629	531.4	536.6	552.5	555.3	1.559	1.672	
SHIFTING EXPANSION															
C STAR = 7073.6 R/F1/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/L	1 OPT	DELVAC	DELVAC	1 SEA	1 AT	1 AT	1 VAC	CP SEA	CP VAC	
			DEG K	KCAL/1000G	CP CAL/L	1 OPT	DELVAC	DELVAC	LVL	10000	10000	10000	LVL	LVL	
1.00C	1.00C	552.850	288.2	-17.81	-1.88	128.5	117.5	-212	262.7	263.6	265.4	265.6	1.256	1.251	
2.00C	8.652	124.033	3024.9	-73.91	-1.94	204.1	50.1	-532	316.6	318.6	322.5	323.2	1.440	1.470	
3.00C	16.625	66.612	2784.6	-95.52	-1.53	297.2	47.0	-685	336.2	337.2	343.1	343.7	1.520	1.580	
4.00C	21.00C	47.616	2610.9	-107.00	-1.52	204.1	50.9	-840	340.0	340.9	346.8	347.2	1.568	1.628	
5.00C	28.516	35.008	2661.0	-114.67	-1.47	172.8	39.5	-1.126	343.6	343.7	349.5	349.5	1.591	1.690	
6.00C	35.751	27.471	2480.2	-121.8E	-1.383	135.2	37.3	-1.553	345.6	355.7	371.0	373.2	1.608	1.698	
7.00C	43.162	21.352	2313.9	-127.5E	-1.55	143.2	35.7	-1.582	356.2	363.0	376.2	378.9	1.620	1.723	
8.00C	51.010	16.156	2160.9	-134.4E	-1.58	143.2	35.7	-1.609	367.6	374.4	386.6	389.3	1.627	1.740	
9.00C	59.712	16.716	2009.4	-140.43	-1.508	153.5	33.2	-1.984	354.4	361.1	369.1	369.5	1.610	1.705	
10.00C	68.427	14.647	2166.8	-140.07	-1.269	156.7	32.3	-2.199	369.4	377.2	391.0		1.778		
11.00C	76.420	15.001	2128.9	-145.26	-1.271	166.5	31.5	-2.421	369.1	369.9	394.0		1.776		
12.00C	84.665	14.353	2089.7	-148.12	-1.258	166.5	30.8	-2.652	369.8	369.8	397.2		1.774		
13.00C	93.050	13.704	2050.7	-150.97	-1.245	166.5	30.1	-2.883	369.8	369.8	399.9		1.772		
14.00C	101.470	6.000	2033.2	-151.07	-1.224	171.0	29.6	-3.081	369.1	369.1	401.4		1.726		
15.00C	111.223	8.786	2006.9	-151.25	-1.210	174.3	29.1	-3.308	367.7	367.7	403.4		1.835		
16.00C	123.666	8.086	2009.9	-155.25	-1.197	176.6	28.6	-3.536	367.7	367.7	405.4		1.835		
17.00C	136.087	7.135	2001.8	-157.90	-1.184	176.6	28.1	-3.763	367.7	367.7	407.4		1.835		
18.00C	148.474	6.952	2000.5	-159.85	-1.174	180.8	27.8	-3.994	367.7	367.7	409.4		1.835		
19.00C	154.000	6.494	2020.5	-160.48	-1.162	182.6	27.4	-4.222	367.9	367.9	411.1		1.805		
20.00C	164.282	6.087	2061.6	-162.01	-1.152	184.4	27.1	-4.449	367.9	367.9	412.8		1.805		
21.00C	174.564	5.681	2102.7	-163.54	-1.142	186.2	26.8	-4.676	367.9	367.9	414.5		1.805		
22.00C	184.939	5.267	2066.8	-166.01	-1.132	187.5	26.5	-4.899	367.9	367.9	416.2		1.805		
23.00C	195.270	4.851	2128.9	-166.11	-1.123	189.0	26.2	-5.116	368.4	368.4	415.2		1.808		
24.00C	205.576	4.434	2085.3	-167.13	-1.114	190.5	25.9	-5.332	368.4	368.4	416.3		1.808		
25.00C	215.857	4.017	2041.6	-168.15	-1.104	192.0	25.6	-5.548	368.4	368.4	417.4		1.808		
26.00C	226.043	3.604	2												

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. C/D
 DEG K GM/CC (KCAL/FORM.WT.)
 128 B*F2 1.53 +3.5 40.
 298 B*H9 0.620 +7.74 20.

BULK DENSITY = 1.193 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 277.41 EU/100GMS

CHAMBER

THREAT

	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.981	1.585	.631	.251	.100	548.7
TEMP, DEG K	4979.4	4086.6	3346.6	2733.8	2276.7	1972.8	1807.0	1460.1	1173.9	958.6	746.1	589.5	4378.8
ENTHALPY (-)	-7.64	30.05	60.96	16.23	106.45	117.04	123.62	137.20	144.14	156.92	163.92	167.47	17.76
CP	.4242	.4199	.4150	.4090	.4031	.3990	.3956	.3864	.3776	.3682	.3588	.3495	.4216
IMPUL OPT	191.08	244.24	245.76	315.59	322.33	337.91	354.96	368.13	378.36	386.32	392.52	398.65	148.65
IMPUL VAC	269.48	248.25	323.45	343.39	352.92	358.98	371.17	380.69	388.13	393.93	398.44	264.69	
EPSILON	1.056	1.610	2.424	5.232	7.593	9.961	19.246	37.475	73.231	143.268	279.749	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	5.981	1.585	.631	.251	.100	573.5
TEMP, DEG K	4979.4	4519.0	4189.6	3572.3	3352.3	3134.1	3266.9	2996.9	2739.7	2491.8	2249.2	2020.2	4718.6
ENTHALPY (-)	-7.64	31.54	66.50	97.42	125.95	140.99	151.24	173.96	194.35	212.62	228.91	243.37	15.56
X PAR	4.557	4.429	4.310	4.201	4.100	4.045	4.008	3.974	3.849	3.743	3.629	3.611	4.478
N	4.557	4.429	4.310	4.201	4.100	4.045	4.008	3.974	3.849	3.743	3.629	3.681	4.478
CP	2.0722	2.0461	1.9521	1.8005	1.6120	1.4993	1.4185	1.2585	1.0710	.9044	.7721	.6502	2.0675
IMPUL OPT	194.67	253.95	302.84	340.90	359.58	371.77	397.46	419.19	437.73	453.64	467.30	467.30	145.09
IMPUL VAC	279.16	215.42	349.14	377.64	392.49	402.21	423.64	440.93	456.35	469.62	461.05	271.00	
EPSILON	1.082	1.767	3.339	6.694	10.202	13.869	29.265	62.446	134.413	249.874	626.626	1.000	

	COMPOSITION SHIFTING (MOL/100 GMS)												
132.60 H	.0013	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 B*F	.4633	.4176	.3548	.2973	.2474	.2225	.2066	.1744	.1499	.1287	.1074	.0760	.4434
-143.00 B*F*O	.8390	.9477	1.0486	1.1376	1.2196	1.2607	1.2878	1.3440	1.3889	1.4236	1.4484	1.4623	.9059
-133.84 B*F2	.0510	.0356	.0240	.0158	.0102	.0079	.0066	.0044	.0032	.0024	.0019	.0015	.0412
-270.00 B*F3	.0078	.0066	.0055	.0045	.0037	.0034	.0033	.0033	.0033	.0033	.0033	.0034	.0071
114.76 B*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*H*O	.0269	.0229	.0195	.0168	.0144	.0132	.0123	.0101	.0078	.0054	.0032	.0017	.0244
-135.32 B*H*O2	.0127	.0136	.0146	.0155	.0164	.0166	.0166	.0157	.0133	.0099	.0064	.0041	.0133
66.00 B*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-49.00 B*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*H3*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*O	.1337	.1112	.0896	.0693	.0504	.0404	.0336	.0199	.0100	.0040	.0012	.0003	.1200
-64.00 B*O2	.0253	.0255	.0247	.0228	.0196	.0170	.0150	.0098	.0052	.0022	.0007	.0002	.0255
199.30 H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2*O2	.0007	.0005	.0004	.0003	.0003	.0002	.0002	.0001	.0001	.0001	.0000	.0000	.0006
-210.10 B2*O3	.0002	.0003	.0003	.0003	.0003	.0004	.0004	.0003	.0003	.0003	.0001	.0001	.0003
-567.00 H3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 B3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.2408	.1716	.1152	.0715	.0402	.0272	.0200	.0086	.0032	.0010	.0007	.0000	.1975
-64.50 F*H	1.2743	1.3348	1.3800	1.4097	1.4243	1.4265	1.4255	1.4167	1.4027	1.3861	1.3627	1.3152	1.3127
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.6159	.7700	.7209	.6642	.5943	.5856	.5067	.4615	.4270	.3774	.3897	.0371	.7883
9.33 H*O	.1223	.0985	.0765	.0563	.0381	.0287	.0227	.0114	.0045	.0014	.0003	.0000	.1077
.00 H2	.2541	.2607	.2751	.2996	.3374	.3666	.3909	.4593	.5364	.6126	.6798	.7372	.2573
-57.80 H2*O	.0445	.0440	.0439	.0439	.0435	.0428	.0418	.0376	.0306	.0220	.0138	.0084	.0442
59.56 O	.2087	.1564	.1095	.0694	.0381	.0246	.0173	.0099	.0015	.0003	.0000	.0000	.1766
.00 O2	.0141	.0103	.0068	.0040	.0019	.0011	.0007	.0002	.0000	.0000	.0000	.0000	.0118
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA				
SYSTEM LIQUID BIPROPELLANT PC 1000 PSIA				
COMPONENT	INTL FORMULA	DENSITY	HEAT FORM	WT. C/O
	LEG K	GM/CC	(KCAL/FORM.WT.)	
12M	0*F2	1.53	+3.5	PP.
29M	B5*H9	0.62C	+7.74	12.

BULK DENSITY = 1.301 GM/CC
MIXTURE RATIO = 7.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
CHAMBER ENTROPY 249.73 EU/100GMS

CHAMBER	THROAT									
	FROZEN EXPANSION									
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631
TEMP, DEG K	4939.9	4002.5	3235.1	2607.5	2094.6	1740.5	1675.8	1534.5	1057.0	832.4
ENTHALPY (-)	-7.17	26.66	54.04	76.14	93.93	102.61	104.14	119.57	128.62	135.76
CP	.3628	.3569	.3545	.3495	.3436	.3395	.3364	.3298	.3221	.3151
IMPUL OPT	171.56	232.77	269.22	296.57	309.05	316.80	322.06	343.70	352.63	359.49
IMPUL VAC	255.23	281.04	303.96	321.90	330.41	335.77	346.47	354.73	361.10	366.00
EPSILON	1.052	1.548	2.756	5.049	7.277	9.499	18.127	34.846	67.214	129.793

	SHIFTING EXPANSION									
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631
TEMP, DEG K	4939.9	4513.4	4139.2	3799.3	3490.4	3325.4	3213.9	2970.0	2754.2	2558.8
ENTHALPY (-)	-7.17	28.15	59.56	87.57	112.61	125.95	135.04	155.18	173.36	189.82
X BAR	4.149	4.025	3.911	3.805	3.706	3.649	3.610	3.517	3.428	3.346
N	4.149	4.025	3.911	3.805	3.706	3.649	3.610	3.517	3.428	3.346
CP	1.7861	1.7277	1.6245	1.5213	1.4740	1.4837	1.5010	1.5497	1.5446	1.4367
IMPUL OPT	175.31	240.94	287.09	322.61	340.32	351.73	375.82	396.30	413.98	429.38
IMPUL VAC	264.93	299.03	330.63	357.45	371.15	380.25	399.85	416.90	431.86	445.03
EPSILON	1.041	1.759	3.312	6.619	10.069	13.686	28.967	62.377	136.013	298.963

COMPOSITION SHIFTING (MOL/100 GM)											
132.60 F	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.47 B*F	.1227	.0016	.0491	.0262	.0124	.0077	.0053	.0022	.0009	.0003	.0000
-143.00 B*F*O	.6904	.7562	.8053	.8349	.8432	.8349	.8321	.8068	.7740	.7387	.7045
-123.84 B*F2	.0555	.0385	.0255	.0160	.0096	.0076	.0055	.0031	.0016	.0008	.0003
-270.00 B*F3	.0179	.0017	.0074	.0571	.0739	.0878	.0996	.1327	.1697	.2074	.2428
-114.76 B*F	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B*F*O	.0014	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-135.32 B*F*O2	.0022	.0018	.0013	.0009	.0006	.0004	.0003	.0002	.0001	.0001	.0001
66.00 B*F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 B*F2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
10.00 B*F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B*O	.0245	.0151	.0083	.0039	.0016	.0009	.0006	.0002	.0001	.0000	.0000
-84.00 B*O2	.0149	.0140	.0125	.0106	.0084	.0072	.0063	.0047	.0034	.0025	.0019
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-210.10 B2*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-567.00 B3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 B3*F3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.8605	.7685	.6624	.6008	.5214	.4748	.4409	.3580	.2746	.1941	.1201
-64.50 F*F	1.3603	1.4503	1.5291	1.5938	1.6412	1.6606	1.6712	1.6882	1.6974	1.7025	1.7069
-26.10 F*F*O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0004	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.1975	.1458	.0993	.0609	.0344	.0226	.0169	.0083	.0041	.0020	.0004
9.33 F*O	.0926	.0724	.0546	.0390	.0262	.0203	.0167	.0105	.0065	.0041	.0026
.00 F2	.0179	.0116	.0062	.0035	.0016	.0009	.0006	.0003	.0001	.0000	.0000
-57.80 F2*O	.0099	.0077	.0057	.0039	.0025	.0019	.0016	.0010	.0006	.0004	.0003
59.56 O	.5434	.4415	.4388	.3824	.3212	.2845	.2585	.2001	.1489	.1050	.0678
.00 O2	.1163	.1270	.1443	.1711	.2044	.2340	.2534	.3007	.3462	.3881	.4252
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/O
 LEG K GP/CC (KCAL/FORM.WT.)
 12R B=F2 1.52 +5.5 66.
 29R H5+H9 0.620 +7.74 34.

BULK DENSITY = 1.021 GM/CC
 MIXTURE RATIO = 1.941 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRUPY 322.45 EU/100GMS

CHAMBER	FROZEN EXPANSION														THROAT
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.5		
TEMP, DEG K	3759.4	3185.7	2693.3	2271.5	1949.3	1710.1	1601.1	1356.9	1111.7	920.4	758.5	621.9	3424.7		
ENTHALPY (-)	-8.44	21.54	46.92	68.36	82.44	96.41	101.56	114.25	124.22	133.59	140.83	146.79	14.31		
CP	.5260	.5192	.5119	.5036	.4972	.4931	.4854	.4745	.4638	.4529	.4417	.4301	.5206		
IMPUL OPT	161.50	219.47	258.49	281.25	297.26	309.36	326.71	340.49	351.51	360.37	367.49	373.45	251.80		
IMPUL VAC	254.25	277.17	299.80	314.51	318.53	331.69	345.95	355.84	363.23	370.27	375.45	379.45	251.80		
EPSILON	1.025	1.421	2.265	3.370	3.817	6.617	11.651	20.701	36.971	66.184	118.509	1.000			
CHAMBER	SHIFTING EXPANSION														THROAT
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.3		
TEMP, DEG K	3759.4	3437.6	3145.3	2872.9	2671.1	2610.3	2347.4	2077.0	1805.3	1572.7	1476.4	1384.3	3540.5		
ENTHALPY (-)	-8.44	22.36	50.00	74.84	92.16	97.14	117.07	134.73	150.15	163.46	175.42	186.43	13.48		
X BAR	5.439	5.330	5.232	5.148	5.094	5.080	5.030	5.002	4.990	4.971	4.885	4.796	5.361		
N	5.439	5.330	5.232	5.148	5.094	5.080	5.030	5.002	4.990	4.971	4.885	4.796	5.361		
CP	1.5103	1.4276	1.3660	1.3145	1.0060	.9612	.7763	.6269	.5467	2.0595	1.4502	2.2683	1.4560		
IMPUL OPT	163.69	225.48	269.17	295.44	303.07	330.45	352.92	371.44	386.72	399.94	411.75	418.09			
IMPUL VAC	260.46	282.58	316.67	335.60	340.89	361.34	378.37	392.41	404.19	415.53	425.73	426.59			
EPSILON	1.038	1.508	2.528	3.911	4.443	8.153	14.957	27.442	50.941	101.192	202.088	1.000			
COMPOSITION SHIFTING (MOL/100 GM)															
132.60 B	.0024	.0011	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0014		
-45.47 B=F	1.5178	1.5132	1.5084	1.5035	1.4998	1.4927	1.4942	1.4904	1.4878	1.4937	1.5434	1.5687	1.5146		
-143.00 B=F+O	.6305	.6908	.7476	.8000	.8365	.8470	.8873	.9183	.9334	.9224	.8380	.7266	.6730		
-133.84 B=F2	.0129	.0092	.0064	.0044	.0033	.0030	.0020	.0013	.0008	.0005	.0005	.0005	.0102		
-270.00 B=F3	.0007	.0006	.0006	.0005	.0005	.0006	.0007	.0011	.0024	.0069	.0178	.0446	.0006		
114.76 F+H	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001		
-47.13 B+H+O	.2625	.2582	.2508	.2401	.2294	.2225	.2063	.1817	.1525	.1181	.0657	.0454	.2598		
-135.32 B+H+O2	.0260	.0265	.0261	.0248	.0231	.0225	.0190	.0147	.0099	.0057	.0024	.0009	.0264		
64.00 B+H2	.0010	.0005	.0002	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0006		
-45.00 B+H2+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
18.00 B+H3	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-238.40 B+H3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
5.74 B+O	.1968	.1443	.1047	.0674	.0438	.0376	.0167	.0051	.0010	.0001	.0000	.0000	.1624		
-84.00 B+O2	.0068	.0031	.0035	.0022	.0013	.0011	.0004	.0001	.0000	.0000	.0000	.0000	.0058		
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-111.60 B2+O2	.0152	.0167	.0185	.0205	.0224	.0230	.0263	.0311	.0387	.0443	.0189	.0077	.0163		
-210.10 B2+O3	.0016	.0020	.0026	.0034	.0041	.0044	.0058	.0081	.0119	.0157	.0064	.0024	.0019		
-567.00 B3+F3+O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-541.69 B3+F3+O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
18.66 F	.0022	.0003	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0011		
-64.50 F+H	.2661	.2195	.1737	.1304	.0998	.0910	.0569	.0299	.0124	.0047	.0041	.0035	.2335		
-26.10 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
52.10 F	.6573	.5325	.3828	.2523	.1679	.1454	.0675	.0222	.0046	.0008	.0004	.0002	.5804		
9.33 F+O	.0055	.0025	.0010	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0032		
.00 F2	1.7671	1.8826	1.9906	2.0886	2.1554	2.1740	2.2443	2.2966	2.3319	2.3573	2.3856	2.4019	1.8487		
-57.80 F2+O	.0250	.0192	.0138	.0092	.0063	.0055	.0028	.0011	.0003	.0001	.0000	.0000	.0209		
59.56 O	.0012	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006		
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		
-305.34 B2+O3/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		

SYSTEM LIQUID NITROGEN
COMPONENT 12H 20F2
12H 20F2
20H 45OH2

100, PSIA
DENSITY
G/CC

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PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/D
 (EG K) (GM/CC) (KCAL/FORM.WT.)
 12H O+F2 1.53 +3.5 72.
 29H H5+H9 0.620 +7.74 28.

BULK DENSITY = 1.084 GM/CC
 MIXTURE RATIO = 2.571 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 310.74 EU/100GMS

CHAMBER												THROAT
FROZEN EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4210.4	3501.3	2904.4	2403.4	2198.2	1983.3	1630.5	1334.8	1087.6	881.8	711.0	569.9
ENTHALPY (-)	-8.10	26.04	54.40	77.90	87.44	97.32	113.31	126.44	137.16	145.87	152.92	158.59
CP	.4842	.4744	.4723	.4655	.4619	.4577	.4486	.4347	.4285	.4180	.4070	.3960
IMPUL GPT	172.34	233.18	273.53	288.29	302.83	325.00	342.11	355.48	365.99	374.27	380.80	384.42
IMPUL VAC	262.53	288.48	312.54	322.14	331.91	347.27	359.43	369.06	376.69	382.71	387.45	390.57
EPSILON	1.042	1.524	2.566	3.343	4.365	5.347	6.347	7.347	8.347	9.347	10.347	11.347
SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	4210.4	3501.3	2904.4	2403.4	2198.2	1983.3	1630.5	1334.8	1087.6	881.8	711.0	569.9
ENTHALPY (-)	-8.10	26.04	54.40	77.90	87.44	97.32	113.31	126.44	137.16	145.87	152.92	158.59
X BAR	5.135	5.009	4.891	4.782	4.715	4.684	4.597	4.524	4.465	4.412	4.353	4.293
N	5.135	5.009	4.891	4.782	4.715	4.684	4.597	4.524	4.465	4.412	4.353	4.293
CP	1.7587	1.7100	1.6424	1.5440	1.4842	1.4034	1.2186	1.0086	.8440	.6872	.5310	.4650
IMPUL GPT	175.18	240.97	287.37	305.21	323.40	342.68	377.04	397.56	414.94	429.62	442.75	454.06
IMPUL VAC	270.16	302.70	333.79	346.78	360.48	383.25	402.68	419.23	433.37	445.72	456.62	466.09
EPSILON	1.061	1.645	2.953	3.971	5.630	7.079	8.2180	9.4734	10.764	12.0947	13.438	1.000
COMPOSITION SHIFTING (MOL/100 GM)												
172.6C B	.0020	.0009	.0004	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0012
-45.47 B+F	.9937	.9662	.9449	.9279	.9209	.9135	.9008	.8887	.8736	.8438	.7935	.7375
-145.00 B+F+C	.0017	.0035	1.0171	1.0924	1.1246	1.1589	1.2158	1.2619	1.2950	1.3135	1.3213	1.3243
-133.84 B+F2	.0245	.0179	.0133	.0100	.0088	.0078	.0063	.0055	.0051	.0048	.0038	.0025
-270.00 B+F3	.0020	.0018	.0018	.0018	.0019	.0021	.0029	.0050	.0126	.0383	.0877	.1441
114.76 B+F	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 B+F+C	.0131	.0550	.0667	.0760	.0762	.0631	.0488	.0341	.0209	.0120	.0079	.0062
-135.32 B+F+C2	.0217	.0222	.0213	.0197	.0174	.0160	.0121	.0080	.0045	.0023	.0014	.0010
-66.00 B+F2	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-45.00 B+F2+C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 B+F3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 B+F3+C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 B+C	.0247	.1576	.1139	.0760	.0609	.0457	.0237	.0098	.0029	.0007	.0002	.0001
-84.00 B+C2	.0163	.0130	.0095	.0063	.0050	.0037	.0018	.0007	.0002	.0000	.0000	.0000
199.30 B2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 B2+C2	.0034	.0032	.0029	.0024	.0022	.0019	.0014	.0008	.0004	.0002	.0001	.0001
-210.10 B2+C3	.0006	.0007	.0008	.0008	.0008	.0007	.0006	.0004	.0002	.0001	.0001	.0001
-567.00 B2+F3+C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.60 B2+F3+C6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.0281	.0142	.0067	.0030	.0020	.0012	.0004	.0001	.0000	.0000	.0000	.0000
-64.50 F+F	.7483	.7114	.6662	.6180	.5958	.5712	.5284	.4899	.4499	.4048	.3612	.3173
-26.10 F+F+C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	1.0975	.9417	.7776	.6128	.5375	.4539	.3073	.1808	.0859	.0335	.0128	.0047
9.33 F+C	.0343	.0197	.0102	.0047	.0032	.0019	.0006	.0002	.0000	.0000	.0000	.0000
.00 F2	.9986	1.0610	1.1818	1.3045	1.3668	1.4235	1.5339	1.6310	1.7104	1.7767	1.8423	1.9047
-57.80 F2+C	.0042	.0385	.0318	.0247	.0215	.0179	.0120	.0071	.0036	.0016	.0007	.0003
59.56 C	.0217	.0097	.0038	.0013	.0007	.0003	.0001	.0000	.0000	.0000	.0000	.0000
.00 F2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
34.10 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID PROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 77.
 298 H5*H9 0.620 +7.74 23.

BULK DENSITY = 1.144 GM/CC
 MIXTURE RATIO = 3.348 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 297.57 EU/100GMS

CHAMBER	FROZEN EXPANSION										SHIFTING EXPANSION															
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	165.2	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	172.0
TEMP, DEG K	4534.2	3753.9	3101.5	2556.3	2333.7	2101.4	1721.5	1404.8	1141.1	922.4	741.7	593.1	3983.9	4534.2	4173.3	3847.9	3550.7	3420.1	3277.2	3025.0	2790.6	2569.0	2353.9	2142.5	1951.1	4298.8
ENTHALPY (-)	-7.81	26.86	55.54	79.21	88.79	98.69	114.69	127.76	138.41	147.04	154.00	159.57	16.68	-7.81	28.21	60.55	89.65	102.24	115.88	139.54	160.91	180.23	197.64	213.30	227.34	15.69
X BAR	4.853	4.726	4.608	4.497	4.448	4.394	4.298	4.209	4.129	4.060	4.000	3.942	4.771	4.853	4.726	4.608	4.497	4.448	4.394	4.298	4.209	4.129	4.060	4.000	3.942	4.771
N	4.853	4.726	4.608	4.497	4.448	4.394	4.298	4.209	4.129	4.060	4.000	3.942	4.771	4.853	4.726	4.608	4.497	4.448	4.394	4.298	4.209	4.129	4.060	4.000	3.942	4.771
CP	2.1379	2.0462	1.9161	1.7772	1.7152	1.6477	1.5195	1.3727	1.1937	1.0048	.8904	.9955	2.0850	2.1379	2.0462	1.9161	1.7772	1.7152	1.6477	1.5195	1.3727	1.1937	1.0048	.8904	.9955	2.0850
IMPLL OPT	173.68	234.76	275.15	289.89	304.39	326.44	343.42	356.66	367.03	375.19	381.60	145.97	173.68	234.76	275.15	289.89	304.39	326.44	343.42	356.66	367.03	375.19	381.60	145.97		
IMPLL VAC	264.37	290.19	314.13	323.66	333.36	348.57	360.59	370.08	377.57	383.48	388.12	260.49	264.37	290.19	314.13	323.66	333.36	348.57	360.59	370.08	377.57	383.48	388.12	260.49		
EPSILON	1.041	1.518	2.548	3.315	4.519	8.239	15.255	28.478	53.392	100.239	188.092	1.000	1.041	1.518	2.548	3.315	4.519	8.239	15.255	28.478	53.392	100.239	188.092	1.000		

COMPOSITION SHIFTING (MOL/100 GM)																										
132.60 H	.0015	.0007	.0003	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0009	.0015	.0007	.0003	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0009
-45.47 H*F	.6515	.5914	.5391	.4969	.4807	.4648	.4411	.4233	.4092	.3962	.3784	.3632	.6122	.6515	.5914	.5391	.4969	.4807	.4648	.4411	.4233	.4092	.3962	.3784	.3632	.6122
-143.00 E*F*O	.8769	.9814	1.0767	1.1605	1.1954	1.2318	1.2900	1.3359	1.3705	1.3948	1.4100	1.4177	.9447	.8769	.9814	1.0767	1.1605	1.1954	1.2318	1.2900	1.3359	1.3705	1.3948	1.4100	1.4177	.9447
-133.84 E*F2	.0313	.0223	.0158	.0113	.0097	.0082	.0062	.0049	.0041	.0036	.0031	.0025		.0313	.0223	.0158	.0113	.0097	.0082	.0062	.0049	.0041	.0036	.0031	.0025	
-270.00 E*F3	.0034	.0029	.0025	.0023	.0022	.0022	.0024	.0029	.0042	.0079	.0196	.0031		.0034	.0029	.0025	.0023	.0022	.0022	.0024	.0029	.0042	.0079	.0196	.0031	
114.76 E*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-47.13 E*H*O	.0369	.0354	.0322	.0290	.0274	.0255	.0214	.0170	.0124	.0083	.0049	.0028	.0366	.0369	.0354	.0322	.0290	.0274	.0255	.0214	.0170	.0124	.0083	.0049	.0028	.0366
-135.32 E*H*O2	.0137	.0148	.0155	.0156	.0153	.0147	.0128	.0101	.0072	.0045	.0025	.0014	.0144	.0137	.0148	.0155	.0156	.0153	.0147	.0128	.0101	.0072	.0045	.0025	.0014	.0144
66.00 E*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-45.00 E*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.00 E*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-238.60 E*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
5.74 E*O	.1767	.1465	.1161	.0868	.0739	.0601	.0379	.0213	.0103	.0040	.0012	.0003	.1574	.1767	.1465	.1161	.0868	.0739	.0601	.0379	.0213	.0103	.0040	.0012	.0003	.1574
-84.00 E*O2	.0239	.0226	.0199	.0159	.0138	.0114	.0072	.0039	.0018	.0006	.0002	.0000	.0232	.0239	.0226	.0199	.0159	.0138	.0114	.0072	.0039	.0018	.0006	.0002	.0000	.0232
199.30 E2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-111.60 E2*O2	.0010	.0009	.0008	.0006	.0006	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0009	.0010	.0009	.0008	.0006	.0006	.0005	.0004	.0003	.0002	.0001	.0000	.0000	.0009
-210.10 E2*O3	.0003	.0003	.0004	.0004	.0004	.0004	.0003	.0003	.0002	.0001	.0001	.0000	.0003	.0003	.0003	.0004	.0004	.0004	.0004	.0003	.0003	.0002	.0001	.0001	.0000	.0003
-567.00 E3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-541.69 E3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
18.86 F	.1315	.0844	.0502	.0274	.0201	.0138	.0063	.0027	.0010	.0003	.0001	.0000	.0998	.1315	.0844	.0502	.0274	.0201	.0138	.0063	.0027	.0010	.0003	.0001	.0000	.0998
-64.50 F*H	1.1193	1.1413	1.1467	1.1377	1.1297	1.1186	1.0950	1.0715	1.0503	1.0295	.9978	.9295	1.1353	1.1193	1.1413	1.1467	1.1377	1.1297	1.1186	1.0950	1.0715	1.0503	1.0295	.9978	.9295	1.1353
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 F	1.1243	1.0522	.9658	.8597	.8031	.7336	.5929	.4475	.3076	.1848	.0928	.0420	1.0795	1.1243	1.0522	.9658	.8597	.8031	.7336	.5929	.4475	.3076	.1848	.0928	.0420	1.0795
9.33 F*O	.0829	.0613	.0420	.0260	.0200	.0143	.0069	.0028	.0010	.0003	.0000	.0000	.0689	.0829	.0613	.0420	.0260	.0200	.0143	.0069	.0028	.0010	.0003	.0000	.0000	.0689
.00 F2	.4086	.4465	.4596	.5696	.6078	.6548	.7492	.8454	.9365	1.0170	1.0852	1.1485	.4313	.4086	.4465	.4596	.5696	.6078	.6548	.7492	.8454	.9365	1.0170	1.0852	1.1485	.4313
-57.80 F2*O	.0401	.0394	.0377	.0347	.0328	.0303	.0246	.0185	.0126	.0077	.0041	.0021	.0397	.0401	.0394	.0377	.0347	.0328	.0303	.0246	.0185	.0126	.0077	.0041	.0021	.0397
59.56 O	.1228	.0790	.0451	.0223	.0152	.0093	.0032	.0009	.0002	.0000	.0000	.0000	.0937	.1228	.0790	.0451	.0223	.0152	.0093	.0032	.0009	.0002	.0000	.0000	.0000	.0937
.00 O2	.0047	.0027	.0013	.0005	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0034	.0047	.0027	.0013	.0005	.0003	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0034
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000		.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		DENSITY		HEAT FORM		WT. O/D																	
COMPONENT										TREF FORMULA		GM/CC		(KCAL/FORM.WT.)		77.23																	
										DEG K		1.33		+3.5																			
										128 DPF2		0.620		+7.74																			
										298 B59HH																							
										C STAR = 6692.9 FT/SEC																							
										FROZEN EXPANSION																							
EPSILON										PC/F		P PSIA		TEMP		ENTHALPY		CP CAL/G DEG C		I OPT DEL VAC		I SEA		I AT		I VAC		CF SEA CP VAC					
1.000										300.000		4554.2		7.81		.447																	
1.000										145.152		145.152		9		-16.48				146.0		116.5		.493		250.3		253.4		259.3			
2.000										9.333		30.509		2779.4		-47.57				.434		200.0		44.1		1.445		282.9		301.7		304.1	
3.000										17.581		17.662		2414.8		-65.31				.430		284.6		35.6		2.085		289.6		298.8		316.7	
4.000										27.149		11.650		2189.3		-64.95				.426		299.0		30.7		2.780				301.7		325.0	
5.000										37.200		7.930		2011.4		-64.95				.424		301.8		29.4		3.303				330.3		336.7	
6.000										47.746		6.039		1911.7		-106.72				.421		315.7		25.6		4.207				333.9		349.7	
7.000										62.070		4.633		1816.6		-110.71				.419		321.1		23.7		4.908				336.5		364.8	
8.000										74.500		3.427		1718.3		-113.99				.417		325.5		22.4		5.564				338.4		367.9	
9.000										89.442		2.994		1672.0		-116.75				.416		329.2		21.3		6.279				339.8		350.5	
10.000										100.000		2.613		1625.2		-119.11				.414		332.4		20.4		7.042				340.7		352.7	
11.000										110.759		2.326		1584.8		-121.19				.413		335.C		19.6		7.755				341.4		354.6	
12.000										124.376		2.123		1520.6		-123.01				.412		337.4		18.9		8.467				341.8		356.3	
13.000										150.032		2.000		1481.0		-124.04				.410		339.5		18.3		9.151				342.2		357.8	
14.000										165.555		1.812		1445.2		-126.11				.408		341.6		17.8		9.842				342.4		358.7	
15.000										180.969		1.658		1412.7		-127.44				.408		343.5		17.3		10.524				343.4		359.3	
16.000										198.266		1.533		1382.8		-128.66				.408		344.6		16.8		11.128				343.4		361.4	
17.000										216.056		1.395		1355.3		-129.78				.407		346.0		16.4		11.808				343.4		362.4	
18.000										235.466		1.274		1329.8		-130.82				.406		347.3		16.1		12.608				343.3		363.3	
19.000										256.018		1.178		1306.1		-131.78				.405		348.5		15.7		13.424				343.2		364.2	
20.000										278.039		1.095		1284.0		-132.67				.404		349.6		15.4		14.074				343.0		365.0	
21.000										293.056		1.022		1263.3		-133.50				.404		350.6		15.1		14.794				342.8		365.7	
22.000										313.404		.957		1243.9		-134.29				.403		351.6		14.8		15.503				342.4		366.4	
23.000										330.000		.901		1225.6		-135.02				.402		352.6		14.6		16.200				342.1		367.1	
24.000										353.003		.850		1208.3		-135.74				.402		353.4		14.3		16.882				341.8		367.8	
25.000										372.800		.803		1192.0		-136.38				.401		354.2		14.1		17.549				341.5		368.3	
26.000										392.644		.764		1176.4		-137.00				.400		354.9		13.9		18.200				341.2		368.8	
27.000										412.521		.731		1161.7		-137.55				.400		355.9		13.7		18.835				340.8		369.4	
28.000										432.440		.701		1147.8		-138.05				.399		356.8		13.5		19.459				340.4		370.0	
29.000										453.027		.672		1134.2		-138.68				.399		357.0		13.3		20.130				340.0		370.3	
30.000										475.822		.630		1121.4		-139.70				.398		357.6		13.2		20.867				339.7		370.8	
31.000										498.964		.591		1109.1		-139.69				.398		358.2		13.0		21.605				339.2		371.2	
32.000										522.157		.554		1097.3		-140.15				.397		358.8		12.8		22.340				338.7		371.6	
33.000										546.109		.521		1086.0		-140.60				.397		359.3		12.7		23.081				338.2		372.0	
34.000										570.269		.496		1075.1		-141.04				.396		359.8		12.5		23.818				337.4		372.4	
35.000										595.251		.472		1064.6		-141.45				.396		360.3		12.3		24.552				337.0		372.7	
36.000										616.611		.450		1054.9		-141.85				.396		360.8		12.1		25.283				336.5		373.1	
37.000										639.148		.428		1044.8		-142.23				.395		361.3		12.1		26.011				336.0		373.4	
38.000										662.785		.406		1035.5		-142.60				.395		361.7		12.0		26.736				335.7		373.7	
39.000										687.711		.384		1026.4		-142.96				.396		362.2		11.9		27.453				335.1		374.1	
40.000										714.239		.361		1017.6		-143.31				.396		362.6		11.8		28.166				334.6		374.6	
41.000										742.448		.339		1009.2		-143.64				.396		363.1		11.7		28.878				334.0		375.0	
42.000										771.720		.317		1001.0		-143.96				.393		363.4		11.6		29.573				333.4		375.4	
43.000										792.834		.295		993.1		-144.28				.393		363.7		11.5		30.267				332.7		375.7	
44.000										817.725		.273		985.3		-144.58				.393		364.1		11.4		30.953				332.0		375.5	
45.000										844.000		.251		977.8		-144.87				.392		364.4		11.3		31.632				331.3		375.6	
46.000										870.576		.229		970.6		-145.16				.392		364.8		11.2		32.306				330.6		375.7	
47.000										893.411		.206		963.4		-145.44				.392		365.1		11.1		32.977				329.9		376.2	
48.000										918.521		.183		956.5		-145.70				.391		365.4		11.0		33.643				329.2		376.7	
49.000										945.559		.160		949.9		-145.97				.391		365.8		10.9		34.327				328.5		377.1	
50.000										974.627		.137		943.6		-146.23				.391		366.2		10.8		35.000				327.8		377.6	
51.000										1004.84		.114		937.7		-146.49				.389		366.5		10.7		35.673				327.1		378.1	
52.000										1036.21		.091		932.1		-146.73				.388		366.8		10.6		36.348				326.4		378.6	
53.000										1068.74		.068		926.8		-146.97				.387		367.1		10.5		37.023				325.7		379.1	
54.000										1102.43		.045		921.8		-147.20				.386		367.4		10.4		37.698				325.0		379.6	
55.000										1137.28		.022		917.1		-147.42				.385		367.7		10.3		38.373				324.3		380.1	
56.000										1173.29		.000		912.7		-147.63				.384		368.0		10.2		39.048				323.6		380.6	
57.000										1210.46		.000		908.6		-147.84				.383		368.3		10.1		39.723				322.9		381.1	
58.000										1248.79		.000		904.8		-148.04				.382		368.6		10.0		40.398				322.2		381.6	
59.000										1288.28		.000		901.2		-148.24				.381		368.9		9.9		41.073				321.5		382.1	
60.000										1328.93		.000		897.8		-148.43				.380		369.2		9.8		41.748				320.8		382.6	
61.000										1370.74		.000		894.6		-148.62				.379		369.5		9.7		42.423				320.1		383.1	
62.000										1413.71		.000		891.6		-148.80				.378		369.8		9.6		43.098				319.4		383.6	
63.000										1457.84		.000		888.8		-148.98				.377		370.1		9.5		43.773				318.7		384.1	
64.000										1503.13		.000		886.2		-149.15				.376		370.4		9.4		44.448				318.0		384.6	
65.000										1549.58		.000		883.8		-149.32				.375		370.7		9.3		45.123				317.3		385.1	
66.000										1597.19		.000		881.5		-149.48				.374		371.0		9.2		45.798				316.6		385.6	
67.000										1645.96		.000		879.3		-149.64				.373		371.3		9.1		46.473				315.9		386.1	
68.000										1695.89		.000		877.2		-149.79				.372		371.6		9.0		47.148				315.2		386.6	
69.000										1746.98		.000		875.3		-149.94				.371		371.9		8.9		47.823				314.5		387.1	
70.000										1799.23		.000		873.5		-150.09				.370		372.2		8.8		48.498				313.8		387.6	
71.000										1852.64		.000		871.8		-150.23				.369													

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 80.
 298 B5*H9 0.620 +7.74 20.

PULK DENSITY = 1.183 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 288.46 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	164.0
TEMP, DEG K	4665.6	3851.0	3172.3	2607.0	2376.7	2136.8	1745.4	1420.2	1150.2	927.1	743.3	592.9	4084.5
ENTHALPY (-)	-7.64	26.69	55.00	78.30	87.70	97.41	113.06	125.81	136.17	144.54	151.27	156.65	16.89
CP	.4235	.4193	.4147	.4094	.4067	.4033	.3959	.3878	.3793	.3705	.3618	.3531	.4206
IMPLL OPT	172.81	233.43	273.42	287.58	302.30	324.03	340.73	353.70	363.85	371.81	378.05	384.07	146.07
IMPLL VAC	262.91	288.37	311.97	321.35	330.88	345.81	357.58	366.85	374.15	379.89	384.39	389.12	259.12
EPSILON	1.040	1.513	2.534	3.293	4.484	8.155	15.061	28.048	52.452	98.232	183.903	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.0
TEMP, DEG K	4665.6	4318.1	4008.4	3727.2	3603.5	3467.2	3222.9	2991.2	2770.6	2560.0	2356.2	2153.1	4440.7
ENTHALPY (-)	-7.64	28.15	60.42	89.63	102.34	116.14	140.23	162.10	181.95	199.97	216.27	230.99	15.44
X BAR	4.677	4.547	4.427	4.316	4.267	4.213	4.118	4.029	3.947	3.872	3.805	3.749	4.593
N	4.677	4.547	4.427	4.316	4.267	4.213	4.118	4.029	3.947	3.872	3.805	3.749	4.593
CP	2.4509	2.4176	2.3119	2.1482	2.0579	1.9485	1.7416	1.5486	1.3773	1.2069	1.0219	.8394	2.4413
IMPLL OPT	176.44	243.33	290.90	309.31	328.15	358.66	384.26	406.12	424.98	441.35	455.63	461.68	
IMPLL VAC	272.64	306.37	338.70	352.29	366.64	390.65	411.38	429.40	445.14	458.91	470.94	476.15	
EPSILON	1.064	1.664	3.012	4.065	5.787	11.482	23.228	47.597	98.399	204.562	425.832	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
132.60 E	.0010	.0005	.0002	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0007
-45.47 E*F	.4980	.4313	.3679	.3096	.2845	.2580	.2149	.1814	.1563	.1375	.1223	.1082	.4555
-143.00 P*F*O	.8514	.9536	1.0487	1.1353	1.1727	1.2125	1.2793	1.3347	1.3791	1.4136	1.4395	1.4580	.9168
-133.84 E*F2	.0353	.0250	.0171	.0114	.0094	.0075	.0049	.0032	.0022	.0016	.0013	.0011	.0285
-270.00 E*F3	.0049	.0042	.0034	.0028	.0025	.0022	.0019	.0017	.0017	.0021	.0033	.0069	.0044
114.76 E*H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-47.13 E*H*O	.0194	.0166	.0143	.0124	.0117	.0109	.0095	.0082	.0068	.0053	.0038	.0024	.0176
-135.32 E*H*O2	.0088	.0094	.0101	.0108	.0111	.0116	.0122	.0122	.0113	.0094	.0069	.0044	.0092
66.00 E*H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-45.00 E*H2*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.00 E*H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-238.60 E*H3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
5.74 E*O	.1385	.1166	.0958	.0764	.0678	.0584	.0420	.0278	.0165	.0085	.0036	.0012	.1245
-84.00 E*O2	.0244	.0248	.0244	.0232	.0223	.0210	.0175	.0130	.0083	.0044	.0019	.0006	.0247
199.30 E2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-111.60 P2*O2	.0005	.0004	.0003	.0002	.0002	.0002	.0002	.0001	.0001	.0001	.0000	.0000	.0004
-210.10 P2*O3	.0002	.0002	.0002	.0002	.0002	.0002	.0003	.0003	.0002	.0002	.0001	.0001	.0002
-567.00 E3*F3*O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-541.69 E3*H3*O6	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
18.86 F	.2631	.1935	.1355	.0891	.0713	.0541	.0297	.0146	.0064	.0025	.0008	.0002	.2177
-64.50 F*H	1.2652	1.3221	1.3663	1.3978	1.4082	1.4167	1.4237	1.4208	1.4115	1.3998	1.3878	1.3735	1.3028
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 F	.9572	.9113	.8640	.8112	.7833	.7480	.6691	.5708	.4557	.3329	.2151	.1159	.9281
9.33 F*O	.1036	.0854	.0686	.0530	.0462	.0387	.0259	.0152	.0076	.0031	.0010	.0002	.0919
.00 H2	.2175	.2224	.2332	.2518	.2639	.2810	.3237	.3815	.4518	.5281	.6021	.6670	.2200
-57.80 F2*O	.0300	.0299	.0299	.0303	.0305	.0307	.0308	.0296	.0264	.0213	.0153	.0095	.0299
59.56 O	.2444	.1899	.1400	.0957	.0775	.0589	.0312	.0136	.0047	.0012	.0002	.0000	.2095
.00 O2	.0131	.0099	.0070	.0045	.0035	.0026	.0012	.0004	.0001	.0000	.0000	.0000	.0111
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

SYSTEM LIQUID RIPOPELLANT										PC 100, PSIA		DENSITY		HEAT FORM		WT. 0/0	
COMPONENT										TREF FORMULA		GM/GC		(KCAL/FORM.WT.)		8C.	
										DEG R		1.53		1.53		20.	
										1218 84F2		0.620		47.74			
										258 854M9							

PULK DENSITY = 1.301 GM/CC
MIXTURE RATIO = 7.333 LB OXIDIZER / LB CF FUEL

CHAMBER ENTROPY 259.77 EU/100GMS

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EPSILON	PC/F	P PSJA	SHIFTING EXPANSION										I SEA	I AT 10000	I AT 50000	I VAC	CF SEA	CF VAC
			TEMP	ENTHALPY	CP CAL	C STAR	I SPT	DELTA	DELTA	DELTA	DELTA	DELTA						
			CEC K	LOG10/LOG2	CP CAL	I SPT	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	
1.000	1.739	172.561	4407.8	-13.70	2.053	134.8	117.7	.0087	242.4	245.5	251.3	252.5	1.236	1.185				
2.000	2.989	37.555	3866.4	-63.34	1.815	248.2	52.4	1.406	280.3	286.6	298.0	301.0	1.370	1.471				
3.000	13.652	21.574	3678.0	-80.23	1.704	275.8	45.0	2.046	296.7	299.7	317.2	320.7	1.420	1.567				
4.000	70.218	14.436	3553.9	-81.17	1.636	292.5	40.5	2.729	292.9	300.0	328.3	330.7	1.431	1.627				
5.000	27.255	11.007	3462.8	-88.10	1.599					308.6	335.9			1.672				
6.000	34.567	7.679	3391.1	-105.20		312.8	35.6	4.099			341.4	348.4		1.702				
7.000	42.461	6.035	3332.3	-110.32		319.7	34.6	4.812			345.5	353.7		1.729				
8.000	50.562	5.930	3282.9	-114.58		325.4	32.7	5.522			348.8	358.2		1.751				
9.000	58.950	5.819	3240.3	-118.20		331.2	30.3	6.215			351.4	362.0		1.770				
10.000	66.947	5.681	3203.0	-121.56		334.4	30.8	6.883			353.5	365.3		1.785				
11.000	74.962	5.602	3170.0	-124.70		338.1	30.1	7.522			355.3	368.2		1.799				
12.000	83.711	5.584	3140.3	-126.74		341.3	29.4	8.215			356.8	370.6		1.812				
13.000	92.915	5.527	3113.5	-129.04		344.2	28.9	8.845			357.8	373.2		1.823				
14.000	102.92	5.450	3089.1	-131.13		347.3	28.3	9.517			358.7	375.7		1.832				
15.000	111.892	5.481	3066.7	-133.06		349.3	27.9	10.196			359.4	377.2		1.843				
16.000	121.422	5.471	3046.0	-134.84		351.5	27.4	11.109			360.0	379.0		1.852				
17.000	130.936	5.491	3026.8	-136.49		353.5	27.1	11.811			360.5	380.6		1.860				
18.000	140.580	5.492	3009.0	-138.04		355.4	26.7	12.417			360.8	382.0		1.867				
19.000	149.743	5.483	2992.3	-139.40		357.2	26.4	13.169			361.1	383.4		1.875				
20.000	159.022	5.487	2976.6	-140.84		358.8	26.1	13.822			361.3	384.9		1.881				
21.000	168.152	5.484	2961.8	-142.12		360.4	25.8	14.457			361.5	386.2		1.887				
22.000	177.148	5.493	2947.9	-143.33		361.8	25.5	15.075			361.7	387.4		1.893				
23.000	186.028	5.494	2934.7	-144.46		363.2	25.3	15.693			361.9	388.6		1.899				
24.000	194.627	5.496	2922.2	-145.57		364.5	25.0	16.316			362.0	389.6		1.904				
25.000	207.153	5.498	2910.4	-146.61		365.8	24.8	17.142			362.0	390.6		1.909				
26.000	217.711	5.498	2899.1	-147.60		366.9	24.6	17.868			362.1	391		1.914				
27.000	227.769	5.498	2888.3	-148.45		367.8	24.4	18.594			362.1	391.9		1.919				
28.000	239.220	5.497	2877.9	-149.46		368.1	24.2	19.319			362.1	392.8		1.922				
29.000	250.024	5.496	2868.1	-150.33		370.2	24.0	20.042			362.0	393.2		1.927				
30.000	260.880	5.495	2858.6	-151.17		371.2	23.9	20.762			362.0	393.9		1.931				
31.000	271.718	5.494	2849.5	-151.97		372.1	23.7	21.479			362.0	394.6		1.935				
32.000	282.683	5.493	2840.7	-152.75		373.0	23.6	22.191			362.0	395.3		1.939				
33.000	293.448	5.492	2832.3	-153.50		373.9	23.4	22.898			362.0	397.3		1.942				
34.000	304.294	5.490	2824.1	-154.22		374.7	23.3	23.599			362.0	398.0		1.945				
35.000	315.119	5.489	2816.3	-154.92		375.5	23.1	24.294			362.0	398.7		1.948				
36.000	325.910	5.487	2808.7	-155.60		376.3	23.0	24.984			362.0	399.4		1.951				
37.000	336.662	5.485	2801.4	-156.25		377.1	22.9	25.685			362.0	399.9		1.955				
38.000	347.365	5.484	2794.2	-156.88		377.8	22.7	26.339			362.0	400.5		1.957				
39.000	358.016	5.483	2787.7	-157.50		378.5	22.6	27.008			362.0	401.1		1.960				
40.000	368.647	5.482	2781.0	-158.10		379.2	22.5	27.674			362.0	401.7		1.963				
41.000	379.136	5.481	2774.2	-158.67		379.9	22.4	28.316			362.0	402.3		1.966				
42.000	389.557	5.480	2767.9	-159.24		380.5	22.3	28.960			362.0	402.8		1.969				
43.000	399.994	5.479	2761.9	-159.79		381.1	22.2	29.595			362.0	403.3		1.971				
44.000	410.120	5.477	2755.8	-160.32		381.7	22.1	30.221			362.0	403.8		1.974				
45.000	420.079	5.476	2750.0	-160.81		382.3	22.0	30.841			362.0	404.3		1.977				
46.000	430.761	5.474	2744.4	-161.35		382.9	21.9	31.455			362.0	404.8		1.978				
47.000	440.878	5.473	2738.9	-161.84		383.5	21.8	32.060			362.0	405.3		1.981				
48.000	452.534	5.471	2733.6	-162.33		384.0	21.7	32.776			362.0	405.7		1.983				
49.000	464.354	5.469	2728.3	-162.80		384.5	21.6	33.488			362.0	406.2		1.985				
50.000	476.210	5.468	2723.1	-163.25		385.0	21.5	34.192			362.0	406.7		1.988				
4.930	20.414	14.696	3550.8	-81.44	1.638	292.0	40.4	2.748	292.9	305.1	328.6	333.3	1.431	1.629				

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Ford Motor Company,
AERONUTRONIC DIVISION

OF₂ - N₂H₄ SYSTEM

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. 8/8
128	O=F2	1.53	3.5	44.
298	N2=H4	1.004	12.05	56.

BULK DENSITY = 1.183 GM/CC
MIXTURE RATIO = .786 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 330.95 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	16.70	10.00	3.981	1.585	.631	.251	.100	546.4
TEMP, DEG K	3421.8	2808.6	2292.9	1859.4	1495.5	1311.7	1191.3	939.6	734.7	570.6	441.2	340.8	3009.9
ENTHALPY (-)	-23.91	11.24	40.02	63.44	82.36	91.59	97.51	109.52	118.95	126.30	132.00	136.38	-2.20
CP	.5799	.5657	.5492	.5301	.5087	.4957	.4867	.4676	.4530	.4433	.4381	.4346	.5707
IMPUL OPT	174.86	235.82	275.66	304.05	316.98	325.00	340.69	352.53	361.49	368.28	373.42	374.60	143.60
IMPUL VAC	260.70	287.79	311.71	330.34	339.10	344.59	355.43	363.67	369.92	374.69	378.30	378.30	255.62
EPSILON	1.056	1.605	2.797	5.123	7.368	9.591	18.127	34.405	65.457	124.791	238.793	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	16.70	10.00	3.981	1.585	.631	.251	.100	559.7
TEMP, DEG K	3421.8	2951.4	2489.5	2052.9	1667.1	1489.5	1339.4	1065.3	839.3	656.1	510.5	400.7	3124.4
ENTHALPY (-)	-23.91	11.92	42.21	67.38	87.95	98.06	104.56	117.84	128.36	136.61	143.05	148.05	-1.67
X BAR	6.182	6.108	6.070	6.059	6.057	6.057	6.057	6.057	6.057	6.057	6.055	6.034	6.131
N	6.182	6.108	6.070	6.059	6.057	6.057	6.057	6.057	6.057	6.057	6.055	6.034	6.131
CP	.9559	.7649	.6248	.5518	.5187	.5045	.4951	.4742	.4570	.4451	.4432	.4328	.8322
IMPUL OPT	176.53	239.63	281.81	311.94	325.73	334.30	351.16	363.96	373.69	381.10	386.78	392.17	142.17
IMPUL VAC	264.81	294.30	319.96	339.93	349.36	355.28	367.05	376.03	382.88	388.12	392.18	392.18	258.65
EPSILON	1.066	1.652	2.906	5.353	7.724	10.081	19.173	36.609	70.010	134.125	259.660	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0024	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0010
-64.50 F=H	1.6272	1.6291	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6287
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1981	.0868	.0244	.0037	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1227
79.20 H=H	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=H=O	.0015	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008
9.33 H=O	.0390	.0126	.0023	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0203
.00 H2	1.7955	1.8301	1.8542	1.8633	1.8649	1.8651	1.8651	1.8650	1.8650	1.8645	1.8615	1.8311	1.8178
40.30 H2=N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.7660	.8000	.8123	.8146	.8148	.8148	.8148	.8148	.8148	.8148	.8148	.8148	.7905
-11.04 H3=N	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0001	.0001	.0004	.0024	.0227	.0001
113.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N=O	.0051	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0022
8.06 N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.7439	1.7465	1.7472	1.7474	1.7474	1.7474	1.7474	1.7474	1.7473	1.7472	1.7462	1.7360	1.7458
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0025	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0008
.00 O2	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001

SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FURN	WT. O/F									
DEG K		ORICE	(KCAL/POUND.WT.)										
120 00FZ		1.53	3.5	44.									
290 N2+H4		1.004	12.05	56.									
FROZEN EXPANSION													
C STAR = 6571.7 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY K CAL/100GM	CP CAL/ G DEG	I OPT	DEL VAC	I SEA	I AT	I AT 10000	I VAC	CF SEA	CF VAC
1.000	1.000	1000.000	3421.8	23.91	.580								
2.000	1.023	98.818	3009.9	-20.77	.571	143.6	112.0	.204	252.6	253.5	255.4	1.237	1.251
3.000	1.041	90.886	2700.4	-35.93	.562	259.6	34.6	.417	305.1	307.9	313.2	1.496	1.538
4.000	17.930	56.085	1812.4	-65.93	.528	279.6	29.6	.436	311.2	316.9	322.0	1.523	1.584
5.000	28.207	35.452	1635.4	-75.28	.518	293.8	24.6	.434	311.2	316.9	322.0	1.523	1.584
6.000	36.551	25.939	1508.4	-81.70	.510	303.1	24.6	1.025	316.6	316.2	328.8	1.540	1.614
7.000	50.492	19.605	1412.4	-84.54	.503	310.0	24.4	1.230	316.3	321.7	332.2	1.540	1.637
8.000	63.232	15.815	1336.1	-90.37	.498	315.3	22.6	1.332	316.9	323.2	335.5	1.552	1.655
9.000	76.067	13.013	1273.0	-93.51	.493	319.6	21.3	1.436	320.1	328.1	340.9	1.609	1.669
10.000	107.222	10.957	1219.4	-96.14	.489	325.2	20.2	1.630	327.8	340.2	343.2	1.691	1.701
11.000	106.409	9.999	1173.1	-98.39	.485	326.2	19.2	2.045	331.0	341.9	345.4	1.691	1.691
12.000	122.445	8.154	1132.5	-100.34	.482	328.8	18.4	2.471	334.3	343.3	347.2	1.700	1.700
13.000	139.596	7.166	1096.4	-102.08	.479	331.1	17.7	2.971	338.6	346.8	348.8	1.706	1.706
14.000	157.113	6.348	1064.5	-103.62	.477	333.1	17.1	3.483	343.6	350.2	351.4	1.716	1.716
15.000	175.082	5.712	1035.0	-105.00	.475	334.9	16.5	2.992	348.5	355.1	355.1	1.720	1.720
16.000	193.309	5.173	1009.0	-106.25	.473	336.5	16.0	3.507	353.2	357.2	357.2	1.726	1.726
17.000	211.762	4.723	984.9	-107.39	.471	338.0	15.6	4.297	357.9	359.5	359.5	1.731	1.731
18.000	230.272	4.363	962.7	-108.44	.469	339.3	15.2	5.491	363.1	361.5	358.5	1.735	1.735
19.000	248.835	4.019	942.1	-109.40	.468	340.5	14.8	6.479	368.1	355.5	355.5	1.740	1.740
20.000	269.768	3.707	923.0	-110.29	.466	341.7	14.4	7.548	373.0	349.5	354.1	1.746	1.746
21.000	291.535	3.430	905.2	-111.13	.465	342.7	14.1	8.114	377.8	346.8	354.9	1.751	1.751
22.000	313.829	3.186	888.5	-111.90	.464	343.7	13.8	8.335	382.5	345.1	355.7	1.756	1.756
23.000	336.562	2.971	872.9	-112.62	.463	344.6	13.5	8.355	387.1	343.4	356.2	1.761	1.761
24.000	359.644	2.780	858.2	-113.30	.462	345.5	13.2	8.375	391.6	341.7	356.8	1.766	1.766
25.000	383.080	2.611	844.3	-113.94	.461	346.3	13.0	8.990	396.0	340.0	357.3	1.769	1.769
26.000	406.707	2.459	831.2	-114.55	.460	347.1	12.8	9.204	400.3	338.3	357.9	1.772	1.772
27.000	430.518	2.323	818.6	-115.12	.459	347.8	12.6	9.415	404.5	336.6	358.4	1.776	1.776
28.000	454.502	2.200	806.7	-115.65	.458	348.5	12.4	9.629	408.6	334.9	358.9	1.781	1.781
29.000	478.427	2.090	795.7	-116.16	.457	349.1	12.2	9.827	412.7	333.2	359.4	1.786	1.786
30.000	502.423	1.990	785.0	-116.64	.456	349.7	12.0	10.026	416.7	331.5	359.9	1.791	1.791
31.000	526.392	1.900	774.6	-117.11	.455	350.3	11.8	10.221	420.6	329.8	360.4	1.796	1.796
32.000	550.298	1.817	764.6	-117.57	.455	350.8	11.7	10.416	424.5	328.1	360.9	1.801	1.801
33.000	574.120	1.742	755.0	-118.00	.454	351.4	11.5	10.608	428.3	326.4	361.4	1.806	1.806
34.000	597.856	1.673	746.7	-118.41	.454	351.9	11.3	10.800	432.1	324.7	361.9	1.811	1.811
35.000	621.434	1.609	738.1	-118.80	.453	352.3	11.2	10.997	435.8	323.0	362.4	1.816	1.816
36.000	644.862	1.548	729.8	-119.17	.453	352.8	11.1	11.198	439.5	321.3	362.9	1.821	1.821
37.000	668.152	1.489	721.8	-119.53	.452	353.3	10.9	11.377	443.1	319.6	363.4	1.826	1.826
38.000	691.397	1.432	714.2	-119.88	.452	353.7	10.8	11.597	446.6	317.9	363.9	1.831	1.831
39.000	714.634	1.365	706.8	-120.21	.451	354.1	10.7	11.817	450.1	316.2	364.4	1.836	1.836
40.000	737.871	1.312	699.6	-120.54	.451	354.5	10.5	12.037	453.5	314.5	364.9	1.841	1.841
41.000	761.120	1.263	692.0	-120.85	.450	354.9	10.4	12.257	456.9	312.8	365.4	1.846	1.846
42.000	784.378	1.218	684.1	-121.15	.450	355.2	10.3	12.477	460.2	311.1	365.9	1.851	1.851
43.000	807.642	1.175	676.4	-121.44	.450	355.6	10.2	12.696	463.5	309.4	366.4	1.856	1.856
44.000	830.912	1.134	673.4	-121.72	.449	355.9	10.1	12.916	466.8	307.7	366.9	1.861	1.861
45.000	854.187	1.094	667.4	-121.99	.449	356.3	10.0	13.136	470.1	306.0	367.4	1.866	1.866
46.000	877.462	1.055	661.4	-122.25	.448	356.6	9.9	13.356	473.4	304.3	367.9	1.871	1.871
47.000	900.737	1.027	655.9	-122.51	.448	356.9	9.8	13.576	476.7	302.6	368.4	1.876	1.876
48.000	924.012	.995	650.3	-122.77	.448	357.2	9.7	13.796	480.0	300.9	368.9	1.881	1.881
49.000	947.287	.965	644.9	-122.99	.447	357.5	9.6	14.016	483.3	299.2	369.4	1.886	1.886
50.000	970.562	.937	639.7	-123.21	.447	357.7	9.5	14.236	486.6	297.5	369.9	1.891	1.891
7.384	66.046	14.696	1311.7	-91.59	.496	317.0	22.1	1.505	317.0	323.6	336.5	1.552	1.640

SHIPPING EXPANSION													
C STAR = 6695.8 FT/SEC													
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY K CAL/100GM	CP CAL/ G DEG	I OPT	DEL VAC	I SEA	I AT	I AT 10000	I VAC	CF SEA	CF VAC
1.000	1.000	1000.000	3421.8	23.91	.580								
2.000	1.787	559.708	3124.4	-67	.582	162.2	116.5	.208	255.6	256.5	258.3	1.243	1.228
3.000	3.571	379.867	2703.7	-88.00	.584	283.7	17.5	.429	297.9	299.8	303.5	1.451	1.462
4.000	5.354	297.867	2401.2	-98.00	.586	304.7	12.2	.451	310.7	312.5	316.2	1.659	1.670
5.000	7.137	215.867	2106.4	-107.25	.588	325.7	28.9	.473	323.6	325.4	329.1	1.867	1.878
6.000	8.920	133.867	1811.1	-116.50	.590	346.7	26.5	.495	336.5	338.3	342.0	2.075	2.086
7.000	10.703	51.867	1515.8	-125.75	.592	367.7	24.1	.517	349.4	351.2	354.9	2.283	2.294
8.000	12.486	13.867	1220.5	-135.00	.594	388.7	21.7	.539	362.3	364.1	367.8	2.491	2.502
9.000	14.269	1.787	1025.2	-144.25	.596	409.7	19.3	.561	375.2	377.0	380.7	2.699	2.710
10.000	16.052	10.115	1045.2	-153.50	.598	430.7	16.9	.583	388.1	389.9	393.6	2.907	2.918
11.000	17.835	8.270	1025.0	-162.75	.599	451.7	14.5	.605	401.0	402.8	406.5	3.115	3.126
12.000	19.618	6.425	1004.8	-172.00	.601	472.7	12.1	.627	413.9	415.7	419.4	3.323	3.334
13.000	21.401	4.579	984.6	-181.25	.602	493.7	9.7	.649	426.8	428.6	432.3	3.531	3.542
14.000	23.184	2.733	964.4	-190.50	.604	514.7	7.3	.671	439.7	441.5	445.2	3.739	3.750
15.000	24.967	1.887	944.2	-199.75	.605	535.7	4.9	.693	452.6	454.4	458.1	3.947	3.958
16.000	26.750	1.041	924.0	-209.00	.607	556.7	2.5	.715	465.5	467.3	471.0	4.155	4.166
17.000	28.533	0.195	903.8	-218.25	.608	577.7	0.1	.737	478.4	480.2	483.9	4.363	4.374
18.000	30.316	0.349	883.6	-227.50	.610	598.7	0.1	.759	491.3	493.1	496.8	4.571	4.582
19.000	32.099	0.503	863.4	-236.75	.611	619.7	0.1	.781	504.2	506.0	509.7	4.779	4.790
20.000	33.882	0.657	843.2	-246.00	.613	640.7	0.1	.803	517.1	518.9	522.6	4.987	4.998
21.000	35.665	0.811	823.0	-255.25	.614	661.7	0.1	.825	530.0	531.8	535.5	5.195	5.206
22.000	37.448	0.965	802.8	-264.50	.616	682.7	0.1	.847	542.9	544.7	548.4	5.403	5.414
23.000	39.231	1.119	782.6	-273.75	.617	703.7	0.1	.869	555.8	557.6	561.3	5.611	5.622
24.000	41.014	1.273	762.4	-283.00	.619	724.7	0.1	.891	568.7	570.5	574.2	5.819	5.830
25.000	42.797	1.427	742.2	-292.25	.620	745.7	0.1	.913	581.6	583.4	587.1	6.027	6.038
26.000	44.580	1.581	722.0	-301.50	.622	766.7	0.1	.935	594.5	596.3	600.0	6.235	6.246
27.000	46.363	1.735	701.8	-310.75	.623	787.7	0.1	.957	607.4	609.2	612.9	6.443	6.454
28.000	48.146	1.889	681.6	-320.00	.625	808.7	0.1	.979	620.3	622.1	625.8	6.651	6.662
29.000	49.929	2.043	661.4	-329.25	.626	829.7	0.1	1.001	633.2	635.0	638.7	6.859	6.870
30.000	51.712	2.197	641.2	-338.50	.628	850.7	0.1	1.023	646.1	647.9	651.6	7.067	7.078
31.000	53.495	2.351	621.0	-347.75	.629	871.7	0.1	1.045	659.0	660.8	664.5	7.275	7.286
32.000	55.278	2.505	600.8	-357.00	.631	892.7	0.1	1.067	671.9	673.7	677.4	7.483	7.494
33.000	57.061	2.659	580.6	-366.25	.632	913.7	0.1	1.089	684.8	686.6	690.3	7.691	7.702
34.000	58.844	2.813	560.4	-375.50	.634	934.7	0.1	1.111	697.7	699.5	703.2	7.899	7.910
35.000	60.627	2.967	540.2	-384.75	.635	955.7	0.1	1.133	710.6	712.4	716.1	8.107	8.118
36.000	62.410	3.121	520.0	-394.00	.637	976.7	0.1	1.155	723.5	725.3	729.0	8.315	8.326
37.000	64.193	3.275	500.0	-403.25	.638	997.7	0.1	1.177	736.4	738.2	741.9	8.523	8.534
38.000	65.976	3.429	480.0	-412.50	.640	1018.7	0.1	1.199	749.3	751.1	754.8	8.731	8.742
39.000	67.759	3.583	460.0	-421.75	.641	1039.7	0.1	1.221	762.2	764.0	767.7	8.939	8.950
40.000	69.542	3.737	440.0	-431.00	.643	1060.7	0.1	1.243	775.1	776.9	780.6	9.147	9.158
41.000	71.325	3.891	420.0	-440.25	.644	1081.7	0.1	1.265	788.0	789.8	793.5	9.355	9.366
42.000	73.108	4.045	400.0	-449.50	.646	1102.7	0.1	1.287	800.9	802.7	806.4	9.563	9.574
43.000	74.891	4.199	380.0	-458.75	.647	1123.7	0.1	1.309	813.8	815.6	819.3	9.771	9.782
44.000	76.674	4.353	360.0	-468.00	.649	1144.7	0.1	1.331	826.7	828.5	832.2	9.979	9.990
45.000	78.457	4.507	340.0	-477.25	.650	1165.7	0.1	1.353	839.6	841.4	845.1	10.187	10.198
46.000	80.240	4.661	320.0	-486.50	.652	1186.7	0.1	1.375	852.5	854.3	858.0	10.395	10.406
47.000	82.023	4.815	300.0	-495.75	.653	1207.7	0.1	1.397	865.4	867.2	870.9	10.603	10.614
48.000	83.806	4.969	280.0	-505.00	.655	1228.7	0.1	1.419	878.3	880.1	883.8	10.811	10.822
49.000	85.589	5.123	260.0	-514.25	.656	1249.7	0.1	1.441	891.2	893.0	896.7	11.019	11.030
50.000	87.372	5.277	240.0	-523.50	.658	1270.7	0.1	1.463	904.1	905.9	909.6	11.227	11.238
51.000	89.155	5.431	220.0	-532.75	.659	1291.7	0.1	1.485	917.0	918.8	922.5	11.435	11.446
52.000	90.938	5.585	200.0	-542.00	.661	1312.7	0.1	1.507	929.9	931.7	935.4	11.643	11.654
53.000	92.721	5.739	180.0	-551.25	.662	1333.7	0.1	1.529	942.8	944.6	948.3	11.851	11.862
54.000	94.504	5.893	160.0	-560.50	.664	1354.7	0.1	1.551	955.7	957.5	961.2	12.059	12.070
55.000	96.287	6.047	140.0	-569.75	.665	1375.7	0.1	1.573	968.6	970.4	974.1	12.267	12.278
56.000	98.070	6.201	120.0	-579.00	.667	1396.7	0.1	1.595	981.5	983.3	987.0	12.475	12.486
57.000	99.853	6.355	100.0	-588.25	.668	1417.7	0.1	1.617	994.4	996.2	1000.0	12.683	12.694
58.000	101.636	6.509	80.0	-597.50	.670	1438.7	0.1	1.639	1007.3	1009.1	1012.8	12.891	12.902
59.000	103.419	6.663	60.0	-606.75	.671	1459.7	0.1	1.661	1020.2	1022.0	1025.7	13.099	13.110
60.000	105.202	6.817	40.0	-616.00	.673	1480.7	0.1	1.683	1033.1	1034.9	1038.6	13.307	13.318
61.000	106.985	6.971	20.0	-625.25	.674	1501.7	0.1	1.705	1046.0	1047.8	1051.5	13.515	13.526
62.000	108.768	7.125	0.0	-634.50	.676	1522.7	0.1	1.727	1058.9	1060.7	1064.4	13.723	13.734
63.000	110.551	7.279		-643.75	.677	1543.7	0.1	1.749	1071.8	1073.6	1077.3	13.931	13.942
64.000	112.334	7.433		-653.00	.679	1564.7	0.1	1.771	1084.7	1086.5	1090.2	14.139	14.150
65.000	114.117	7.587		-662.25	.680	1585.7	0.1	1.793	1097.6	1099.4	1103.1	14.347	14.358
66.000	115.900	7.741		-671.50	.682	1606.7	0.1	1.815	1110.5	1112.3	1116.0	14.555	14.566
67.000	117.683	7.895		-680.75	.683	1627.7	0.1	1.837	1123.4	1125.2	1128.9	14.763	14.774
68.000	119.466	8.049		-690.00	.685	1648.7	0.1	1.859	1136.3	1138.1	1141.8	14.971	14.982
69.000	121.249	8.203		-699.25	.686	1669.7	0.1	1.881	1149.2	1151.0	1154.7	15.179	15.190
70.000	123.032	8.357		-708.50	.688	1690.7	0.1	1.903	1162.1	1163.9	1167.6	15.387	15.398
71.000	124.815	8.511		-717.75	.689	1711.7	0.1	1.925	1175.0	1176.8	1180.5	15.595	15.606
72.000	126.598	8.665		-727.00	.691	1732.7	0.1	1.947	1187.9	1189.7	1193.4	15.803	15.814
73.000	128.381	8.819		-736.25	.692	1753.7	0.1	1.969	1200.8	1202.6	1206.3	16.011	16.022
74.000	130.164	8.973		-745.50	.694	1774.7	0.1	1.991	1213.7	1215.5	1219.2	16.219	16.230
75.000	131.947	9.127		-754.75	.695	1795.7	0.1	2.013	1226.6	1228.4	1232.1	16.427	16.438
76.000	133.730	9.281		-764.00	.697	1816.7	0.1	2.035	1239.5	1241.3	1245.0	16.635	16.646
77.000	135.513	9.435		-773.25	.698	1837.7	0.1	2.057	1252.4	1254.2	1257.9	16.843	16.854
78.000	137.296	9.589		-782.50	.699	1858.7	0.1	2.079	1265.3	1267.1	1270.8	17.051	17.062
79.000	139.079	9.743		-791.75	.701	1879.7	0.1	2.101	1278.2	1280.0	1283.7	17.259	17.270
80.000	140.862	9.897		-801.00	.702	1900.7	0.1	2.123	1291.1	1292.9	1296.6	17.467	17.478
81.000	142.645	10.051		-810.25	.704	1921.7	0.1	2.145	1304.0	1305.8	1309.5	17.675	17.686
82.000	144.428	10.205		-819.50	.705	1942.7	0.1	2.167	1316.9	1318.7	1322.4	17.883	17.894
83.000	146.211	10.359		-828.75	.707	1963.7	0.1	2.189	1329.8	1331.6	1335.3	18.091	18.102
84.000	147.994	10.513		-838.00	.708	1984.7	0.1	2.211	1342.7	1344.5	1348.2	18.299	18.310
85.000	149.777	10.667		-847.25	.710	2005.7	0.1	2.233	1355.6	1357.4	1361.1	18.507	18.518
86.000	151.560	10.821		-8									

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 50.
 298 N2*H4 1.004 +12.05 50.

BULK DENSITY = 1.212 GM/CC
 MIXTURE RATIO = 1.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 321.08 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	548.8
TEMP, DEG K	3710.0	3047.5	2491.1	2024.0	1632.1	1434.0	1304.1	1031.7	808.4	628.7	488.3	375.3	3265.5
ENTHALPY (-)	-22.04	13.95	43.46	67.51	86.98	96.50	102.61	115.04	124.83	132.48	138.40	142.97	2.20
CP	.5492	.5367	.5230	.5058	.4866	.4745	.4659	.4467	.4309	.4199	.4135	.4098	.5414
IMPUL OPT	176.96	238.71	279.11	307.96	321.13	329.30	345.33	357.45	366.63	373.60	378.88	383.88	145.23
IMPUL VAC	263.87	291.37	315.71	334.71	343.67	349.29	360.41	368.87	375.29	380.17	383.88	383.88	258.71
EPSILON	1.056	1.607	2.805	5.150	7.417	9.666	18.316	34.830	66.331	126.479	241.759	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	565.3
TEMP, DEG K	3710.0	3276.9	2848.4	2413.9	1994.9	1771.4	1622.5	1305.4	1039.7	820.1	641.8	499.7	3440.0
ENTHALPY (-)	-22.04	14.91	46.82	73.96	96.58	107.81	115.09	130.07	142.06	151.96	159.03	164.86	1.46
X BAR	5.838	5.730	5.656	5.619	5.608	5.607	5.607	5.606	5.606	5.606	5.606	5.606	5.767
N	5.838	5.730	5.656	5.619	5.608	5.607	5.607	5.606	5.606	5.606	5.606	5.606	5.767
CP	1.1913	.9670	.7443	.5890	.5150	.4943	.4834	.4611	.4415	.4250	.4134	.4081	1.0562
IMPUL OPT	179.30	244.75	288.99	321.23	336.10	345.39	363.76	377.83	388.62	396.89	403.23	403.23	143.00
IMPUL VAC	269.83	301.66	329.57	351.34	361.65	368.16	381.16	391.17	398.85	404.73	409.23	409.23	262.94
EPSILON	1.072	1.692	3.031	5.649	8.193	10.731	20.591	39.660	76.403	147.063	283.047	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0087	.0029	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0046
-64.50 F*H	1.8431	1.8490	1.8512	1.8518	1.8519	1.8519	1.8519	1.8519	1.8519	1.8519	1.8519	1.8519	1.8473
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F*N*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.2975	.1743	.0777	.0217	.0032	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.2188
79.20 H*N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H*N*O	.0030	.0014	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019
9.33 H*O	.1030	.0517	.0173	.0031	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0697
.00 H2	1.2160	1.2229	1.2415	1.2595	1.2670	1.2681	1.2684	1.2685	1.2684	1.2684	1.2683	1.2674	1.2186
40.30 H2*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	.7807	.8591	.9054	.9225	.9257	.9259	.9259	.9259	.9259	.9259	.9259	.9259	.8327
-11.04 H3*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0007	.0000
113.00 N	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
21.65 N*O	.0179	.0071	.0017	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0105
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.5494	1.5558	1.5590	1.5600	1.5601	1.5602	1.5602	1.5602	1.5602	1.5601	1.5601	1.5598	1.5538
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0141	.0043	.0007	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0072
.00 O2	.0036	.0012	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0019

SYSTEM LIQUID NITROPROPellant										PC 1000, PSIA									
COMPONENT										TREF FORMULA									
DEG K										HEAT FORM									
128 0°F2										1.50									
298 N2+H4										1.00									
PROZEN EXPANSION										C STAR = 6832.5 FT/SEC									
EPSILON										I SEA									
PC/P										I AT 10000									
P PSIA										I VAC									
TEMP										CF SEA									
ENTHALPY										CF VAC									
CP CAL / I OPT										LVL									
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PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 56.
 298 N2*H4 1.004 +12.05 44.

BULK DENSITY = 1.243 GM/CC
 MIXTURE RATIO = 1.273 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 310.08 EU/100GMS

CHAMBER	FROZEN EXPANSION										THRUST		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	548.5
TEMP, DEG K	3930.8	3224.2	2632.5	2137.4	1722.9	1513.9	1376.8	1089.4	853.6	663.5	512.8	395.1	3456.1
ENTHALPY (-)	-20.17	15.92	45.47	89.53	89.01	98.53	104.64	117.07	126.86	134.51	140.43	145.00	4.17
CP	.5159	.5054	.4928	.4783	.4607	.4500	.4418	.4233	.4076	.3966	.3898	.3863	.5091
IMPUL OPT	177.21	238.97	279.36	308.19	321.35	329.51	345.54	357.65	366.83	373.78	379.06	384.04	145.51
IMPUL VAC	264.18	291.63	315.93	334.91	343.87	349.49	360.61	369.06	375.47	380.34	384.04	384.04	259.05
EPSILON	1.055	1.605	2.800	5.140	7.403	9.649	18.288	34.776	66.198	126.123	240.688	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.0
TEMP, DEG K	3930.8	3530.8	3157.6	2781.6	2381.2	2143.7	1977.8	1813.6	1613.9	1439.7	1222.2	1044.9	3681.4
ENTHALPY (-)	-20.17	17.10	49.78	78.32	102.85	115.29	123.42	140.33	154.05	165.06	173.81	180.70	3.22
X BAR	5.529	5.398	5.289	5.210	5.170	5.160	5.158	5.156	5.156	5.156	5.156	5.156	5.447
N	5.529	5.398	5.289	5.210	5.170	5.160	5.158	5.156	5.156	5.156	5.156	5.156	5.447
CP	1.4389	1.2836	1.0426	.7668	.5681	.5081	.4828	.4505	.4295	.4107	.3946	.3834	1.3546
IMPUL OPT	180.07	246.70	292.71	327.14	343.29	353.44	373.67	389.31	401.42	410.80	418.03	424.03	142.66
IMPUL VAC	271.57	305.22	335.52	359.67	371.15	378.39	392.92	404.21	412.97	419.72	424.91	424.91	264.17
EPSILON	1.076	1.729	3.177	6.065	8.878	11.685	22.642	44.044	85.688	166.325	322.014	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0235	.0108	.0040	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0148
-64.50 F*H	2.0505	2.0633	2.0701	2.0731	2.0740	2.0741	2.0741	2.0741	2.0741	2.0741	2.0741	2.0741	2.0592
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F*N*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.3449	.2359	.1431	.0684	.0205	.0075	.0031	.0002	.0000	.0000	.0000	.0000	.2763
79.20 H*N	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-10.00 H*N*O	.0048	.0028	.0014	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0035
9.33 H*O	.1955	.1354	.0766	.0297	.0059	.0015	.0005	.0000	.0000	.0000	.0000	.0000	.1590
.00 H2	.7433	.7042	.6736	.6611	.6654	.6690	.6705	.6717	.6718	.6718	.6718	.6718	.7189
40.30 H2*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	.7044	.6228	.5267	.3990	1.0302	1.0353	1.0365	1.0370	1.0370	1.0370	1.0370	1.0370	.7778
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
21.65 N*O	.0448	.0264	.0123	.0036	.0005	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0331
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.3476	1.3582	1.3661	1.3709	1.3726	1.3729	1.3729	1.3729	1.3729	1.3729	1.3729	1.3729	1.3544
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0502	.0258	.0095	.0019	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0343
.00 O2	.0186	.0119	.0053	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0146
34.10 O3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O₂F₂ 1.53 +3.5 62.
 298 N₂H₄ 1.004 +12.05 38.

BULK DENSITY = 1.276 GM/CC
 MIXTURE RATIO = 1.632 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 298.05 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	547.4
TEMP, DEG K	4082.5	3336.7	2715.1	2197.1	1765.7	1548.8	1406.9	1110.2	867.6	672.6	518.6	398.7	3579.4
ENTHALPY (-)	-18.31	17.26	46.27	69.81	88.80	98.07	104.00	116.06	125.53	132.90	138.60	142.99	5.77
CP	.4815	.4717	.4608	.4477	.4319	.4222	.4146	.3977	.3832	.3733	.3671	.3641	.4753
IMPUL OPT	175.90	237.01	276.87	305.25	318.18	326.19	341.89	353.74	362.69	369.46	374.59	379.42	144.72
IMPUL VAC	262.06	289.05	312.92	331.53	340.29	345.79	356.64	364.88	371.11	375.84	379.42	379.42	257.06
EPSILON	1.055	1.600	2.784	5.097	7.331	9.547	18.053	34.253	65.058	123.688	235.566	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	570.2
TEMP, DEG K	4082.5	3686.1	3335.2	3014.0	2705.7	2524.3	2389.7	2039.5	1678.6	1361.9	1093.6	869.3	3834.4
ENTHALPY (-)	-18.31	18.53	50.97	79.65	105.00	118.31	127.24	146.41	162.40	175.46	186.00	194.42	4.72
X BAR	5.254	5.116	4.993	4.887	4.800	4.760	4.738	4.709	4.706	4.705	4.705	4.705	5.169
N	5.254	5.116	4.993	4.887	4.800	4.760	4.738	4.709	4.706	4.705	4.705	4.705	5.169
CP	1.5151	1.4527	1.3349	1.1585	.9355	.7938	.6907	.4836	.4231	.4022	.3836	.3674	1.4835
IMPUL OPT	179.00	245.49	291.92	327.52	344.75	355.83	378.54	396.49	410.56	421.58	430.19	441.53	
IMPUL VAC	270.09	304.14	335.54	361.79	374.88	383.34	400.48	413.71	424.06	432.14	438.41	441.53	
EPSILON	1.078	1.743	3.256	6.428	9.658	12.957	25.954	51.184	100.731	197.869	387.162	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0515	.0275	.0136	.0060	.0022	.0010	.0005	.0000	.0000	.0000	.0000	.0000	.0353
-64.50 F=H	2.2448	2.2688	2.2827	2.2903	2.2941	2.2953	2.2958	2.2963	2.2963	2.2963	2.2963	2.2963	2.2609
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.3235	.2263	.1461	.0834	.0390	.0217	.0130	.0025	.0002	.0000	.0000	.0000	.2623
79.20 H=N	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
-10.00 H=N=O	.0058	.0039	.0025	.0015	.0008	.0005	.0003	.0001	.0000	.0000	.0000	.0000	.0046
9.33 H=O	.2743	.2249	.1705	.1155	.0650	.0401	.0253	.0040	.0002	.0000	.0000	.0000	.2450
.00 H2	.4066	.3524	.2920	.2273	.1623	.1275	.1060	.0777	.0751	.0751	.0751	.0751	.3743
40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.5404	.6570	.7785	.8988	1.0097	1.0652	1.0983	1.1423	1.1480	1.1481	1.1481	1.1481	.6105
-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0007	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
21.65 N=O	.0833	.0618	.0428	.0267	.0139	.0081	.0049	.0006	.0000	.0000	.0000	.0000	.0700
8.06 N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.1406	1.1526	1.1630	1.1716	1.1784	1.1814	1.1831	1.1854	1.1857	1.1857	1.1857	1.1857	1.1481
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.1198	.0812	.0492	.0252	.0097	.0043	.0020	.0001	.0000	.0000	.0000	.0000	.0955
.00 O2	.0622	.0596	.0523	.0403	.0246	.0150	.0087	.0006	.0000	.0000	.0000	.0000	.0612

SYSTEM LIQUID BIPHOPPELLANT
COMPONENT 1HEF FORMULA
DEC K
178 2062
298 22844

PC 1000, PSIA
DENSITY
CM/CC
1.53
1.004
+12.05

HEAT FORM
KCAL/FORM.M.T.
31.5
36.

WT. O/D
67.
36.

EPSILON	PC/F	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I OPT	DEL VAC DEL VAC	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
1.000	1.000	1000.000	4082.5	18.31	4.01	112.3	255.0	255.0	255.0	255.0	1.238	1.238
2.000	1.027	947.439	3579.4	-5.77	4.75	144.7	255.0	255.0	255.0	255.0	1.431	1.431
3.000	1.100	840.012	2475.4	-57.27	4.55	257.1	255.0	255.0	255.0	255.0	1.431	1.431
4.000	1.178	756.624	2117.4	-72.48	4.44	281.1	255.0	255.0	255.0	255.0	1.431	1.431
5.000	1.252	684.171	1825.4	-81.85	4.18	295.3	255.0	255.0	255.0	255.0	1.431	1.431
6.000	1.321	620.157	1597.4	-94.28	4.32	304.5	255.0	255.0	255.0	255.0	1.431	1.431
7.000	1.387	567.817	1417.4	-104.99	4.28	311.4	255.0	255.0	255.0	255.0	1.431	1.431
8.000	1.451	524.101	1267.4	-114.00	4.26	316.7	255.0	255.0	255.0	255.0	1.431	1.431
9.000	1.512	488.888	1147.4	-122.73	4.20	320.9	255.0	255.0	255.0	255.0	1.431	1.431
10.000	1.571	460.107	1047.4	-130.49	4.13	327.5	255.0	255.0	255.0	255.0	1.431	1.431
11.000	1.628	436.896	957.4	-137.65	4.11	330.1	255.0	255.0	255.0	255.0	1.431	1.431
12.000	1.683	418.140	882.4	-144.40	4.08	332.4	255.0	255.0	255.0	255.0	1.431	1.431
13.000	1.736	402.854	822.4	-150.82	4.06	334.4	255.0	255.0	255.0	255.0	1.431	1.431
14.000	1.787	389.937	772.4	-156.99	4.04	336.2	255.0	255.0	255.0	255.0	1.431	1.431
15.000	1.837	379.289	732.4	-162.90	4.02	337.8	255.0	255.0	255.0	255.0	1.431	1.431
16.000	1.886	370.811	692.4	-168.55	4.01	339.3	255.0	255.0	255.0	255.0	1.431	1.431
17.000	1.934	363.414	652.4	-173.95	3.99	340.6	255.0	255.0	255.0	255.0	1.431	1.431
18.000	1.981	357.097	612.4	-179.10	3.98	341.8	255.0	255.0	255.0	255.0	1.431	1.431
19.000	2.027	351.859	572.4	-184.00	3.96	343.0	255.0	255.0	255.0	255.0	1.431	1.431
20.000	2.072	346.690	532.4	-188.65	3.95	344.0	255.0	255.0	255.0	255.0	1.431	1.431
21.000	2.117	341.490	492.4	-193.05	3.94	345.0	255.0	255.0	255.0	255.0	1.431	1.431
22.000	2.161	336.259	452.4	-197.20	3.93	345.9	255.0	255.0	255.0	255.0	1.431	1.431
23.000	2.205	331.000	412.4	-201.10	3.92	346.8	255.0	255.0	255.0	255.0	1.431	1.431
24.000	2.248	325.711	372.4	-204.75	3.91	347.6	255.0	255.0	255.0	255.0	1.431	1.431
25.000	2.291	320.392	332.4	-208.15	3.90	348.3	255.0	255.0	255.0	255.0	1.431	1.431
26.000	2.334	315.043	292.4	-211.30	3.89	348.9	255.0	255.0	255.0	255.0	1.431	1.431
27.000	2.376	309.664	252.4	-214.20	3.88	349.5	255.0	255.0	255.0	255.0	1.431	1.431
28.000	2.418	304.255	212.4	-216.85	3.87	350.4	255.0	255.0	255.0	255.0	1.431	1.431
29.000	2.459	298.816	172.4	-219.25	3.86	351.0	255.0	255.0	255.0	255.0	1.431	1.431
30.000	2.500	293.347	132.4	-221.40	3.85	351.6	255.0	255.0	255.0	255.0	1.431	1.431
31.000	2.541	287.848	92.4	-223.30	3.84	352.1	255.0	255.0	255.0	255.0	1.431	1.431
32.000	2.581	282.319	52.4	-224.95	3.83	352.6	255.0	255.0	255.0	255.0	1.431	1.431
33.000	2.621	276.760	12.4	-226.35	3.82	353.1	255.0	255.0	255.0	255.0	1.431	1.431
34.000	2.661	271.171	-27.4	-227.50	3.81	353.6	255.0	255.0	255.0	255.0	1.431	1.431
35.000	2.701	265.552	-67.4	-228.40	3.80	354.0	255.0	255.0	255.0	255.0	1.431	1.431
36.000	2.741	259.903	-107.4	-229.05	3.79	354.4	255.0	255.0	255.0	255.0	1.431	1.431
37.000	2.781	254.224	-147.4	-229.45	3.78	354.8	255.0	255.0	255.0	255.0	1.431	1.431
38.000	2.821	248.515	-187.4	-229.60	3.77	355.2	255.0	255.0	255.0	255.0	1.431	1.431
39.000	2.861	242.776	-227.4	-229.50	3.76	355.6	255.0	255.0	255.0	255.0	1.431	1.431
40.000	2.901	237.007	-267.4	-229.15	3.75	355.9	255.0	255.0	255.0	255.0	1.431	1.431
41.000	2.941	231.208	-307.4	-228.55	3.74	356.2	255.0	255.0	255.0	255.0	1.431	1.431
42.000	2.981	225.379	-347.4	-227.70	3.73	356.5	255.0	255.0	255.0	255.0	1.431	1.431
43.000	3.021	219.520	-387.4	-226.60	3.72	356.8	255.0	255.0	255.0	255.0	1.431	1.431
44.000	3.061	213.631	-427.4	-225.15	3.71	357.1	255.0	255.0	255.0	255.0	1.431	1.431
45.000	3.101	207.712	-467.4	-223.35	3.70	357.4	255.0	255.0	255.0	255.0	1.431	1.431
46.000	3.141	201.763	-507.4	-221.20	3.69	357.7	255.0	255.0	255.0	255.0	1.431	1.431
47.000	3.181	195.784	-547.4	-218.70	3.68	358.0	255.0	255.0	255.0	255.0	1.431	1.431
48.000	3.221	189.775	-587.4	-215.85	3.67	358.3	255.0	255.0	255.0	255.0	1.431	1.431
49.000	3.261	183.736	-627.4	-212.65	3.66	358.6	255.0	255.0	255.0	255.0	1.431	1.431
50.000	3.301	177.667	-667.4	-209.10	3.65	358.9	255.0	255.0	255.0	255.0	1.431	1.431
7.331	68.046	14.696	1548.8	-18.07	4.22	318.2	22.1	1.505	318.2	324.8	337.7	1.550

SHIFTING EXPANSION

EPSILON	PC/F	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I OPT	DEL VAC DEL VAC	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
1.000	1.000	1000.000	4082.5	18.31	1.535	121.1	255.0	250.4	262.2	265.5	1.231	1.222
2.000	1.154	970.183	3834.8	-4.72	1.481	141.5	255.0	250.4	262.2	265.5	1.440	1.470
3.000	1.252	840.012	2475.4	-58.29	1.298	258.6	255.0	250.4	262.2	265.5	1.431	1.431
4.000	1.321	756.624	2117.4	-76.43	1.103	287.4	255.0	250.4	262.2	265.5	1.431	1.431
5.000	1.387	684.171	1825.4	-87.85	1.094	304.0	255.0	250.4	262.2	265.5	1.431	1.431
6.000	1.451	620.157	1597.4	-104.28	1.021	315.7	255.0	250.4	262.2	265.5	1.431	1.431
7.000	1.512	567.817	1417.4	-122.73	0.959	324.4	255.0	250.4	262.2	265.5	1.431	1.431
8.000	1.571	524.101	1267.4	-130.49	0.906	331.3	255.0	250.4	262.2	265.5	1.431	1.431
9.000	1.628	488.888	1147.4	-144.00	0.859	337.1	255.0	250.4	262.2	265.5	1.431	1.431
10.000	1.683	460.107	1047.4	-150.82	0.819	341.9	255.0	250.4	262.2	265.5	1.431	1.431
11.000	1.736	436.896	957.4	-156.99	0.781	346.1	255.0	250.4	262.2	265.5	1.431	1.431
12.000	1.787	418.140	882.4	-162.90	0.748	349.8	255.0	250.4	262.2	265.5	1.431	1.431
13.000	1.837	402.854	822.4	-168.55	0.717	353.0	255.0	250.4	262.2	265.5	1.431	1.431
14.000	1.886	389.937	772.4	-173.95	0.690	356.0	255.0	250.4	262.2	265.5	1.431	1.431
15.000	1.934	379.289	732.4	-179.10	0.664	358.6	255.0	250.4	262.2	265.5	1.431	1.431
16.000	1.981	370.811	692.4	-184.00	0.641	361.0	255.0	250.4	262.2	265.5	1.431	1.431
17.000	2.027	363.414	652.4	-188.65	0.619	363.2	255.0	250.4	262.2	265.5	1.431	1.431
18.000	2.072	357.097	612.4	-193.05	0.600	365.3	255.0	250.4	262.2	265.5	1.431	1.431
19.000	2.117	351.859	572.4	-197.20	0.585	367.2	255.0	250.4	262.2	265.5	1.431	1.431
20.000	2.161	346.690	532.4	-201.10	0.565	368.9	255.0	250.4	262.2	265.5	1.431	1.431
21.000	2.205	341.490	492.4	-204.75	0.550	370.6	255.0	250.4	262.2	265.5	1.431	1.431
22.000	2.248	336.259	452.4	-208.15	0.537	372.1	255.0	250.4	262.2	265.5	1.431	1.431
23.000	2.291	331.000	412.4	-211.30	0.524	373.6	255.0	250.4	262.2	265.5	1.431	1.431
24.000	2.334	325.711	372.4	-214.20	0.512	374.9	255.0	250.4	262.2	265.5	1.431	1.431
25.000	2.376	320.392	332.4	-216.85	0.502	376.2	255.0	250.4	262.2	265.5	1.431	1.431
26.000	2.418	315.043	292.4	-219.25	0.492	377.4	255.0	250.4	262.2	265.5	1.431	1.431
27.000	2.459	309.664	252.4	-221.40	0.483	378.6	255.0	250.4	262.2	265.5	1.431	1.431
28.000	2.500	304.255	212.4	-223.30	0.477	379.7	255.0	250.4	262.2	265.5	1.431	1.431
29.000	2.541	298.816	172.4	-224.95	0.472	380.7	255.0	250.4	262.2	265.5	1.431	1.431
30.000	2.581	293.347	132.4	-226.35	0.467	381.7	255.0	250.4	262.2	265.5	1.431	1.431
31.000	2.621	287.878	92.4	-227.50	0.462	382.7	255.0	250.4	262.2	265.5	1.431	1.431
32.000	2.661	282.409	52.4	-228.50	0.457	383.6	255.0	250.4	262.2	265.5	1.431	1.431
33.000	2.701	276.940	12.4	-229.35	0.452	384.5	255.0	250.4	262.2	265.5	1.431	1.431
34.000	2.741	271.471	-27.6	-230.05	0.447	385.4	255.0	250.4	262.2	265.5	1.431	1.431
35.000	2.781	266.002	-67.6	-230.60	0.442	386.3	255.0	250.4	262.2	265.5	1.431	1.431
36.000	2.821	260.533	-117.6	-231.00	0.437	387.1	255.0	250.4	262.2	265.5	1.431	1.431
37.000	2.861	255.064	-167.6	-231.35	0.432	388.0	255.0	250.4	262.2	265.5	1.431	1.431
38.000	2.901	249.595	-217.6	-231.65	0.427	388.9	255.0	250.4	262.2	265.5	1.431	1.431
39.000	2.941	244.126	-267.6	-231.90	0.422	389.8	255.0	250.4	262.2	265.5	1.431	1.431
40.000	2.981	238.657	-317.6	-232.10	0.417	390.7	255.0	250.4	262.2	265.5	1.431	1.431
41.000	3.021	233.188	-367.6	-232.25	0.412	391.6	255.0	250.4	262.2	265.5	1.431	1.431
42.000	3.061	227.719	-417.6	-232.35	0.407	392.5	255.0	250.4	262.2	265.5	1.431	1.431
43.000	3.101	222.250	-467.6	-232.40	0.402	393.4	255.0	250.4	262.2	265.5	1.431	1.431
44.000	3.141	216.781	-517.6	-232.40	0.397	394.3	255.0	250.4	262.2	265.5	1.431	1.431
45.000	3.181	211.312	-567.6	-232.35	0.392	395.2	255.0	250.4	262.2	265.5	1.431	1.431
46.000	3.221	205.843	-617.6	-232.25	0.387	396.1	255.0	250.4	262.2	265.5	1.431	1.431
47.000	3.261	200.374	-667.6	-232.10	0.382	397.0	255.0	250.4	262.2	265.5	1.431	1.431
48.000	3.301	194.905	-717.6	-231.90	0.377	397.9	255.0	250.4	262.2	265.5	1.431	1.431
49.000	3.341	189.436	-767.6	-231.65	0.372	398.8	255.0	250.4	262.2	265.5	1.431	1.431
50.000	3.381	183.967	-817.6	-231.35	0.367	399.7	255.0	250.4	262.2	265.5	1.431	1.431
51.000	3.421	178.498	-867.6	-231.00	0.362	400.6	255.0	250.4	262.2	265.5	1.431	1.431
52.000	3.461	173.029	-917.6	-230.60	0.357	401.5	255.0	250.4	262.2	265.5	1.431	1.431
53.000	3.501	167.560	-967.6	-230.05	0.352	402.4	255.0	250.4	262.2	265.5	1.431	1.431
54.000	3.541	162.091	-1017.6	-229.35	0.347	403.3	255.0	250.4	262.2	265.5	1.431	1.431
55.000	3.581	156.622	-1067.6	-228.50	0.342	404.2	255.0	250.4	262.2	265.5	1.431	1.431
56.000	3.621	151.153	-1117.6	-227.50	0.337	405.1	255.0	250.4	262.2	265.5	1.431	1.431
57.000	3.661	145.684	-1167.6	-226.35	0.332	406.0	255.0	250.4	262.2	265.5	1.431	1.431
58.000	3.701	140.215	-1217.6	-224.95	0.327	406.9	255.0	250.4	262.2	265.5	1.431	1.431
59.000	3.741	134.746	-1267.6	-223.35	0.322	407.8	255.0	250.4	262.2	265.5	1.431	1.431
60.000	3.781	129.277	-1317.6	-221.40	0.317	408.7	255.0	250.4	262.2	265.5	1.431	1.431
61.000	3.821	123.808	-1367.6	-219.25	0.312	409.6	255.0	250.4	262.2	265.5	1.431	1.431
62.000	3.861	118.339	-1417.6	-216.85	0.307	410.5	255.0	250.4	262.2	265.5	1.431	1.431
63.000	3.901	112.870	-1467.6	-214.20	0.302	411.4	255.0	250.4	262.2	265.5	1.431	1.431
64.000	3.941	107.401	-1517.6	-211.30	0.297	412.3	255.0	250.4	262.2	265.5	1.431	1.431
65.000	3.981	101.932	-1567.6	-208.15	0.292	413.2	255.0	250.4	262.2	265.5	1.431	1.431
66.000	4.021	96.463	-1617.6	-204.75	0.287	414.1	255.0	250.4	262.2	265.5	1.431	1.431
67.000	4.061	90.994	-1667.6	-201.10	0.282	415.0	255.0	250.4	262.2	265.5	1.431	1.431
68.000	4.101	85.525	-1717.6	-197.20	0.277	415.9	255.0	250.4	262.2	265.5	1.431	1.431
69.000	4.141	80.056	-1767.6	-193.05	0.272	416.8	255.0	250.4	262.2	265.5	1.431	1.431
70.000	4.181	74.587	-1817.6	-188.65	0.267	417.7	255.0	250.4	262.2	265.5	1.431	1.431
71.000	4.221	69.118	-1867.6	-184.00	0.262	418.6	255.0	250.4	262.2	265.5	1.431	1.431
72.000	4.261	63.649	-1917.6	-179.10	0.257	419.5	255.0	250.4	262.2	265.5	1.431	1.431
73.000	4.301	58.180	-1967.6	-173.95	0.252	420.4	255.0	250.4	262.2	265.5	1.431	1.431
74.000	4.341	52.711	-2017.6	-168.55	0.247	421.3	255.0	250.4	262.2	265.5	1.431	1.431
75.000	4.381	47.242	-2067.6	-162.90	0.242	422.2	255.0	250.4	262.2	265.5	1.431	1.431
76.000	4.421	41.773	-2117.6	-156.99	0.237	423.1	255.0	250.4	262.2	265.5	1.431	1.431
77.000	4.461	36.304	-2167.6	-150.82	0.232	424.0	255.0	250.4	262.2	265.5	1.431	1.431
78.000	4.501	30.835	-2217.6	-144.00	0.227	424.9	255.0	250.4	262.2	265.5	1.431	1.431
79.000	4.541	25.366	-2267.6	-136.45	0.222	425.8	255.0	250.4	262.2	265.5	1.431	1.431
80.000	4.581	19.897	-2317.6	-127.50	0.217	426.7	255.0	250.4	262.2	265.5	1.431	1.431
81.000	4.621	14.428	-2367.6	-117.10	0.212	427.6	255.0	250.4	262.2	265.5	1.431	1.431
82.000	4.661	8.959	-2417.6	-105.55	0.207	428.5	255.0	250.4	262.2	265.5	1.431	1.431
83.000	4.701	3.490	-2467.6	-92.80	0.202	429.4	255.0	250.4	262.2	265.5	1.431	1.431
84.000	4.741	-1.979	-2517.6	-78.85	0.197	430.3	255.0	250.4	262.2	265.5	1.431	1.431
85.000	4.781	-7.510	-2567.6	-63.60	0.192	431.2	255.0	250.4	262.2	265.5	1.431	1.431
86.000	4.821	-13.041	-2617.6	-47.05	0.187	432.1	255.0	250.4	262.2	265.5	1.431	1.431
87.000	4.861	-18.572	-2667.6	-29.20	0.182	433.0	255.0	250.4	262.2	265.5	1.431	1.431
88.000	4.901	-24.103	-2717.6	9.75	0.177	433.9	255.0	250.4	262.2	265.5	1.431	1.431
89.000	4.941	-29.634	-2767.6	49.30	0.172	434.8	255.0	250.4	262.2			

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/O
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O₂F₂ 1.53 +3.5 70.
 298 N₂H₄ 1.004 +12.05 30.

BULK DENSITY = 1.322 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 280.40 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	544.8
TEMP, DEG K	4205.9	3412.0	2755.5	2213.1	1765.0	1541.4	1395.9	1093.5	848.9	654.3	502.0	384.3	3665.6
ENTHALPY (-)	-15.82	18.39	46.08	68.39	86.25	94.91	100.44	111.61	120.32	127.06	132.24	136.21	7.53
CP	.4347	.4264	.4167	.4051	.3914	.3831	.3767	.3622	.3504	.3426	.3381	.3361	.4295
IMPUL OPT		172.51	232.06	270.66	297.98	310.37	318.02	332.95	344.14	352.56	358.89	363.67	142.53
IMPUL VAC		256.69	282.60	305.46	323.19	331.50	336.70	346.93	354.64	360.46	364.85	368.17	251.99
EPSILON		1.053	1.587	2.745	4.996	7.159	9.299	17.478	32.974	62.317	117.980	223.898	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	569.1
TEMP, DEG K	4205.9	3784.4	3405.9	3053.3	2706.1	2497.7	2343.2	1963.7	1603.0	1288.4	1024.2	806.4	3941.9
ENTHALPY (-)	-15.82	19.69	50.87	78.29	102.33	114.84	123.15	140.80	155.34	167.13	176.54	183.99	6.46
X BAR	4.923	4.798	4.688	4.596	4.526	4.498	4.484	4.468	4.465	4.465	4.465	4.465	4.845
N	4.923	4.798	4.688	4.596	4.526	4.498	4.484	4.468	4.465	4.465	4.465	4.465	4.845
CP	1.3497	1.2578	1.1198	.9354	.7241	.6082	.5378	.4302	.3860	.3640	.3485	.3360	1.2985
IMPUL OPT		175.75	240.86	286.13	320.60	337.14	347.70	369.11	385.88	398.94	409.07	416.92	139.22
IMPUL VAC		265.07	298.17	328.53	353.62	365.95	373.82	389.66	401.91	411.40	418.74	424.39	257.82
EPSILON		1.077	1.735	3.225	6.310	9.407	12.517	24.772	48.556	94.814	184.621	358.254	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.1305	.0738	.0382	.0174	.0064	.0030	.0016	.0002	.0000	.0000	.0000	.0000	.0929
-64.50 F=H	2.4619	2.5188	2.5544	2.5751	2.5862	2.5896	2.5910	2.5924	2.5926	2.5926	2.5926	2.5926	2.4996
-26.10 F=H+O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.2197	.1455	.0856	.0413	.0140	.0057	.0025	.0001	.0000	.0000	.0000	.0000	.1727
19.20 H=N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=N+O	.0049	.0036	.0025	.0016	.0009	.0006	.0005	.0002	.0000	.0000	.0000	.0000	.0041
9.33 H=O	.2797	.2422	.1956	.1418	.0857	.0558	.0374	.0097	.0013	.0001	.0000	.0000	.2579
.00 H2	.1340	.1049	.0755	.0469	.0222	.0117	.0064	.0008	.0000	.0000	.0000	.0000	.1162
40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.2549	.3122	.3777	.4454	.5065	.5347	.5501	.5702	.5752	.5759	.5759	.5759	.2888
-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0009	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
21.65 N=O	.1352	.1117	.0880	.0651	.0436	.0320	.0244	.0102	.0029	.0006	.0001	.0000	.1209
8.06 N=O2	.0001	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 N2	.8653	.8782	.8908	.9027	.9138	.9198	.9237	.9309	.9346	.9358	.9361	.9361	.8732
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.2502	.1875	.1271	.0742	.0335	.0173	.0094	.0012	.0001	.0000	.0000	.0000	.2119
.00 O2	.1855	.2194	.2526	.2841	.3130	.3280	.3373	.3525	.3584	.3599	.3602	.3602	.2062

SYSTEM LIQUID BIPHROPELLANT										PC 1000, PSIA					
COMPONENT										DENSITY					
TRIP FORMULA										HEAT FGMH					
DEG K										[KCAL/FORM.WT.]					
128 O2F2										70.					
298 N2O4										12.05					
FROZEN EXPANSION										C STAR = 4463.9 FT/SEC					
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL / I	OPT DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	CF SEA	CF VAC
			DEG K	KCAL/100GM	GM DEG		/P	LVL	10000	50000		LVL	LVL		
1.000	1.000	1000.000	4205.9	15.82	.435										
2.000	1.015	944.339	3665.6	-7.53	.429	142.5	109.5	.201	249.0	249.9	251.7	252.0	1.240	1.254	
3.000	10.113	96.963	2493.0	-56.98	.412	252.3	41.2	.425	287.3	289.2	292.8	293.5	1.430	1.461	
4.000	18.429	54.261	2138.6	-71.40	.403	275.5	33.0	.408	299.6	302.2	307.5	308.5	1.491	1.536	
5.000	29.155	34.253	1917.7	-80.24	.397	289.1	28.2	.422	305.2	308.9	315.9	317.3	1.519	1.579	
6.000	39.865	25.085	1764.4	-86.28	.391	298.0	25.2	1.005	308.5	312.9	321.5	323.2	1.559	1.609	
7.000	52.555	18.026	1647.5	-90.83	.387	304.6	23.0	1.210	309.8	315.2	325.5	327.6	1.582	1.631	
8.000	65.870	13.182	1554.6	-94.41	.384	309.7	21.4	1.407	310.3	316.6	328.6	331.0	1.585	1.648	
9.000	80.268	12.498	1478.0	-97.33	.380	313.7	20.0	1.609		317.3	331.0	333.8		1.661	
10.000	95.352	10.483	1411.3	-99.78	.377	317.1	19.0	1.809		317.5	333.0	336.1		1.673	
11.000	111.526	9.767	1357.6	-101.88	.375	320.0	18.1	2.014		316.6	338.0			1.683	
12.000	128.122	7.770	1306.9	-103.70	.373	322.4	17.3	2.223		315.9	339.7			1.691	
13.000	146.612	6.821	1265.7	-105.30	.371	324.6	16.6	2.433		317.0	341.2			1.698	
14.000	165.003	6.057	1227.2	-106.72	.369	326.5	16.0	2.640		338.0	342.5			1.705	
15.000	183.900	5.435	1192.4	-108.00	.367	328.2	15.5	2.844		338.8	343.7			1.711	
16.000	203.162	4.922	1160.9	-109.16	.366	329.0	15.0	3.044		339.5	344.7			1.716	
17.000	222.455	4.496	1132.0	-110.21	.364	331.1	14.5	3.237		340.1	345.7			1.721	
18.000	241.902	4.134	1105.5	-111.18	.363	332.4	14.2	3.424		340.7	346.5			1.725	
19.000	262.746	3.806	1080.9	-112.06	.362	333.5	13.8	3.624		341.2	347.3			1.729	
20.000	285.181	3.504	1058.2	-112.89	.360	334.6	13.5	3.841		341.5	348.1			1.733	
21.000	308.405	3.240	1036.9	-113.65	.359	335.6	13.1	4.058		341.8	348.8			1.736	
22.000	332.339	3.009	1017.1	-114.37	.358	336.5	12.9	4.274		342.1	349.4			1.739	
23.000	356.507	2.805	998.5	-115.03	.358	337.4	12.6	4.489		342.3	350.0			1.742	
24.000	381.028	2.624	981.0	-115.66	.357	338.2	12.3	4.701		342.5	350.5			1.745	
25.000	405.826	2.466	964.5	-116.26	.356	339.0	12.1	4.913		342.7	351.1			1.747	
26.000	430.829	2.321	948.9	-116.80	.355	339.7	11.9	5.121		342.8	351.6			1.750	
27.000	455.969	2.193	934.1	-117.32	.354	340.3	11.7	5.325		342.9	352.0			1.752	
28.000	481.193	2.078	920.1	-117.82	.354	341.0	11.5	5.525		343.0	352.4			1.754	
29.000	506.418	1.975	906.7	-118.29	.353	341.6	11.3	5.721		343.1	352.9			1.756	
30.000	531.627	1.881	894.1	-118.74	.352	342.1	11.1	5.912		343.2	353.3			1.758	
31.000	556.774	1.796	881.9	-119.16	.352	342.7	11.0	6.098		343.2	353.6			1.760	
32.000	581.810	1.719	870.4	-119.57	.351	343.2	10.8	6.280		343.3	354.0			1.762	
33.000	606.777	1.648	859.1	-119.96	.351	343.7	10.6	6.457		343.3	354.3			1.764	
34.000	631.718	1.583	848.7	-120.33	.350	344.2	10.5	6.630		343.3	354.6			1.765	
35.000	656.601	1.513	838.5	-120.69	.350	344.6	10.4	6.806		343.3	354.9			1.767	
36.000	681.466	1.447	828.7	-121.03	.349	345.0	10.2	7.062		343.3	355.3			1.768	
37.000	706.271	1.387	819.3	-121.36	.349	345.5	10.1	7.278		343.3	355.6			1.770	
38.000	731.074	1.330	810.2	-121.68	.348	345.9	10.0	7.495		343.3	355.9			1.771	
39.000	755.878	1.277	801.5	-121.98	.348	346.2	9.9	7.711		343.3	356.1			1.772	
40.000	780.681	1.228	793.0	-122.28	.348	346.6	9.7	7.927		343.3	356.3			1.774	
41.000	805.484	1.182	784.9	-122.56	.348	347.0	9.6	8.143		343.3	356.6			1.775	
42.000	830.287	1.139	777.0	-122.83	.347	347.3	9.5	8.358		343.3	356.8			1.776	
43.000	855.090	1.099	769.4	-123.10	.347	347.6	9.4	8.572		343.3	357.1			1.777	
44.000	879.893	1.061	762.1	-123.35	.347	348.0	9.3	8.785		343.3	357.3			1.778	
45.000	904.696	1.025	754.9	-123.60	.346	348.3	9.2	8.997		343.3	357.5			1.779	
46.000	929.499	.992	748.0	-123.84	.346	348.6	9.1	9.204		343.3	357.7			1.780	
47.000	954.302	.960	741.3	-124.07	.346	348.9	9.0	9.411		343.3	357.9			1.781	
48.000	979.105	.931	734.8	-124.30	.346	349.1	9.0	9.623		343.3	358.1			1.782	
49.000	1003.908	.903	728.5	-124.51	.345	349.4	8.9	9.829		343.3	358.3			1.783	
50.000	1028.711	.876	722.4	-124.72	.345	349.7	8.8	10.032		343.3	358.5			1.784	
51.000	1053.514	.851	716.4	-124.93	.345	349.9	8.7	10.233		343.3	358.6			1.785	
52.000	1078.317	.826	710.4	-125.14	.345	350.2	8.6	10.434		343.3	358.8			1.786	
53.000	1103.120	.801	704.4	-125.35	.345	350.4	8.5	10.635		343.3	358.9			1.787	
54.000	1127.923	.776	698.4	-125.56	.345	350.6	8.4	10.836		343.3	359.0			1.788	
55.000	1152.726	.751	692.4	-125.77	.345	350.8	8.3	11.037		343.3	359.1			1.789	
56.000	1177.529	.726	686.4	-125.98	.345	351.0	8.2	11.238		343.3	359.2			1.790	
57.000	1202.332	.701	680.4	-126.19	.345	351.2	8.1	11.439		343.3	359.3			1.791	
58.000	1227.135	.676	674.4	-126.40	.345	351.4	8.0	11.640		343.3	359.4			1.792	
59.000	1251.938	.651	668.4	-126.61	.345	351.6	7.9	11.841		343.3	359.5			1.793	
60.000	1276.741	.626	662.4	-126.82	.345	351.8	7.8	12.042		343.3	359.6			1.794	
61.000	1301.544	.601	656.4	-127.03	.345	352.0	7.7	12.243		343.3	359.7			1.795	
62.000	1326.347	.576	650.4	-127.24	.345	352.2	7.6	12.444		343.3	359.8			1.796	
63.000	1351.150	.551	644.4	-127.45	.345	352.4	7.5	12.645		343.3	359.9			1.797	
64.000	1375.953	.526	638.4	-127.66	.345	352.6	7.4	12.846		343.3	360.0			1.798	
65.000	1400.756	.501	632.4	-127.87	.345	352.8	7.3	13.047		343.3	360.1			1.799	
66.000	1425.559	.476	626.4	-128.08	.345	353.0	7.2	13.248		343.3	360.2			1.800	
67.000	1450.362	.451	620.4	-128.29	.345	353.2	7.1	13.449		343.3	360.3			1.801	
68.000	1475.165	.426	614.4	-128.50	.345	353.4	7.0	13.650		343.3	360.4			1.802	
69.000	1500.000	.401	608.4	-128.71	.345	353.6	6.9	13.851		343.3	360.5			1.803	
7.000	65.870	13.182	1554.6	-94.41	.384	309.7	21.4	1.407	310.3	316.6	328.6	331.0	1.585	1.648	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O*F2 1.53 +3.5 44.
 298 N2*H4 1.004 +12.05 56.

BULK DENSITY = 1.183 GM/CC
 MIXTURE RATIO = .786 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 345.80 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.7
TEMP, DEG K	3319.9	2791.6	2337.7	1947.8	1686.6	1613.4	1327.0	1083.3	877.9	707.1	566.7	452.8	2916.8
ENTHALPY (-)	-23.91	6.33	31.71	52.92	66.72	70.53	85.07	96.99	106.69	114.52	120.82	125.86	-7.77
CP	.5780	.5659	.5515	.5354	.5215	.5173	.4980	.4801	.4645	.4528	.4447	.4402	.5691
IMPUL OPT		162.19	219.96	258.52	280.79	286.62	307.91	324.31	337.06	347.03	354.83	360.96	141.86
IMPUL VAC		254.94	277.24	299.12	313.16	316.96	331.13	342.31	351.10	358.01	363.44	367.72	252.66
EPSILON		1.024	1.408	2.222	3.275	3.697	6.304	10.881	18.894	32.916	57.460	100.493	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	169.2
TEMP, DEG K	3319.9	2958.9	2593.8	2225.1	1952.0	1872.9	1558.0	1285.3	1052.3	855.3	691.1	555.8	3061.7
ENTHALPY (-)	-23.91	7.01	34.04	57.33	72.77	77.06	93.56	107.23	118.46	127.63	135.05	141.04	-1.39
X BAR	6.233	6.147	6.091	6.065	6.059	6.058	6.057	6.057	6.057	6.057	6.057	6.057	6.169
N	6.233	6.147	6.091	6.065	6.059	6.058	6.057	6.057	6.057	6.057	6.057	6.057	6.169
CP	1.1376	.9151	.7237	.5988	.5491	.5393	.5119	.4908	.4731	.4580	.4466	.4395	.9771
IMPUL OPT		163.99	224.52	265.84	290.01	296.38	319.67	337.76	351.93	363.08	371.87	378.81	199.96
IMPUL VAC		259.88	285.35	309.73	325.27	329.47	345.19	357.68	367.58	375.41	381.60	386.49	256.62
EPSILON		1.032	1.459	2.343	3.479	3.935	6.757	11.750	20.559	36.072	63.368	111.405	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0030	.0009	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0013
-64.50 F*H	1.6266	1.6287	1.6295	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6296	1.6283
-26.10 F*H*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F*N*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.2808	.1522	.0615	.0159	.0039	.0024	.0002	.0000	.0000	.0000	.0000	.0000	.1855
19.20 H*N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-10.00 H*N*O	.0012	.0005	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006
9.33 H*O	.0517	.0223	.0064	.0010	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0293
.00 H2	1.7653	1.8045	1.8384	1.8577	1.8633	1.8640	1.8650	1.8651	1.8651	1.8651	1.8650	1.8646	1.7933
40.30 H2*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2*O	.7492	.7884	.8076	.8137	.8146	.8147	.8148	.8148	.8148	.8148	.8148	.8148	.7794
-11.04 H3*N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0004	.0000
113.00 N	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
21.65 N*O	.0064	.0021	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0030
8.06 N*O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.7435	1.7460	1.7471	1.7473	1.7474	1.7474	1.7474	1.7474	1.7474	1.7474	1.7473	1.7472	1.7455
19.50 N2*O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0047	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0018
.00 O2	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003

SHIFTING EXPANSION															
C STAR = 0.655, 7 F/SEC															
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/G	ENTHALPY	CP CAL/G	DELTA V	DELTA V	I SFA	I AT	I AT	I VAC	CP SFA	CP VAC
			DEG F	KCAL/1000G	CM	DEG F	CM	DELTA V	DELTA V	LVL	10000	50000		LVL	
1.000	1.000	3000	2000	231.19	1.11	231.19	1.11	11.0	11.0						
1.000	1.713	1049.100	1001.7	-1.39	.977	145.0	116.7	.690	246.5	249.5	255.4	256.6	1.241	1.192	
2.000	4.072	33.070	2337.8	-0.87	.028	255.3	47.3	1.430	281.6	287.9	300.1	102.6	1.361	1.404	
3.000	16.332	18.376	2050.9	-0.732	.564	281.7	38.1	2.077	289.3	270.5	316.8	319.8	1.349	1.546	
4.000	25.216	11.897	1862.5	-0.7752	.538	207.2	32.8	2.757			326.3	330.0		1.545	
5.000	35.163	8.843	1727.0	-0.861	.525	157.0	27.0	3.017			331.0			1.679	
6.000	46.273	6.483	1622.9	-0.9023	.516	315.1	27.0	4.158			335.0			1.654	
7.000	57.767	5.191	1539.2	-0.9432	.504	321.0	25.1	4.836			339.9			1.673	
8.000	70.684	4.244	1449.8	-0.9806	.505	325.7	23.6	5.565			342.9			1.689	
9.000	84.122	3.566	1361.1	-1.0100	.500	328.7	22.1	6.300			345.3			1.700	
10.000	97.817	3.026	1300.1	-1.0349	.496	330.0	20.4	7.031			347.2			1.713	
11.000	111.640	2.607	1315.4	-1.0575	.493	335.9	20.5	7.631			349.3			1.723	
12.000	125.889	2.383	1275.8	-1.0789	.490	338.6	19.7	8.283			349.0			1.731	
13.000	141.782	2.116	1240.2	-1.0994	.487	340.6	19.1	8.910			344.3			1.740	
14.000	158.197	1.883	1208.0	-1.1190	.485	342.8	18.5	9.529			344.4			1.748	
15.000	175.006	1.716	1176.7	-1.1242	.483	346.4	17.9	10.452			344.5			1.751	
16.000	192.104	1.562	1151.8	-1.1372	.481	346.0	17.4	11.158			341.4			1.757	
17.000	209.462	1.433	1127.0	-1.1490	.479	347.0	17.0	11.851			346.5			1.762	
18.000	226.862	1.323	1104.1	-1.1590	.477	348.6	16.6	12.540			346.6			1.767	
19.000	244.310	1.226	1082.8	-1.1702	.475	350.1	16.2	13.185			346.3			1.771	
20.000	261.830	1.146	1062.8	-1.1796	.474	351.3	15.8	13.638			347.1			1.775	
21.000	280.214	1.070	1044.2	-1.1884	.473	352.4	15.5	14.499			347.9			1.779	
22.000	300.184	.999	1026.7	-1.1967	.471	353.5	15.2	15.220			346.6			1.782	
23.000	320.491	.934	1010.1	-1.2055	.470	354.6	14.9	15.848			346.4			1.786	
24.000	341.153	.874	994.5	-1.2118	.469	355.3	14.7	16.667			346.9			1.788	
25.000	362.125	.828	979.8	-1.2187	.467	356.1	14.4	17.387			370.5			1.790	
26.000	383.166	.783	965.7	-1.2252	.466	356.9	14.2	18.103			371.1			1.794	
27.000	404.816	.740	952.4	-1.2315	.465	357.6	13.9	18.819			371.5			1.798	
28.000	426.466	.703	939.7	-1.2374	.464	358.4	13.7	19.516			372.1			1.799	
29.000	448.313	.669	927.6	-1.2430	.463	359.1	13.5	20.212			372.6			1.801	
30.000	470.275	.638	916.1	-1.2483	.463	359.7	13.3	20.899			373.1			1.803	
31.000	492.295	.609	905.0	-1.2534	.462	360.3	13.1	21.578			373.5			1.805	
32.000	514.469	.582	894.2	-1.2583	.461	360.9	12.9	22.250			373.9			1.807	
33.000	536.980	.559	882.6	-1.2630	.460	361.5	12.8	22.906			374.3			1.809	
34.000	558.793	.537	874.4	-1.2675	.459	362.0	12.6	23.556			374.7			1.811	
35.000	581.039	.516	865.0	-1.2718	.459	362.5	12.5	24.197			375.0			1.813	
36.000	603.316	.495	856.0	-1.2759	.458	363.0	12.3	24.831			375.3			1.815	
37.000	627.993	.474	846.2	-1.2800	.457	363.5	12.2	25.544			375.7			1.816	
38.000	653.035	.459	838.8	-1.2838	.457	364.1	12.1	26.267			376.0			1.818	
39.000	678.433	.442	830.7	-1.2875	.456	364.4	11.9	26.991			376.4			1.819	
40.000	704.111	.426	822.8	-1.2911	.456	364.9	11.8	27.715			376.7			1.821	
41.000	730.052	.410	815.2	-1.2946	.455	365.3	11.7	28.439			377.0			1.822	
42.000	756.234	.397	807.9	-1.2979	.454	365.7	11.6	29.160			377.2			1.824	
43.000	782.445	.383	800.7	-1.3012	.454	366.1	11.5	29.880			377.5			1.825	
44.000	809.265	.371	793.8	-1.3043	.453	366.4	11.3	30.598			377.8			1.826	
45.000	836.079	.359	787.1	-1.3073	.453	366.8	11.2	31.316			378.0			1.828	
46.000	863.020	.348	780.6	-1.3102	.452	367.1	11.1	32.031			378.3			1.829	
47.000	890.223	.337	774.3	-1.3131	.452	367.5	11.0	32.737			378.5			1.830	
48.000	917.522	.327	768.1	-1.3159	.452	367.8	10.9	33.443			378.7			1.831	
49.000	944.915	.317	762.2	-1.3186	.451	368.0	10.8	34.145			378.9			1.832	
50.000	972.500	.307	756.5	-1.3212	.451	368.3	10.7	34.846			379.2			1.833	
34.73	270.919	1.0496	1552.0	-1.7177	.549	289.0	35.3	2.899	290.0	300.6	321.2	325.3	1.402	1.572	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 128 O=F2 1.53 +3.5 50.
 298 N2=H4 1.004 +12.05 50.

BULK DENSITY = 1.212 GM/CC
 MIXTURE RATIO = 1.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 335.13 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.4
TEMP, DEG K	3559.2	2992.3	2506.1	2089.4	1810.5	1732.2	1426.8	1166.4	946.4	762.7	611.5	488.3	3125.4
ENTHALPY (-)	-22.04	8.68	34.47	56.02	70.07	73.94	88.75	100.91	110.81	118.82	125.25	130.41	1.52
CP	.5471	.5362	.5241	.5096	.4972	.4933	.4755	.4579	.4422	.4299	.4212	.4159	.5392
IMPUL OPT	163.48	221.73	260.59	283.07	288.96	310.46	327.05	339.96	350.06	357.96	364.17	364.17	143.18
IMPUL VAC	256.98	279.46	301.55	315.74	319.59	333.93	345.26	354.18	361.19	366.69	371.07	371.07	254.68
EPSILON	1.023	1.407		2.223	3.278	3.702	6.320	10.922	18.987	33.095	57.779	101.006	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	170.1
TEMP, DEG K	3559.2	3232.0	2908.7	2574.2	2307.0	2225.1	1881.7	1570.1	1298.8	1066.0	868.6	703.2	3326.1
ENTHALPY (-)	-22.04	9.56	37.66	62.42	79.20	83.92	102.24	117.60	130.37	140.89	149.50	156.48	.74
X BAR	5.909	5.796	5.707	5.647	5.622	5.617	5.608	5.607	5.606	5.606	5.606	5.606	5.826
N	5.909	5.796	5.707	5.647	5.622	5.617	5.608	5.607	5.606	5.606	5.606	5.606	5.826
CP	1.4448	1.2133	.9548	.7282	.6061	.5795	.5101	.4807	.4605	.4435	.4284	.4171	1.2856
IMPUL OPT	165.81	227.89	271.07	296.78	303.61	328.81	348.55	364.13	376.49	386.30	394.09	394.09	140.78
IMPUL VAC	263.48	290.86	317.43	334.56	339.20	356.56	370.38	381.42	390.21	397.20	402.74	402.74	259.79
EPSILON	1.036	1.488		2.440	3.675	4.171	7.241	12.691	22.377	39.560	69.955	123.636	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
18.86 F	.0098	.0042	.0014	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0055
-64.50 F=H	1.8420	1.8477	1.8505	1.8516	1.8518	1.8518	1.8519	1.8519	1.8519	1.8519	1.8519	1.8519	1.8464
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N=C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.3941	.2655	.1531	.0670	.0266	.0188	.0030	.0003	.0000	.0000	.0000	.0000	.3015
19.20 H=N	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=N=C	.0022	.0012	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0015
9.33 H=O	.1230	.0747	.0356	.0115	.0033	.0021	.0002	.0000	.0000	.0000	.0000	.0000	.0881
.00 H2	1.1932	1.2006	1.2187	1.2425	1.2572	1.2603	1.2671	1.2683	1.2685	1.2685	1.2685	1.2684	1.1974
40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.7463	.8251	.8817	.9127	.9223	.9237	.9257	.9259	.9259	.9259	.9259	.9259	.8041
-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
21.65 N=O	.0200	.0100	.0038	.0009	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0125
8.06 N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.5488	1.5545	1.5580	1.5596	1.5600	1.5601	1.5602	1.5602	1.5602	1.5602	1.5602	1.5602	1.5531
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0230	.0096	.0027	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0128
.00 O2	.0057	.0026	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0034

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA									
COMPONENT										DENSITY									
TE FORMULA										HEAT FORM									
DEG K										WT. B/O									
128 04P2										SC.									
298 N2O4										SC.									
GREEN EXPANSION										C STAR = 8545.4 FT/SEC									
C STAR = 8545.4 FT/SEC										I SEA									
I SEA										I AT									
I AT										I VAC									
I VAC										CF SEA									
CF SEA										CF VAC									
CF VAC										LVL									
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC					
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000								
1.000	1.000	300.000	3559.2	22.04	547														
1.000	1.824	184.433	3125.4	-1.32	539	143.2	111.5	6.78	244.7	247.7	253.5	254.7	1.203	1.252					
2.000	9.807	30.590	2168.5	-51.99	513	254.3	42.9	1.403	276.6	282.8	294.8	297.2	1.359	1.441					
3.000	17.862	18.796	1869.9	-67.10	500	278.5	34.3	2.041	282.8	291.8	309.3	312.8	1.390	1.537					
4.000	27.709	10.827	1684.2	-76.31	491	292.5	29.4	2.716			317.3	321.9		1.582					
5.000	38.943	7.704	1553.3	-82.88	483	301.8	26.3	3.411			322.3	328.1		1.613					
6.000	50.880	5.896	1454.0	-87.46	477	308.8	24.1	4.081			325.7	332.7		1.635					
7.000	64.051	4.486	1374.5	-91.23	472	313.9	22.4	4.774			328.1	336.3		1.653					
8.000	78.368	3.828	1308.7	-94.32	468	318.2	21.0	5.486			329.8	339.2		1.667					
9.000	93.159	3.220	1253.1	-96.91	464	321.7	19.9	6.176			331.1	341.6		1.679					
10.000	108.117	2.774	1205.2	-99.13	461	324.7	19.0	6.833			332.0	343.6		1.689					
11.000	123.283	2.433	1163.3	-101.05	458	327.2	18.2	7.462			332.7	345.4		1.698					
12.000	140.531	2.135	1126.0	-102.75	455	329.5	17.5	8.176			333.0	346.9		1.705					
13.000	158.424	1.894	1092.7	-104.26	453	331.5	16.8	8.889			333.2	348.3		1.712					
14.000	176.762	1.697	1062.6	-105.62	451	333.3	16.3	9.594						1.718					
15.000	195.471	1.535	1035.3	-106.85	449	334.9	15.8	10.287						1.724					
16.000	214.416	1.399	1010.2	-107.97	447	336.3	15.3	10.964						1.729					
17.000	233.904	1.285	987.2	-109.00	445	337.6	14.9	11.623						1.733					
18.000	252.669	1.187	965.9	-109.95	444	338.9	14.6	12.263						1.737					
19.000	271.904	1.103	946.2	-110.82	442	340.0	14.2	12.888						1.741					
20.000	293.548	1.022	927.7	-111.64	441	341.0	13.9	13.507						1.745					
21.000	315.700	.950	910.5	-112.40	440	342.0	13.6	14.110						1.748					
22.000	338.303	.887	894.3	-113.11	439	342.9	13.3	14.701						1.751					
23.000	361.299	.830	878.0	-113.78	438	343.7	13.1	15.270						1.754					
24.000	384.633	.780	864.7	-114.40	437	344.5	12.8	15.834						1.757					
25.000	408.253	.735	851.1	-115.00	436	345.3	12.6	16.387						1.759					
26.000	432.107	.694	838.2	-115.56	435	346.0	12.4	16.922						1.762					
27.000	456.152	.658	826.0	-116.09	434	346.7	12.2	17.450						1.764					
28.000	480.344	.625	814.3	-116.59	433	347.3	12.0	17.974						1.766					
29.000	504.656	.594	803.3	-117.07	433	347.9	11.8	18.493						1.768					
30.000	529.093	.567	792.7	-117.53	432	348.5	11.6	19.009						1.770					
31.000	553.515	.542	782.6	-117.97	431	349.0	11.5	19.513						1.772					
32.000	578.029	.519	772.9	-118.38	431	349.5	11.3	20.014						1.774					
33.000	602.585	.498	763.6	-118.78	430	350.0	11.1	20.514						1.775					
34.000	627.183	.478	754.7	-119.16	429	350.5	11.0	21.010						1.777					
35.000	651.815	.458	746.1	-119.53	429	350.9	10.9	21.508						1.778					
36.000	676.513	.438	737.8	-119.89	428	351.4	10.7	22.001						1.780					
37.000	701.283	.420	730.0	-120.23	428	351.8	10.6	22.488						1.781					
38.000	726.111	.404	722.3	-120.55	427	352.2	10.5	22.974						1.783					
39.000	751.000	.389	715.0	-120.87	427	352.6	10.4	23.456						1.784					
40.000	775.950	.374	707.8	-121.17	427	353.0	10.2	23.931						1.785					
41.000	800.969	.361	700.9	-121.47	426	353.3	10.1	24.401						1.787					
42.000	826.046	.349	694.3	-121.75	426	353.7	10.0	24.875						1.788					
43.000	851.183	.337	687.8	-122.02	425	354.0	9.9	25.345						1.789					
44.000	876.384	.326	681.6	-122.29	425	354.3	9.8	25.810						1.790					
45.000	901.641	.315	675.5	-122.55	425	354.7	9.7	26.271						1.791					
46.000	926.957	.306	669.7	-122.80	424	355.0	9.6	26.728						1.792					
47.000	1012.158	.296	664.0	-123.04	424	355.3	9.5	27.180						1.793					
48.000	1042.903	.288	658.4	-123.27	424	355.5	9.5	27.628						1.794					
49.000	1073.747	.279	653.0	-123.50	423	355.8	9.4	28.071						1.795					
50.000	1104.675	.272	647.8	-123.72	423	356.1	9.3	28.511						1.796					
3.278	20.414	14.696	1810.5	-10.07	447	283.1	32.7	2.223	283.1	292.9	311.9	315.7	1.391	1.552					

SHIFTING EXPANSION													
C STAR = 6751.8 FT/SEC													
EPSILON	P	PSIA	TEMP	ENTHALPY	CP	C	I	A	I	A	I	V	CF
				LOG10/LOGH	CP	STAR	DELTA	SEA	SEA	SEA	SEA	SEA	SEA
					DEG	DEG	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA	DELTA
1.000	1.000	300.00	3559.2		1.466								
1.000	1.763	170.130	3126.1	-7.74	1.286	140.8	119.0	1.700	749.5	252.6	258.6	259.8	1.238
2.000	6.628	34.771	2700.7	-53.48	.805	257.3	50.6	1.454	286.5	292.9	305.4	307.9	1.365
3.000	15.187	19.754	2418.7	-71.22	.600	284.9	41.6	2.108	249.5	309.0	322.9	326.5	1.408
4.000	23.136	12.777	2177.7	-87.94	.456	312.7	32.7	2.509			332.9	337.9	1.409
5.000	32.171	9.325	2019.0	-90.33	.349	312.7	32.7	2.509			339.4	345.4	
6.000	42.002	7.142	1995.6	-96.38	.527	321.0	30.1	4.220			343.9	351.1	1.673
7.000	52.259	5.741	1901.9	-101.21	.513	327.5	28.2	6.905			347.2	355.6	1.695
8.000	63.531	4.722	1823.5	-105.19	.503	332.7	26.6	5.625			349.7	359.3	1.712
9.000	76.576	3.916	1756.2	-108.55	.496	337.1	25.2	4.968			351.5	363.5	1.746
10.000	87.895	3.140	1697.5	-111.45	.490	340.8	24.1	7.078			352.8	364.9	1.739
11.000	100.582	2.583	1645.6	-113.97	.486	344.0	23.2	7.772			353.9	367.2	1.750
12.000	113.236	2.046	1599.3	-116.20	.483	346.8	22.3	8.436			354.6	369.1	1.759
13.000	126.067	1.587	1557.7	-118.20	.481	349.7	21.4	9.071			355.4	370.9	1.767
14.000	140.875	1.230	1520.1	-120.00	.477	351.5	20.5	9.681			355.7	372.5	
15.000	155.746	1.026	1485.8	-121.63	.474	353.5	20.4	10.576			355.9	373.9	1.782
16.000	171.043	1.156	1454.2	-123.13	.472	355.4	19.8	11.105			355.9	375.2	1.788
17.000	186.538	1.058	1425.0	-124.50	.470	357.1	19.1	12.025			356.4	376.4	1.794
18.000	202.190	1.022	1398.0	-125.77	.468	358.8	18.4	12.968			356.8	377.6	1.799
19.000	217.958	1.376	1372.8	-126.95	.466	360.0	18.5	13.427			357.4		1.806
20.000	233.852	1.283	1349.2	-128.04	.464	361.3	18.1	14.105			357.6		1.808
21.000	249.739	1.201	1327.1	-129.07	.463	362.6	17.7	14.767			358.0		1.812
22.000	265.339	1.129	1306.3	-130.03	.461	363.7	17.3	15.411			358.1		1.816
23.000	282.715	1.061	1286.7	-130.93	.460	364.8	17.1	16.110			358.1		1.819
24.000	300.779	.997	1268.1	-131.78	.458	365.8	16.8	16.844			358.2		1.823
25.000	319.157	.940	1250.5	-132.59	.457	366.8	16.5	17.579			358.3		1.826
26.000	337.817	.886	1233.8	-133.35	.456	367.7	16.3	18.317			358.3		1.830
27.000	356.728	.835	1217.9	-134.08	.455	368.6	16.0	19.051			358.4		1.834
28.000	375.858	.784	1202.7	-134.76	.454	369.3	15.8	19.770			358.5		1.835
29.000	395.178	.759	1188.2	-135.42	.452	370.1	15.6	20.491			358.7		1.840
30.000	414.658	.728	1174.3	-136.05	.451	370.9	15.3	21.210			358.7		1.848
31.000	434.271	.693	1161.0	-136.65	.450	371.7	15.1	21.928			358.7		1.856
32.000	453.989	.661	1148.3	-137.22	.450	372.2	14.9	22.646			358.7		1.865
33.000	473.812	.631	1136.0	-137.77	.449	372.9	14.8	23.319			358.6		1.847
34.000	493.646	.608	1124.2	-138.30	.448	373.5	14.6	24.007			358.5		1.849
35.000	513.532	.586	1112.9	-138.81	.447	374.1	14.4	24.686			358.5		1.851
36.000	533.405	.562	1102.0	-139.29	.446	374.6	14.3	25.361			358.4		1.853
37.000	553.615	.542	1091.4	-139.76	.445	375.2	14.1	26.018			358.3		1.855
38.000	573.644	.523	1081.2	-140.22	.445	375.7	13.9	26.671			358.7		1.857
39.000	593.452	.505	1071.4	-140.65	.444	376.2	13.8	27.315			359.0		1.860
40.000	613.015	.487	1061.9	-141.05	.443	376.7	13.6	27.954			359.4		1.859
41.000	632.742	.469	1052.6	-141.43	.443	377.2	13.5	28.728			359.7		1.862
42.000	651.813	.455	1043.7	-141.80	.442	377.6	13.4	29.461			359.1		1.863
43.000	682.715	.439	1035.0	-142.24	.441	378.1	13.3	30.194			359.3		1.865
44.000	705.335	.425	1026.6	-142.63	.441	378.5	13.1	30.928			359.2		1.870
45.000	728.141	.410	1018.0	-142.99	.440	378.9	13.0	31.651			359.0		1.868
46.000	752.680	.399	1010.5	-143.34	.439	379.3	12.9	32.392			359.2		1.869
47.000	776.780	.386	1002.7	-143.68	.439	379.7	12.8	33.123			359.2		1.870
48.000	800.249	.375	995.2	-144.01	.438	380.1	12.7	33.851			359.2		1.872
49.000	824.300	.363	987.8	-144.33	.438	380.4	12.6	34.578			359.2		1.873
50.000	848.445	.351	980.8	-144.64	.437	380.8	12.5	35.302			359.3		1.874
3.675	20.414	14.696	2307.0	-79.20	.606	296.8	37.8	2.571	296.8	308.2	330.2	334.6	1.414

PRESSURE PROFILE DATA					
SYSTEM LIQUID		BIPROPELLANT		PC 300	PSIA
COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. 0/0	
	DEG K	GM/CC	(KCAL/FORM.WT.)		
128	O ₂ F ₂	1.53	+3.5	56.	
298	N ₂ H ₄	1.004	+12.05	44.	

BULK DENSITY = 1.243 GM/CC
MIXTURE RATIO = 1.273 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA													
CHAMBER ENTROPY 323.41 EU/100GMS													
CHAMBER	THROAT												
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.0
TEMP, DEG K	3739.5	3137.9	2623.5	2184.1	1890.7	1808.6	1488.2	1215.6	985.5	793.5	635.3	506.7	3281.4
ENTHALPY (-)	-20.17	10.47	36.14	57.56	71.51	75.35	90.03	102.08	111.88	119.79	126.15	131.23	3.21
CP	.5140	.5044	.4934	.4809	.4696	.4660	.4498	.4332	.4184	.4064	.3979	.3924	.5069
IMPUL OPT	163.27	221.34	260.05	282.41	288.27	309.64	326.11	338.93	348.95	356.79	362.92	362.92	142.63
IMPUL VAC	256.55	278.87	300.81	314.90	318.72	332.94	344.70	353.04	359.98	365.43	369.70	369.70	254.29
EPSILON	1.023	1.405	2.217	3.267	3.689	6.293	10.869	18.882	32.881	57.337	100.117	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.0
TEMP, DEG K	3739.5	3434.1	3150.6	2873.6	2653.3	2583.5	2264.8	1932.0	1620.1	1345.6	1108.8	906.8	3522.4
ENTHALPY (-)	-20.17	11.48	39.91	65.42	83.15	88.20	108.23	125.47	140.02	152.16	162.20	170.45	2.37
X BAR	5.614	5.486	5.373	5.279	5.223	5.210	5.172	5.158	5.156	5.156	5.156	5.156	5.523
N	5.614	5.486	5.373	5.279	5.223	5.210	5.172	5.158	5.156	5.156	5.156	5.156	5.523
CP	1.7301	1.5930	1.3767	1.0900	.8581	.7941	.5844	.4881	.4524	.4327	.4157	.4007	1.6413
IMPUL OPT	165.93	228.62	272.88	299.81	307.06	334.22	355.96	373.31	387.19	398.32	407.22	407.22	140.05
IMPUL VAC	264.09	292.63	320.94	339.77	344.95	364.52	380.16	392.65	402.68	410.72	417.15	417.15	260.14
EPSILON	1.038	1.507	2.520	3.873	4.425	7.678	14.016	24.947	44.487	79.356	141.364	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0245	.0131	.0063	.0025	.0010	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0159
-64.50 F=H	2.0495	2.0610	2.0678	2.0716	2.0731	2.0734	2.0740	2.0741	2.0741	2.0741	2.0741	2.0741	2.0581
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.4403	.3286	.2301	.1440	.0875	.0725	.0243	.0046	.0005	.0000	.0000	.0000	.3406
79.20 H=H	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=H=O	.0032	.0021	.0013	.0007	.0003	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0024
9.33 H=O	.2136	.1640	.1127	.0644	.0337	.0262	.0060	.0006	.0000	.0000	.0000	.0000	.1792
.00 H2	.7383	.7080	.6799	.6604	.6555	.6559	.6635	.6699	.6716	.6718	.6718	.6718	.7170
40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.6542	.7600	.8601	.9452	.9931	1.0038	1.0302	1.0364	1.0370	1.0370	1.0370	1.0370	.7286
-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
21.65 N=O	.0450	.0302	.0178	.0085	.0037	.0027	.0004	.0000	.0000	.0000	.0000	.0000	.0344
8.06 N=O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.3485	1.3566	1.3633	1.3684	1.3709	1.3715	1.3727	1.3729	1.3729	1.3729	1.3729	1.3729	1.3543
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.0713	.0436	.0224	.0085	.0028	.0018	.0001	.0000	.0000	.0000	.0000	.0000	.0512
.00 O2	.0249	.0186	.0114	.0049	.0017	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0206

SYSTEM LIQUID BIPROPELLANT PC 300 PSIA

COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. G/G
DEG K		GM/CC	(KCAL/FORM.WT.)	
128	0°F2	1.53	+3.5	62.
298	N2+H4	1.004	+12.05	38.

BULK DENSITY = 1.276 GM/CC
MIXTURE RATIO = 1.632 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 310.73 EU/100GMS

CHAMBER													THROAT	
FROZEN EXPANSION														
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.1	
TEMP, DEG K	3868.0	3234.4	2695.1	2236.4	1931.2	1846.0	1514.3	1233.3	997.1	800.5	639.3	508.7	3381.1	
ENTHALPY (-)	-18.31	11.81	36.96	57.87	71.45	73.19	89.43	101.08	110.52	118.15	124.25	129.11	4.89	
CP	.4794	.4711	.4611	.4497	.4399	.4366	.4221	.4067	.3932	.3822	.3746	.3698	.4730	
IMPUL OPT		161.87	219.27	257.44	279.43	285.19	306.15	322.27	334.79	344.54	352.16	358.11	142.08	
IMPUL VAC		254.19	276.06	297.57	311.36	315.09	329.00	339.95	348.55	355.27	360.54	364.67	252.02	
EPSILON		1.022	1.401	2.205	3.242	3.658	6.225	10.726	18.589	32.296	56.191	97.911	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.3
TEMP, DEG K	3868.0	3562.2	3287.8	3036.2	2853.2	2798.8	2565.8	2324.3	2094.4	1750.6	1464.4	1214.5	3650.4
ENTHALPY (-)	-18.31	12.87	40.94	66.29	84.07	89.20	109.92	128.52	145.03	159.29	171.30	181.31	3.85
X BAR	5.344	5.214	5.095	4.987	4.913	4.892	4.812	4.751	4.715	4.706	4.705	4.705	5.252
N	5.344	5.214	5.095	4.987	4.913	4.892	4.812	4.751	4.715	4.706	4.705	4.705	5.252
CP	1.7920	1.7408	1.6834	1.6420	1.6117	1.5912	1.5507	.7920	.5477	.4347	.4089	.3919	1.7610
IMPUL OPT	164.69	227.02	271.28	298.44	305.82	333.98	357.39	376.95	393.06	406.14	416.72	428.83	
IMPUL VAC	262.19	290.81	319.53	339.05	344.53	365.95	384.11	399.17	411.18	420.81	428.57	438.22	
EPSILON	1.039	1.513	2.550	3.966	4.554	8.375	15.588	28.870	52.437	94.523	170.151	1.000	

COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.0517	.0305	.0174	.0093	.0054	.0045	.0019	.0006	.0001	.0000	.0000	.0000	.0359
-64.50 F+H	2.2446	2.2657	2.2789	2.2870	2.2909	2.2918	2.2944	2.2957	2.2962	2.2963	2.2963	2.2963	2.2604
-26.10 F+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F+N+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.4118	.3116	.2251	.1522	.1058	.0734	.0491	.0199	.0053	.0008	.0001	.0000	.3403
79.20 H+N	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H+N+O	.0037	.0027	.0019	.0013	.0009	.0008	.0005	.0002	.0001	.0000	.0000	.0000	.0030
9.33 H+O	.2815	.2432	.2000	.1544	.1195	.1091	.0669	.0317	.0083	.0007	.0000	.0000	.2553
.00 H2	.4140	.3747	.3294	.2791	.2378	.2249	.1693	.1176	.0826	.0753	.0751	.0751	.3871
40.30 H2+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2+O	.4865	.5851	.6890	.7949	.8751	.8990	.9967	1.0801	1.1339	1.1473	1.1481	1.1481	.5548
-11.04 H3+N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0006	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
21.45 N+O	.0775	.0609	.0459	.0326	.0238	.0214	.0123	.0053	.0012	.0001	.0000	.0000	.0657
8.04 N+O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 N2	1.1447	1.1537	1.1618	1.1687	1.1733	1.1744	1.1794	1.1829	1.1851	1.1857	1.1857	1.1857	1.1511
19.50 N2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.1555	.1147	.0792	.0500	.0322	.0277	.0122	.0035	.0004	.0000	.0000	.0000	.1244
.00 O2	.0717	.0708	.0661	.0574	.0483	.0451	.0298	.0137	.0022	.0000	.0000	.0000	.0714

PRESSURE PROFILE DATA				
SYSTEM LIQUID BIPROPELLANT PC 300 PSIA				
COMPONENT	TREF FORMULA	DENSITY	HEAT FORM	WT. O/O
	DEG K	GM/CC	(KCAL/FORM.WT.)	
128 O ₂ F ₂		1.53	+3.5	70.
298 N ₂ H ₄		1.004	+12.05	30.

BULK DENSITY = 1.322 GM/CC
MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
CHAMBER ENTROPY 292.28 EU/100GMS

CHAMBER	THROAT												
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	163.4
TEMP, DEG K	3987.9	3313.0	2742.6	2260.7	1942.3	1853.8	1510.8	1222.6	982.5	784.5	623.5	493.9	3465.6
ENTHALPY (-)	-15.82	13.19	57.25	57.13	69.96	73.48	86.84	97.70	106.45	113.47	119.05	123.49	6.68
CP	.4333	.4257	.4172	.4072	.3987	.3958	.3832	.3701	.3588	.3500	.3441	.3407	.4277
IMPUL OPT	158.85	214.86	251.90	273.16	278.71	298.84	314.24	326.14	335.36	342.53	348.12	349.89	
IMPUL VAC	249.14	270.12	290.76	303.95	307.51	320.73	331.09	339.18	345.49	350.41	354.26	247.14	
EPSILON	1.021	1.392	2.179	3.192	3.597	6.089	10.435	17.994	31.115	53.916	93.595	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	171.6
TEMP, DEG K	3987.9	3663.6	3369.2	3096.2	2894.9	2834.3	2570.2	2287.6	1979.1	1668.0	1384.4	1138.0	3758.0
ENTHALPY (-)	-15.82	14.28	41.31	65.63	82.63	87.52	107.16	124.61	139.83	152.78	163.60	172.54	5.53
X BAR	5.008	4.889	4.780	4.683	4.618	4.600	4.534	4.491	4.471	4.466	4.465	4.465	4.923
N	5.008	4.889	4.780	4.683	4.618	4.600	4.534	4.491	4.471	4.466	4.465	4.465	4.923
CP	1.5991	1.5168	1.4001	1.2378	1.0831	1.0321	.8006	.5893	.4533	.3951	.3707	.3553	1.5458
IMPUL OPT	161.82	222.92	266.19	292.65	299.85	327.08	349.51	367.97	382.97	395.07	404.79	136.29	
IMPUL VAC	257.50	285.38	313.28	332.14	337.42	357.89	374.92	388.75	399.79	408.60	415.64	253.65	
EPSILON	1.038	1.509	2.534	3.928	4.505	8.221	15.102	27.514	49.561	88.779	158.614	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
18.86 F	.1322	.0815	.0477	.0261	.0155	.0130	.0055	.0017	.0003	.0000	.0000	.0000	.0948
-64.50 F=H	2.4604	2.5111	2.5449	2.5664	2.5771	2.5796	2.5871	2.5909	2.5923	2.5926	2.5926	2.5926	2.4977
-26.10 F=H=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
58.60 F=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-15.70 F=N=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
32.40 F=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 F2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.2890	.2116	.1450	.0899	.0562	.0475	.0189	.0045	.0005	.0000	.0000	.0000	.2339
79.20 H=N	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
-10.00 H=N=O	.0030	.0023	.0017	.0012	.0009	.0008	.0005	.0003	.0001	.0000	.0000	.0000	.0025
9.33 H=O	.2736	.2479	.2151	.1759	.1423	.1318	.0855	.0431	.0143	.0028	.0003	.0000	.2564
.00 H2	.1411	.1197	.0970	.0726	.0539	.0483	.0258	.0094	.0018	.0002	.0000	.0000	.1263
40.30 H2=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-57.80 H2=O	.2180	.2661	.3219	.3826	.4300	.4441	.5003	.5434	.5668	.5743	.5757	.5759	.2506
-11.04 H3=N	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
113.00 N	.0008	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
21.65 N=O	.1188	.1012	.0837	.0667	.0543	.0506	.0355	.0218	.0106	.0038	.0010	.0002	.1066
8.06 N=O2	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 N2	.8747	.8841	.8933	.9021	.9085	.9103	.9181	.9251	.9307	.9342	.9356	.9360	.8813
19.50 N2=O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
59.56 O	.3091	.2466	.1851	.1282	.0895	.0788	.0396	.0138	.0026	.0002	.0000	.0000	.2655
.00 O2	.1868	.2161	.2444	.2708	.2896	.2951	.3174	.3370	.3509	.3575	.3596	.3601	.2073

SYSTEM LIQUID BI-PROPELLANT PC 300 PSIA											
COMPONENT		THERM FORMULA		DENSITY		HEAT FORM		HT. S/R			
		DEG K		GM/CC		(KCAL/POUND.WT.)					
		128.822		1.004		+12.05		70.			
		298 H2+H2		1.004		+12.05		30.			
FARZEN EXPANSION											
C STAR = 6334.0 FT/SEC											
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELYAC	DELYAC	I SEA	I AT	I AT
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000
1.000	1.000	100.000	1007.9	15.82	1.592						
1.000	1.036	103.428	1005.4	-0.68	.428	139.9	107.3	.650	237.5	240.4	246.0
2.000	10.053	29.841	2334.9	-54.12	.409	297.1	49.5	1.351	281.2	273.2	285.1
3.000	18.571	16.156	1989.9	-66.06	.400	270.1	51.9	1.973	273.0	261.7	290.6
4.000	29.041	10.330	1778.4	-76.44	.393	283.1	27.2	2.431	283.2	306.0	310.5
5.000	40.983	7.320	1630.9	-87.21	.388	292.0	24.2	3.101	310.6	316.2	321.5
6.000	53.625	5.549	1519.4	-96.51	.380	298.4	22.0	3.921	313.7	320.4	327.2
7.000	68.024	4.210	1430.4	-104.90	.380	303.3	20.4	4.829	315.8	323.7	331.4
8.000	83.546	3.399	1357.4	-112.44	.376	307.2	19.1	5.816	317.5	326.5	335.7
9.000	99.135	3.026	1296.2	-119.46	.374	310.4	18.1	6.971	318.5	328.5	340.9
10.000	115.045	2.608	1243.4	-126.93	.371	313.2	17.2	8.391	319.1	330.4	346.8
11.000	132.213	2.269	1197.3	-134.83	.369	315.5	16.4	9.999	319.6	332.0	353.4
12.000	150.758	1.987	1156.5	-142.18	.367	317.6	15.8	11.851	319.8	333.4	360.5
13.000	170.532	1.761	1120.1	-149.07	.365	319.4	15.2	13.917	319.9	334.6	368.0
14.000	190.181	1.577	1087.3	-155.67	.364	321.1	14.7	16.292	319.7	335.7	375.7
15.000	210.352	1.426	1057.5	-162.05	.362	322.5	14.2	18.951	319.4	336.7	383.6
16.000	230.723	1.300	1030.3	-168.17	.361	323.8	13.8	21.899	319.0	337.6	391.5
17.000	251.209	1.196	1005.4	-174.05	.360	325.0	13.4	25.121	318.6	338.4	399.4
18.000	271.775	1.109	982.3	-179.68	.359	326.1	13.0	28.613	318.2	339.2	407.2
19.000	296.476	1.017	961.0	-185.07	.358	327.2	12.7	32.370	317.9	340.0	415.0
20.000	316.778	.941	941.1	-190.23	.357	328.1	12.4	36.403	317.6	340.5	422.8
21.000	341.102	.861	922.5	-195.16	.356	329.0	12.1	40.721	317.3	341.1	430.5
22.000	367.883	.815	905.1	-199.87	.355	329.8	11.9	45.327	317.0	341.7	438.2
23.000	393.052	.763	888.7	-204.36	.355	330.6	11.6	50.227	316.7	342.2	445.9
24.000	418.543	.717	873.3	-208.64	.354	331.3	11.4	55.420	316.4	342.7	453.6
25.000	444.297	.676	858.8	-212.81	.353	332.0	11.2	60.907	316.2	343.2	461.2
26.000	470.260	.638	845.0	-216.88	.353	332.6	11.0	66.689	316.0	343.6	468.8
27.000	496.384	.604	832.0	-220.85	.352	333.2	10.8	72.764	315.8	344.0	476.4
28.000	522.632	.574	819.5	-224.72	.351	333.8	10.6	79.131	315.6	344.4	484.0
29.000	549.073	.546	807.7	-228.50	.351	334.3	10.5	85.790	315.4	344.8	491.5
30.000	575.666	.521	796.5	-232.18	.350	334.8	10.3	92.741	315.3	345.1	499.0
31.000	601.861	.498	785.7	-235.77	.350	335.3	10.1	100.000	315.2	345.5	506.5
32.000	627.497	.475	775.4	-239.28	.350	335.8	10.0	107.570	315.1	345.8	514.0
33.000	653.810	.454	765.6	-242.71	.349	336.2	9.9	115.440	315.0	346.1	521.5
34.000	680.442	.434	756.1	-246.07	.349	336.6	9.7	123.610	314.9	346.4	529.0
35.000	707.233	.415	747.1	-249.37	.348	337.1	9.6	132.090	314.8	346.6	536.5
36.000	734.217	.398	738.3	-252.60	.348	337.4	9.5	140.887	314.7	346.9	544.0
37.000	761.467	.382	730.0	-255.77	.348	337.8	9.4	149.996	314.7	347.2	551.5
38.000	788.947	.367	721.9	-258.88	.348	338.2	9.2	159.420	314.6	347.4	559.0
39.000	816.627	.353	714.1	-261.92	.347	338.5	9.1	169.160	314.5	347.7	566.5
40.000	844.320	.340	706.6	-264.90	.347	338.9	9.0	179.210	314.4	347.9	574.0
41.000	872.046	.328	699.3	-267.83	.347	339.2	8.9	189.570	314.3	348.1	581.5
42.000	900.780	.317	692.3	-270.71	.346	339.5	8.8	199.940	314.3	348.3	589.0
43.000	929.517	.306	685.5	-273.55	.346	339.8	8.7	210.620	314.2	348.5	596.5
44.000	958.257	.296	679.0	-276.35	.346	340.1	8.6	221.610	314.1	348.7	604.0
45.000	987.000	.287	672.4	-279.11	.346	340.4	8.6	232.910	314.0	348.9	611.5
46.000	1015.752	.278	666.4	-281.83	.346	340.6	8.5	244.420	314.0	349.1	619.0
47.000	1044.517	.269	660.5	-284.51	.345	340.9	8.4	256.140	313.9	349.3	626.5
48.000	1073.287	.262	654.7	-287.15	.345	341.2	8.3	268.070	313.8	349.5	634.0
49.000	1102.063	.254	649.0	-289.77	.345	341.4	8.2	280.210	313.8	349.6	641.5
50.000	1130.845	.247	643.5	-292.36	.345	341.7	8.2	292.570	313.7	349.8	649.0
51.000	1159.632	.240	638.0	-294.92	.345	341.9	8.0	305.140	313.7	349.9	656.5

SHIFTING EXPANSION											
C STAR = 6033.2 FT/SEC											
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELYAC	DELYAC	I SEA	I AT	I AT
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000
1.000	1.000	100.000	1007.9	15.82	1.592						
1.000	1.749	171.534	1756.5	-5.51	1.346	156.4	117.4	.688	245.6	246.0	252.5
2.000	8.517	16.069	5204.6	-55.76	1.313	250.2	51.4	1.426	280.7	287.0	299.3
3.000	16.137	21.220	5016.6	-72.48	1.180	277.2	43.8	2.063	290.6	299.0	317.4
4.000	20.931	16.333	2886.8	-65.29	1.076	293.6	39.2	2.737	304.7	320.2	332.9
5.000	26.359	10.579	2786.4	-70.13	.992	305.0	36.2	3.427	306.1	335.4	351.3
6.000	36.324	6.252	2708.8	-77.22	.922	313.6	33.1	4.127	308.4	347.7	369.8
7.000	44.572	4.731	2641.3	-102.18	.862	320.4	32.4	4.816	314.6	354.6	382.8
8.000	52.926	3.668	2582.3	-106.33	.811	326.0	31.1	5.481	317.7	357.7	405.7
9.000	61.497	2.839	2527.5	-109.00	.766	330.7	29.9	6.184	319.1	360.6	423.2
10.000	71.542	2.183	2481.6	-111.03	.728	334.8	28.9	6.928	319.2	363.8	440.4
11.000	81.300	1.690	2437.8	-112.79	.693	338.4	28.1	7.611	319.3	366.5	457.2
12.000	91.179	1.290	2397.2	-114.27	.663	341.5	27.3	8.305	319.4	369.0	473.7
13.000	101.110	2.767	2359.5	-120.51	.636	344.4	26.6	8.980	319.5	371.0	490.0
14.000	111.044	2.102	2324.2	-122.55	.615	346.9	26.0	9.655	319.5	373.0	506.1
15.000	120.961	2.480	2290.9	-124.42	.591	349.3	25.5	10.328	319.2	374.8	522.0
16.000	131.981	2.273	2258.9	-126.16	.573	351.4	24.9	10.971	319.7	376.4	537.6
17.000	143.374	2.092	2228.4	-127.77	.557	353.4	24.4	11.604	319.7	377.9	553.0
18.000	156.493	1.936	2199.4	-129.27	.542	355.3	24.0	12.228	319.6	379.3	568.1
19.000	170.781	1.799	2171.8	-130.67	.528	357.0	23.6	12.844	319.2	380.5	583.0
20.000	178.781	1.678	2145.5	-131.99	.516	358.6	23.2	13.456	319.1	381.7	597.7
21.000	190.890	1.572	2120.3	-133.22	.505	360.1	22.8	14.063	318.9	382.9	612.2
22.000	205.107	1.477	2096.2	-134.39	.495	361.5	22.4	14.665	318.9	383.9	626.5
23.000	215.412	1.393	2073.5	-135.49	.486	362.8	22.1	15.262	318.8	384.9	640.7
24.000	227.784	1.317	2050.8	-136.53	.478	364.1	21.8	15.852	318.8	385.8	654.8
25.000	240.211	1.249	2029.3	-137.53	.470	365.2	21.5	16.435	318.7	386.7	668.8
26.000	252.682	1.187	2008.9	-138.48	.463	366.4	21.2	17.012	318.6	387.6	682.7
27.000	265.192	1.131	1989.0	-139.38	.456	367.4	20.9	17.584	318.6	388.4	696.5
28.000	278.515	1.078	1969.7	-140.24	.451	368.5	20.7	18.151	318.5	389.1	710.2
29.000	292.209	1.027	1951.1	-141.06	.446	369.4	20.4	18.714	318.5	389.8	723.8
30.000	306.299	.979	1933.0	-141.85	.441	370.4	20.2	19.272	318.4	390.5	737.3
31.000	320.571	.936	1915.6	-142.61	.437	371.2	19.9	19.825	318.4	391.2	750.7
32.000	335.012	.895	1898.7	-143.34	.433	372.0	19.7	20.372	318.3	391.9	764.0
33.000	349.611	.858	1882.3	-144.04	.429	372.7	19.5	20.921	318.3	392.6	777.1
34.000	364.355	.823	1866.4	-144.71	.426	373.7	19.3	21.462	318.2	393.0	790.1
35.000	379.230	.791	1851.0	-145.36	.423	374.5	19.1	22.003	318.1	393.5	803.0
36.000	394.227	.761	1836.0	-145.99	.420	375.2	18.9	22.538	318.0	394.0	815.8
37.000	409.334	.733	1821.4	-146.60	.417	376.0	18.7	23.072	317.9	394.5	828.5
38.000	424.560	.707	1807.3	-147.18	.415	376.6	18.5	23.607	317.8	395.1	841.1
39.000	439.835	.682	1793.5	-147.75	.412	377.2	18.4	24.137	317.8	395.6	853.7
40.000	455.210	.659	1780.1	-148.29	.410	377.8	18.2	24.663	317.7	396.0	866.1
41.000	470.654	.637	1767.1	-148.80	.408	378.4	18.0	25.185	317.7	396.5	878.4
42.000	486.166	.617	1754.4	-149.30	.406	379.0	17.9	25.704	317.6	396.9	890.6
43.000	501.732	.598	1742.0	-149.80	.405	379.6	17.7	26.231	317.5	397.3	902.8
44.000	517.350	.580	1730.0	-150.30	.403	380.2	17.6	30.749	317.4	397.7	914.8
45.000	533.012	.563	1717.8	-150.78	.401	380.7	17.4	30.287	317.3	398.1	926.8
46.000	548.715	.547	1705.7	-151.25	.400	381.2	17.3	30.824	317.2	398.5	938.6
47.000	564.456	.531	1693.5	-151.69	.398	381.7	17.1	32.244	317.1	398.9	950.3
48.000	580.232	.517	1681.6	-152.13	.397	382.2	17.0	32.709	317.0	399.2	961.9
49.000	596.041	.503	1669.7	-152.55	.396	382.7	16.9	33.169	316.9	399.6	973.4
50.000	611.880	.490	1658.0	-152.96	.395	383.2	16.8	33.625	316.8	399.9	984.8
51.000	627.746	.478	1646.4	-153.35	.394	383.7	16.7	34.077	316.7	400.2	996.1
52.000	643.636	.466	1634.9	-153.73	.393	384.2	16.6	34.525	316.6	400.5	1007.3
53.000	659.556	.455	1623.4	-154.10	.392	384.7	16.5	34.969	316.5	400.8	1018.4
54.000	675.501	.444	1612.0	-154.46	.391	385.2	16.4	35.409	316.4	401.1	1029.4
55.000	691.476	.434	1600.6	-154.81	.390	385.7	16.3	35.845	316.3	401.4	1040.3
56.000	707.476	.424	1589.3	-155.15	.389	386.2	16.2	36.277	316.2	401.7	1051.1
57.000	723.505	.414	1578.0	-155.48	.388	386.7	16.1	36.705	316.1	402.0	1061.8
58.000	739.558	.405	1566.8	-155.80	.387	387.2	16.0	37.129	316.0	402.3	1072.4
59.000	755.639	.396	1555.6	-156.11	.386	387.7	15.9	37.549	315.9	402.6	1082.9
60.000	771.743	.387	1544.5	-156.41	.385	388.2	15.8	37.965	315.8	402.9	1093.3
61.000	787.874	.379	1533.4	-156.70	.384	388.7	15.7	38.377	315.7	403.2	1103.6
62.000	804.035	.371	1522.4	-156.98	.383	389.2	15.6	38.785	315.6	403.5	1113.8
63.000	820.221	.363	1511.4	-157.26	.382	389.7	15.5	39.189	315.5	403.8	1123.9
64.000	836.436	.355	1500.5	-157.53	.381	390.2	15.4	39.589	315.4	404.1	1133.9
65.000	852.674	.348	1489.6	-157.79	.380	390.7	15.3	39.985	315.3	404.4	1143.8
66.000	868.940	.341	1478.8	-158.04	.379	391.2	15.2	40.377	315.2	404.7	1153.6
67.000	885.228	.334	1468.0	-158.29	.378	391.7	15.1	40.765	315.1	405.0	1163.3
68.000	901.542	.327	1457.3	-158.53	.377	392.2	15.0	41.149	315.0	405.3	1172.9
69.000	917.886	.320	1446.6	-158.77	.376	392.7	14.9	41.529	314.9	405.6	1182.4
70.000	934.255	.313	1436.0	-159.00	.375	393.2	14.8	41.905	314.8	405.9	1191.8
71.000	950.644	.307	1425.4	-159.22	.374	393.7	14.7	42.277	314.7	406.2	1201.1
72.000	967.058	.301	1414.8	-159.44	.373	394.2	14.6	42.645	314.6	406.5	1210.3
73.000	983.491	.295	1404.3	-159.65	.372	394.7	14.5	43.009	314.5	406.8	1219.5
74.000	1000.000	.289	1393.8	-159.86	.371	395.2	14.4	43.370	314.4	407.1	1228.6
75.000	1016.529	.283	1383.3	-160.06	.370	395.7	14.3	43.727	314.3	407.4	1237.6
76.000	1033.082	.277	1372.8	-160.26	.369	396.2	14.2	44.081	314.2	407.7	1246.5
77.000	1049.654	.271	1362.3	-160.45	.368	396.7	14.1	44.432	314.1	408.0	1255.3
78.000	1066.249	.265	1351.8	-160.64	.367	397.2	14.0	44.780	314.0	408.3	1264.1
79.000	1082.869	.260	1341.3	-160.82	.366	397.7	13.9	45.125	313.9	408.6	1272.8
80.000	1100.000	.254	1330.8	-161.00	.365	398.2	13.8	45.467	313.8	408.9	1281.4
81.000	1116.646	.249	1320.3	-161.17	.364	398.7	13.7	45.807	313.7	409.2	1290.0
82.000	1133.311	.244	1309.8	-161.34	.363	399.2	13.6	46.144	313.6	409.5	1298.5
83.000	1150.000	.239	1299.3	-161.50	.362	399.7	13.5	46.478	313.5	409.8	1306.9
84.000	1166.706	.234	1288.8	-161.66	.361	400.2	13.4	46.810	313.4	410.1	1315.2
85.000	1183.433	.229	1278.3	-161.81	.360	400.7	13.3	47.139	313.3	410.4	1323.5
86.000	1200.184	.224	1267.8	-161.96	.359	401.2	13.2	47.465	313.2	410.7	1331.7
87.000	1216.953	.219	1257.3	-162.11	.358	401.7	13.1	47.789	313.1	411.0	1339.8
88.000	1233.744	.214	1246.8	-162.25	.357	402.2	13.0	48.111	313.0	411.3	1347.9
89.000	1250.559	.209	1236.3	-162.39	.356	402.7	12.9	48.431	312.9	411.6	1355.9
90.000	1267.392	.204	1225.8	-162.53	.355	403.2	12.8	48.748	312.8	411.9	1363.8
91.000	1284.246	.200	1215.3	-162.66	.354	403.7	12.7	49.063	312.7	412.2	1371.6
92.000	1301.123	.195	1204.8	-162.79	.353	404.2	12.6	49.375	312.6	412.5	1379.4
93.000	1318.026	.190	1194.3	-162.92	.352	404.7	12.5	49.685	312.5	412.8	1387.1
94.000	1334.948	.186	1183.8	-163.04	.351	405.2	12.4	49.992	312.4	413.1	1394.7
95.000	1351.892	.181	1173.3	-163.16	.350	405.7	12.3	50.297	312.3	413.4	1402.3
96.000	1368.859	.177	1162.8	-163.28							

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Ford Motor Company
AERONUTRONIC DIVISION

O₂ - H₂ SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 68.
 LM2 20.4 H2 0.071 -1.887 32.

BULK DENSITY = .196 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 671.05 EU/100GMS

	CHAMBER										THROAT												
	FROZEN EXPANSION																						
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	545.1										
TEMP, DEG K	1919.3	1565.0	1262.4	1007.3	796.3	692.1	625.1	488.3	380.5	295.3	225.5	166.2	1679.6										
ENTHALPY (-)	36.50	86.97	127.93	160.79	186.89	199.46	207.45	223.55	236.09	245.88	253.82	260.49	70.91										
CP	1.4574	1.3901	1.3173	1.2597	1.2161	1.1969	1.1866	1.1697	1.1554	1.1427	1.1313	1.1211	1.4124										
IMPUL OPT		209.55	282.04	328.84	361.71	376.53	385.65	403.40	416.71	426.80	434.82	441.44	173.03										
IMPUL VAC		312.04	343.46	370.87	391.92	401.75	407.89	420.02	429.24	436.30	441.93	446.61	306.24										
EPSILON		1.053	1.586	2.726	4.922	7.024	9.102	17.075	32.352	61.577	115.926	211.473	1.000										
	SHIFTING EXPANSION																						
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	545.5										
TEMP, DEG K	1919.3	1565.5	1262.9	1007.7	796.7	692.4	625.3	488.6	380.7	295.4	225.6	166.3	1680.4										
ENTHALPY (-)	36.50	86.98	127.95	160.82	186.93	199.51	207.50	223.61	236.15	245.95	253.89	260.56	70.87										
K BAR	15.874	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873										
N	15.874	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873										
CP	1.4638	1.3907	1.3174	1.2598	1.2163	1.1972	1.1865	1.1696	1.1553	1.1432	1.1310	1.1212	1.4141										
IMPUL OPT		209.57	282.07	328.88	361.76	376.58	385.70	403.46	416.77	426.87	434.89	441.51	172.92										
IMPUL VAC		312.08	343.51	370.92	391.98	401.81	407.95	420.08	429.30	436.37	442.00	446.68	306.27										
EPSILON		1.053	1.586	2.726	4.921	7.023	9.100	17.073	32.348	61.572	115.921	211.486	1.000										
	COMPOSITION SHIFTING (MOL/100 GM)																						
52.10 H	.0015	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003										
9.33 H2O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000										
.00 H2	11.6223	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6229										
-57.80 H2O	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500										
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000										
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000										

SYSTEM LIQUID PROPELLANT													PC 10000 .PSIA			
		COMPONENT		TREF FORMULA		DENSITY	HEAT FURN		WT. O/F							
		DEG K		DEG K		G/CC	(KCAL/FORM.WT.)		68.							
		LOX		90.2 02		1.14	-3.08		32.							
		LM2		20.4 H ₂		0.701	-1.887									
FROZEN EXPANSION																
C STAR = 7865.0 FT/SEC																
DEL VAC																
I SEA																
I AT																
I VAC																
CF SEA																
CF VAC																
LVL																
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY K CAL/1000GM	CP CAL/GM	I OPT DELVAC	I SEA	I AT	I VAC	CF SEA	CF VAC	LVL				
1.000	1.000	1000.000	1079.6	-70.91	1.412	173.0	133.2	.244	302.6	303.7	305.8	306.2	1.238	1.253		
1.000	1.835	945.088	1079.6	-70.91	1.412	173.0	133.2	.244	302.6	303.7	305.8	306.2	1.238	1.253		
2.000	10.352	96.601	1138.1	-140.18	1.289	306.0	49.9	.516	349.2	351.5	355.9	356.8	1.429	1.460		
3.000	10.805	93.516	969.0	-105.40	1.251	335.2	39.6	.740	363.9	367.2	373.5	376.8	1.501	1.534		
4.000	29.715	33.513	864.0	-178.63	1.230	351.7	30.4	.959	370.7	375.1	383.6	387.4	1.511	1.547		
5.000	40.801	24.400	800.0	-212.44	1.212	367.2	25.3	1.000	370.7	375.1	383.6	387.4	1.511	1.547		
6.000	53.931	18.942	736.4	-196.14	1.205	370.7	27.3	1.471	376.0	382.5	395.1	397.6	1.539	1.572		
7.000	67.713	14.768	693.0	-199.35	1.197	376.4	25.3	1.711	376.0	381.1	398.7	401.7	1.541	1.644		
8.000	82.725	12.088	657.6	-203.59	1.191	381.3	23.7	1.959	384.8	401.4	404.9			1.657		
9.000	98.381	9.848	617.8	-207.82	1.184	387.2	21.6	2.201		401.9	407.7			1.689		
10.000	115.496	8.673	602.4	-210.14	1.183	388.7	21.3	2.452		405.8	409.9			1.729		
11.000	133.173	7.509	583.2	-212.76	1.181	391.6	20.3	2.707		407.3	411.9			1.806		
12.000	151.771	6.589	560.7	-215.06	1.178	394.1	19.5	2.962		408.6	415.7			1.893		
13.000	170.928	5.891	543.4	-217.10	1.176	396.3	18.8	3.196		409.7	415.2			1.918		
14.000	190.400	5.252	527.8	-218.93	1.174	398.4	18.2	3.441		410.7	416.6			1.705		
15.000	210.106	4.740	513.7	-220.58	1.173	400.2	17.6	3.701		411.5	417.8			1.710		
16.000	229.901	4.350	500.9	-222.08	1.171	401.8	17.1	3.933		412.2	418.9			1.714		
17.000	249.701	4.005	489.2	-223.45	1.170	403.3	16.6	4.156		412.9	419.8			1.718		
18.000	269.501	3.718	478.4	-224.72	1.168	404.7	16.2	4.377		413.3	420.9			1.722		
19.000	289.301	3.482	468.3	-225.89	1.167	405.9	15.8	4.602		413.8	421.6			1.726		
20.000	319.101	3.288	459.1	-226.97	1.166	407.1	15.5	4.947		414.1	422.7			1.729		
21.000	348.901	3.124	450.0	-227.98	1.165	408.2	15.1	5.210		414.4	423.3			1.732		
22.000	369.030	2.910	442.3	-228.93	1.164	409.3	14.8	5.474		414.7	424.0			1.736		
23.000	394.171	2.537	434.7	-229.81	1.163	410.1	14.5	5.731		414.9	424.6			1.738		
24.000	419.522	2.384	427.5	-230.65	1.162	411.0	14.3	5.986		415.0	425.1			1.740		
25.000	445.006	2.267	420.1	-231.43	1.161	411.8	14.0	6.237		415.2	425.8			1.742		
26.000	470.548	2.170	412.4	-232.17	1.160	412.6	13.8	6.488		415.4	426.5			1.744		
27.000	496.093	2.016	408.3	-232.87	1.159	413.3	13.6	6.723		415.6	426.9			1.747		
28.000	521.578	1.917	402.5	-233.56	1.158	414.0	13.3	6.957		415.8	427.4			1.749		
29.000	546.963	1.828	397.1	-234.17	1.158	414.7	13.1	7.186		415.9	427.8			1.751		
30.000	572.213	1.748	391.9	-234.76	1.157	415.4	12.9	7.408		416.0	428.1			1.753		
31.000	597.308	1.677	386.9	-235.35	1.156	416.1	12.8	7.624		416.1	428.7			1.754		
32.000	622.230	1.607	382.1	-235.90	1.156	416.5	12.6	7.834		416.2	429.1			1.756		
33.000	650.110	1.538	377.6	-236.43	1.155	417.1	12.4	8.076		416.3	429.5			1.757		
34.000	680.040	1.471	373.2	-236.96	1.154	417.6	12.3	8.360		416.4	429.8			1.760		
35.000	710.020	1.408	368.0	-237.47	1.154	418.1	12.2	8.600		416.5	430.2			1.762		
36.000	741.185	1.349	363.0	-237.88	1.153	418.6	12.0	8.888		416.6	430.5			1.766		
37.000	772.342	1.295	361.1	-238.33	1.153	419.0	11.8	9.136		416.7	430.9			1.763		
38.000	803.649	1.244	357.3	-238.76	1.152	419.5	11.7	9.396		416.8	431.2			1.764		
39.000	835.097	1.195	353.7	-239.18	1.152	419.9	11.6	9.647		416.9	431.5			1.766		
40.000	867.766	1.152	350.3	-239.58	1.151	420.3	11.4	9.921		417.0	431.8			1.767		
41.000	900.177	1.111	346.9	-239.97	1.151	420.7	11.3	10.183		417.1	432.0			1.768		
42.000	932.791	1.072	343.6	-240.34	1.150	421.1	11.2	10.443		417.2	432.3			1.769		
43.000	965.610	1.036	340.1	-240.71	1.150	421.5	11.1	10.702		417.3	432.6			1.771		
44.000	998.654	1.003	336.7	-241.07	1.149	421.9	11.0	10.960		417.4	432.8			1.773		
45.000	1031.750	.969	333.5	-241.40	1.149	422.2	10.9	11.213		417.5	433.1			1.772		
46.000	1065.018	.939	331.4	-241.73	1.148	422.6	10.8	11.466		417.6	433.3			1.773		
47.000	1098.387	.910	328.8	-242.05	1.148	422.9	10.7	11.717		417.7	433.5			1.774		
48.000	1131.851	.881	326.1	-242.36	1.147	423.2	10.6	11.968		417.8	433.7			1.775		
49.000	1165.329	.858	323.4	-242.66	1.147	423.5	10.5	12.210		417.9	434.0			1.776		
50.000	1198.861	.834	320.9	-242.96	1.147	423.8	10.4	12.453		418.0	434.2			1.777		
7.024	68.046	14.696	692.1	-199.46	1.197	376.5	25.2	1.710	376.5	384.1	398.8	401.8	1.541	1.644		

SHIPPING EXPANSION														
C STAR = 7865.0 FT/SEC														
DEL VAC														
I SEA														
I AT														
I VAC														
CF SEA														
CF VAC														
LVL														
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY K CAL/1000GM	CP DEG	I OPT DELVAC	I SEA	I AT	I VAC	CF SEA	CF VAC	LVL		
1.000	1.000	1000.000	1919.3	-36.50	1.464	172.9	133.4	.244	302.7	303.8	305.9	306.3	1.253	1.238
2.000	10.355	96.611	1138.6	-140.22	1.289	307.0	49.9	.516	349.2	351.5	355.9	356.8	1.429	1.459
3.000	10.809	93.522	969.3	-105.43	1.251	336.0	39.6	.740	364.0	367.3	373.6	376.9	1.501	1.533
4.000	29.722	33.523	864.3	-178.67	1.230	351.0	33.6	1.000	370.7	375.1	383.7	385.4	1.516	1.576
5.000	40.811	24.503	791.6	-187.54	1.215	362.5	30.0	1.223	374.1	379.9	390.4	392.5	1.532	1.605
6.000	53.942	18.939	716.7	-196.19	1.205	374.0	27.3	1.472	376.1	382.6	395.2	397.7	1.538	1.627
7.000	67.725	14.769	678.8	-199.38	1.197	376.5	25.3	1.711	376.6	382.2	398.8	401.9	1.540	1.657
8.000	82.741	12.086	638.8	-203.64	1.192	381.3	23.7	1.959		401.7	405.0			1.657
9.000	98.401	10.622	602.1	-207.17	1.187	385.3	22.4	2.201		403.9	407.7			1.688
10.000	115.518	8.672	602.6	-210.20	1.183	388.7	21.3	2.453		405.8	410.0			1.677
11.000	133.198	7.510	583.9	-212.80	1.180	391.6	20.3	2.707		407.4	411.9			1.729
12.000	151.798	6.590	560.9	-215.11	1.178	394.2	19.5	2.963		408.7	413.7			1.692
13.000	170.935	5.850	543.6	-217.16	1.176	396.5	18.8	3.215		409.8	415.3			1.699
14.000	190.433	5.251	528.0	-218.99	1.174	398.5	18.2	3.462		410.7	416.6			1.704
15.000	210.141	4.750	514.0	-220.64	1.172	400.5	17.6	3.702		411.6	417.9			1.709
16.000	229.937	4.400	500.1	-222.14	1.170	402.5	17.1	3.940		412.5	419.0			1.714
17.000	249.739	4.050	489.4	-223.51	1.170	403.4	16.6	4.158		413.4	420.0			1.718
18.000	272.337	3.672	478.6	-224.78	1.168	404.7	16.2	4.418		413.8	420.9			1.722
19.000	295.736	3.381	468.5	-225.95	1.167	406.0	15.8	4.683		413.8	421.8			1.725
20.000	319.738	3.122	459.2	-226.97	1.166	407.1	15.5	4.948		413.9	422.6			1.729
21.000	344.241	2.905	450.6	-227.98	1.165	408.2	15.1	5.212		414.5	423.4			1.732
22.000	369.091	2.709	442.5	-228.99	1.164	409.2	14.8	5.474		414.7	424.1			1.735
23.000	394.234	2.537	434.8	-229.87	1.163	410.2	14.5	5.733		414.9	424.7			1.737
24.000	419.587	2.387	427.7	-230.71	1.162	411.1	14.3	5.990		415.0	425.1			1.740
25.000	445.076	2.267	420.9	-231.49	1.161	411.9	14.0	6.239		415.3	425.9			1.742
26.000	470.623	2.125	415.4	-232.23	1.160	412.7	13.8	6.485		415.6	426.4			1.744
27.000	496.168	2.015	408.5	-232.96	1.159	413.4	13.6	6.725		415.8	427.0			1.746
28.000	521.805	1.916	402.3	-233.60	1.158	414.0	13.4	6.967		416.0	427.4			1.748
29.000	547.443	1.828	397.2	-234.24	1.158	414.6	13.1	7.188						

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 73.
 LM2 20.4 H2 0.071 -1.887 27.

BULK DENSITY = .225 GM/CC
 MIXTURE RATIO = 2.704 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 609.47 EU/100GMS

	CHAMBER										THROAT										
	FROZEN EXPANSION																				
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	549.8								
TEMP, DEG K	2304.5	1906.7	1563.8	1269.2	1018.9	892.4	810.0	638.9	501.3	391.8	305.3	234.5	2039.5								
ENTHALPY (-)	32.30	83.82	126.27	160.92	188.90	202.52	211.24	228.94	242.86	253.75	262.25	269.13	66.87								
CP	1.3213	1.2665	1.2078	1.1440	1.0914	1.0657	1.0503	1.0203	1.0022	.9881	.9767	.9671	1.2870								
IMPUL OPT		211.72	285.93	334.52	369.10	384.82	394.56	413.61	427.99	438.93	447.27	453.92	173.42								
IMPUL VAC		316.05	349.29	378.47	401.08	411.69	418.34	431.50	441.56	449.27	455.18	459.90	309.66								
EPSILON		1.058	1.613	2.811	5.137	7.377	9.597	18.139	34.545	66.134	127.013	241.480	1.000								
	SHIFTING EXPANSION																				
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	551.2								
TEMP, DEG K	2304.5	1911.6	1568.8	1273.6	1022.7	895.9	813.2	641.6	503.4	393.5	306.7	235.7	2044.7								
ENTHALPY (-)	32.30	83.89	126.44	161.19	189.25	202.91	211.66	229.43	243.40	254.33	262.87	269.77	66.75								
X BAR	13.400	13.394	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393								
N	13.400	13.394	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393								
CP	1.3629	1.2748	1.2095	1.1449	1.0920	1.0664	1.0506	1.0203	1.0022	.9876	.9759	.9673	1.3027								
IMPUL OPT		211.85	286.18	334.86	369.51	385.27	395.02	414.12	428.54	439.51	447.87	454.52	173.13								
IMPUL VAC		316.33	349.65	378.90	401.56	412.19	418.86	432.06	442.15	449.87	455.80	460.53	309.90								
EPSILON		1.058	1.614	2.813	5.142	7.385	9.608	18.161	34.592	66.229	127.219	241.984	1.000								
	COMPOSITION SHIFTING (MOL/100 GM)																				
52.10 H	.0130	.0018	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0039								
9.33 H2O	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002								
.00 H2	8.8244	8.8295	8.8303	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8285								
-57.80 H2O	4.5614	4.5624	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5623								
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000								
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000								

SYSTEM LIQUID BIPROPELLANT
COMPONENT TREF FORMULA
PC 1000, PSIA
DENSITY
GR/CC
HEAT FORM
(KCAL/FORM.WT.)
WT. 0/0

LOX
LM2
DEG K
20.4 M2
0.071
-1.887

PC STAR = 7973.4 FT/SEC

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL / I OPT	DELTVAC	DELTVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
				DEG K	GM DEG	/P	/P	LVL	10000	50000		LVL	
1.000	1.000	1000.000	2304.5	-12.30	1.331	173.4	136.2	306.0	307.1	309.2	309.7	1.235	1.250
2.000	1.819	549.776	2039.5	-66.87	1.287	309.4	52.7	354.5	356.0	361.2	362.1	1.430	1.461
3.000	9.889	101.123	1634.3	-141.79	1.181	339.0	42.3	370.3	373.6	380.0	381.3	1.494	1.539
4.000	17.685	56.565	1239.1	-184.56	1.138	356.8	36.3	378.1	382.6	390.9	392.6	1.524	1.584
5.000	28.013	35.472	1115.6	-178.26	1.112	367.8	32.9	381.6	387.4	398.1	400.2	1.561	1.615
6.000	38.404	26.038	1028.9	-187.80	1.094	376.2	29.6	383.9	390.5	403.3	405.9	1.599	1.638
7.000	50.340	19.865	962.6	-194.99	1.080	382.7	27.5	392.4	407.3	410.3	415.2	1.552	1.655
8.000	63.101	15.867	909.8	-200.67	1.069	388.0	25.9	393.4	410.4	413.8	418.8	1.602	1.670
9.000	76.731	13.032	866.2	-205.31	1.061	392.3	24.5	393.9	413.0	416.8	421.6	1.652	1.701
10.000	91.145	10.969	829.4	-209.20	1.054	396.0	23.3	401.1	415.1	419.3	424.0	1.701	1.721
11.000	106.315	9.406	797.8	-212.52	1.048	399.1	22.3	408.5	416.8	421.5	426.0	1.751	1.772
12.000	122.566	8.159	770.1	-215.42	1.043	401.9	21.5	410.5	419.3	424.0	428.6	1.772	1.792
13.000	139.525	7.167	745.6	-217.97	1.038	404.4	20.7	412.6	421.6	426.0	430.6	1.792	1.812
14.000	157.051	6.367	723.7	-220.24	1.035	406.5	20.1	414.8	423.8	428.6	433.2	1.812	1.832
15.000	174.958	5.714	704.0	-222.27	1.031	408.5	19.4	416.8	425.9	430.6	435.2	1.832	1.852
16.000	193.232	5.175	686.0	-224.12	1.028	410.5	18.9	418.4	427.4	433.2	437.8	1.852	1.872
17.000	211.636	4.725	669.7	-225.80	1.025	411.9	18.4	419.3	428.6	435.2	440.9	1.872	1.892
18.000	230.120	4.366	654.6	-227.33	1.023	413.4	18.0	420.4	429.8	437.8	443.9	1.892	1.912
19.000	248.619	4.022	640.8	-228.75	1.021	414.8	17.5	421.6	430.6	439.2	446.9	1.912	1.932
20.000	269.449	3.711	627.9	-230.06	1.019	416.1	17.1	423.8	431.6	440.9	449.2	1.932	1.952
21.000	291.175	3.434	615.9	-231.28	1.017	417.4	16.8	425.9	433.2	443.9	451.6	1.952	1.972
22.000	313.356	3.191	604.7	-232.42	1.015	418.4	16.5	427.4	435.2	446.9	454.0	1.972	1.992
23.000	336.041	2.976	594.3	-233.49	1.014	419.3	16.3	428.6	437.8	449.2	456.4	1.992	2.012
24.000	359.041	2.785	584.4	-234.49	1.013	420.4	16.0	429.8	440.9	451.6	458.8	2.012	2.032
25.000	382.324	2.616	575.1	-235.43	1.011	421.6	15.8	430.6	443.9	454.0	461.2	2.032	2.052
26.000	405.825	2.466	566.3	-236.31	1.010	422.7	15.6	431.6	446.9	456.4	463.6	2.052	2.072
27.000	429.418	2.328	558.0	-237.15	1.009	423.8	15.3	432.6	449.2	458.8	466.0	2.072	2.092
28.000	453.224	2.204	550.1	-237.95	1.008	424.8	15.1	433.2	451.6	461.2	468.4	2.092	2.112
29.000	477.058	2.096	542.7	-238.70	1.007	425.9	14.8	434.3	454.0	463.6	470.8	2.112	2.132
30.000	500.783	1.997	535.5	-239.42	1.006	426.9	14.6	435.2	456.4	466.0	473.2	2.132	2.152
31.000	524.507	1.907	528.7	-240.11	1.005	427.4	14.4	436.2	458.8	468.4	475.6	2.152	2.172
32.000	548.147	1.824	522.2	-240.76	1.005	428.6	14.2	437.8	461.2	470.8	478.0	2.172	2.192
33.000	571.674	1.749	516.0	-241.38	1.004	429.8	14.0	438.4	463.6	473.2	480.4	2.192	2.212
34.000	595.075	1.680	510.0	-241.98	1.003	430.6	13.8	439.2	466.0	475.6	482.8	2.212	2.232
35.000	618.334	1.617	504.3	-242.55	1.003	431.6	13.7	440.9	468.4	478.0	485.2	2.232	2.252
36.000	641.425	1.554	498.8	-243.10	1.002	432.6	13.5	441.6	470.8	480.4	487.6	2.252	2.272
37.000	664.125	1.490	493.5	-243.63	1.001	433.2	13.3	442.6	473.2	482.8	490.0	2.272	2.292
38.000	687.026	1.430	488.4	-244.14	1.000	434.3	13.2	443.2	475.6	485.2	492.4	2.292	2.312
39.000	710.027	1.374	483.5	-244.63	1.000	435.2	13.0	444.3	478.0	487.6	494.8	2.312	2.332
40.000	733.128	1.322	478.8	-245.11	1.000	436.2	12.9	445.2	480.4	490.0	497.2	2.332	2.352
41.000	756.457	1.273	474.2	-245.56	1.000	437.8	12.8	446.2	482.8	492.4	499.6	2.352	2.372
42.000	780.007	1.227	469.8	-246.01	1.000	438.4	12.6	447.4	485.2	494.8	502.0	2.372	2.392
43.000	803.678	1.184	465.5	-246.43	1.000	439.2	12.5	448.4	487.6	497.2	504.4	2.392	2.412
44.000	827.470	1.144	461.4	-246.84	1.000	440.9	12.4	449.2	490.0	499.6	506.8	2.412	2.432
45.000	851.383	1.106	457.4	-247.24	1.000	441.6	12.3	450.4	492.4	502.0	509.2	2.432	2.452
46.000	875.418	1.070	453.5	-247.63	1.000	442.6	12.1	451.6	494.8	504.4	511.6	2.452	2.472
47.000	899.575	1.036	449.7	-248.01	1.000	443.2	12.0	452.6	497.2	506.8	514.0	2.472	2.492
48.000	923.854	1.004	446.1	-248.37	1.000	444.3	11.9	453.2	499.6	509.2	516.4	2.492	2.512
49.000	948.254	0.974	442.5	-248.72	1.000	445.2	11.8	454.3	502.0	511.6	518.8	2.512	2.532
50.000	972.775	0.946	438.9	-249.07	1.000	446.2	11.7	455.2	504.4	514.0	521.2	2.532	2.552
51.000	997.418	0.919	435.7	-249.40	1.000	447.4	11.6	456.2	506.8	516.4	523.6	2.552	2.572
52.000	1022.183	0.894	432.4	-249.72	1.000	448.4	11.5	457.4	509.2	518.8	526.0	2.572	2.592
53.000	1047.068	0.870	429.1	-250.03	1.000	449.2	11.4	458.4	511.6	521.2	528.4	2.592	2.612
54.000	1072.073	0.846	425.8	-250.33	1.000	450.4	11.3	459.2	514.0	523.6	530.8	2.612	2.632
55.000	1097.198	0.823	422.4	-250.62	1.000	451.6	11.2	460.4	516.4	526.0	533.2	2.632	2.652
56.000	1122.443	0.800	419.0	-250.90	1.000	452.6	11.1	461.6	518.8	528.4	535.6	2.652	2.672
57.000	1147.808	0.778	415.5	-251.17	1.000	453.2	11.0	462.6	521.2	530.8	538.0	2.672	2.692
58.000	1173.293	0.756	412.0	-251.43	1.000	454.3	10.9	463.2	523.6	533.2	540.4	2.692	2.712
59.000	1198.898	0.734	408.4	-251.68	1.000	455.2	10.8	464.3	526.0	535.6	542.8	2.712	2.732
60.000	1224.623	0.712	404.8	-251.92	1.000	456.2	10.7	465.2	528.4	538.0	545.2	2.732	2.752
61.000	1250.468	0.690	401.1	-252.15	1.000	457.4	10.6	466.2	530.8	540.4	547.6	2.752	2.772
62.000	1276.433	0.668	397.4	-252.37	1.000	458.4	10.5	467.4	533.2	542.8	550.0	2.772	2.792
63.000	1302.518	0.646	393.7	-252.58	1.000	459.2	10.4	468.4	535.6	545.2	552.4	2.792	2.812
64.000	1328.723	0.624	389.9	-252.78	1.000	460.4	10.3	469.2	538.0	547.6	554.8	2.812	2.832
65.000	1355.048	0.602	386.1	-252.97	1.000	461.6	10.2	470.4	540.4	550.0	557.2	2.832	2.852
66.000	1381.493	0.580	382.4	-253.15	1.000	462.6	10.1	471.6	542.8	552.4	559.6	2.852	2.872
67.000	1408.058	0.558	378.6	-253.32	1.000	463.2	10.0	472.6	545.2	554.8	562.0	2.872	2.892
68.000	1434.743	0.536	374.8	-253.48	1.000	464.3	9.9	473.2	547.6	557.2	564.4	2.892	2.912
69.000	1461.548	0.514	370.9	-253.63	1.000	465.2	9.8	474.3	550.0	559.6	566.8	2.912	2.932
70.000	1488.473	0.492	367.0	-253.77	1.000	466.2	9.7	475.2	552.4	562.0	569.2	2.932	2.952
71.000	1515.518	0.470	363.1	-253.90	1.000	467.4	9.6	476.2	554.8	564.4	571.6	2.952	2.972
72.000	1542.683	0.448	359.2	-254.02	1.000	468.4	9.5	477.4	557.2	566.8	574.0	2.972	2.992
73.000	1569.968	0.426	355.3	-254.13	1.000	469.2	9.4	478.4	559.6	569.2	576.4	2.992	3.012
74.000	1597.373	0.404	351.4	-254.23	1.000	470.4	9.3	479.2	562.0	571.6	578.8	3.012	3.032
75.000	1624.898	0.382	347.4	-254.32	1.000	471.6	9.2	480.4	564.4	574.0	581.2	3.032	3.052
76.000	1652.543	0.360	343.5	-254.40	1.000	472.6	9.1	481.6	566.8	576.4	583.6	3.052	3.072
77.000	1680.308	0.338	339.5	-254.47	1.000	473.2	9.0	482.6	569.2	578.8	586.0	3.072	3.092
78.000	1708.193	0.316	335.6	-254.53	1.000	474.3	8.9	483.2	571.6	581.2	588.4	3.092	3.112
79.000	1736.198	0.294	331.6	-254.58	1.000	475.2	8.8	484.3	574.0	583.6	590.8	3.112	3.132
80.000	1764.323	0.272	327.6	-254.62	1.000	476.2	8.7	485.2	576.4	586.0	593.2	3.132	3.152
8													

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 80.
 LM2 20.4 H2 0.071 -1.887 20.

BULK DENSITY = .284 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 513.80 EU/100GMS

	CHAMBER											THROAT
	FROZEN EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 557.3
TEMP, DEG K	2976.0	2513.5	2110.5	1759.2	1453.5	1294.5	1188.4	961.3	769.9	611.4	482.5	379.2 2675.0
ENTHALPY (-)	26.42	76.58	118.83	154.19	183.54	198.17	207.67	227.30	243.10	255.69	265.68	273.51 59.24
CP	1.1002	1.0671	1.0282	.9834	.9347	.9053	.8853	.8420	.8082	.7828	.7654	.7527 1.0798
IMPUL OPT		208.89	283.55	333.40	369.72	386.55	397.09	418.04	434.17	446.61	456.23	463.64 168.98
IMPUL VAC		312.96	347.92	379.04	403.72	415.51	422.98	437.93	449.51	458.45	465.38	470.72 305.90
EPSILON		1.064	1.653	2.944	5.510	8.022	10.536	20.333	39.384	76.382	148.208	287.922 1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100 561.8
TEMP, DEG K	2976.0	2570.7	2184.8	1831.9	1519.5	1356.4	1247.2	1012.7	813.9	648.4	513.0	403.9 2720.7
ENTHALPY (-)	26.42	77.03	120.23	156.65	187.02	202.20	212.08	232.54	249.07	262.30	272.80	281.09 59.00
X BAR	10.005	9.949	9.927	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921 9.965
N	10.005	9.949	9.927	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921 9.965
CP	1.4346	1.2144	1.0774	.9998	.9458	.9155	.8947	.8506	.8139	.7855	.7667	.7527 1.2878
IMPUL OPT		209.82	285.67	336.59	373.78	391.05	401.89	423.46	440.11	453.00	462.97	470.70 168.35
IMPUL VAC		315.20	351.31	383.27	408.65	420.80	428.51	443.97	455.97	465.27	472.48	478.06 307.57
EPSILON		1.068	1.671	2.985	5.601	8.168	10.740	20.789	40.382	78.507	152.679	296.996 1.000
	COMPOSITION SHIFTING (MGL/100 GM)											
52.10 H	.1236	.0455	.0109	.0016	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0691
9.33 H+O	.0426	.0108	.0016	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0191
.00 H2	4.8813	4.9034	4.9160	4.9199	4.9206	4.9206	4.9206	4.9206	4.9206	4.9206	4.9206	4.9206 4.8959
-57.80 H2+O	4.9562	4.9891	4.9984	4.9999	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000	5.0000 4.9806
59.56 O	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0002
.00 O2	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000 .0001

SYSTEM LIQUID BIPROPELLANT										PC 1000, PSIA										HEAT FORM										WT. 8/0									
COMPONENT										DENSITY										(KCAL/FORM.WT.)										80.									
TREF FORMULA										GN/CC										1.14										-3.08									
DEG K										0.071										-1.687										20.									
LOX										20.4 H2																													
LM2																																							
FROZEN EXPANSION										C STAR = 7905.6 FT/SEC																													
C STAR = 7905.6 FT/SEC										I SEA										I AT										I VAC									
I SEA										I AT										I VAC										CF SEA									
I AT										I VAC										CF SEA										CF VAC									
I VAC										CF SEA										CF VAC																			
CF SEA																																							
CF VAC																																							
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PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/G
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 85.
 LM2 20.4 H2 0.071 -1.887 15.

BULK DENSITY = .350 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 438.04 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	561.4
TEMP, DEG K	3452.1	2951.5	2513.1	2128.4	1790.9	1613.8	1494.7	1235.4	1010.2	817.3	654.9	520.7	3130.6
ENTHALPY (-)	22.22	67.57	106.25	139.11	166.84	180.89	190.10	209.42	225.31	238.23	248.64	256.95	51.47
CP	.9165	.8941	.8689	.8388	.8037	.7817	.7651	.7241	.6866	.6542	.6282	.6102	.9030
IMPUL OPT		198.62	270.37	318.88	354.71	371.53	382.17	403.56	420.34	433.50	443.82	451.89	159.52
IMPUL VAC		298.17	332.64	363.60	388.53	400.63	408.37	424.07	436.44	446.13	453.71	459.61	290.99
EPSILON		1.068	1.678	3.026	5.750	8.455	11.188	21.996	43.378	85.478	168.050	329.634	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	572.6
TEMP, DEG K	3452.1	3120.1	2792.5	2458.9	2124.0	1935.9	1806.4	1519.2	1265.0	1042.3	849.7	686.0	3249.7
ENTHALPY (-)	22.22	68.43	109.40	145.44	176.71	192.81	203.45	226.07	244.99	260.67	273.51	283.94	50.85
X BAR	7.749	7.621	7.527	7.471	7.448	7.443	7.442	7.441	7.440	7.440	7.440	7.440	7.668
N	7.749	7.621	7.527	7.471	7.448	7.443	7.442	7.441	7.440	7.440	7.440	7.440	7.668
CP	2.0055	1.6647	1.3203	1.0496	.8909	.8388	.8124	.7654	.7229	.6848	.6509	.6228	1.8035
IMPUL OPT		200.50	275.40	327.41	366.61	385.23	397.07	421.12	440.23	455.46	467.57	477.17	157.80
IMPUL VAC		303.03	341.38	375.92	403.91	417.57	426.34	444.32	458.71	470.18	479.26	486.41	294.32
EPSILON		1.080	1.746	3.225	6.229	9.229	12.276	24.450	48.918	97.860	195.216	387.902	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.2630	.1740	.0965	.0400	.0109	.0041	.0018	.0002	.0000	.0000	.0000	.0000	.2081
9.33 H*O	.2807	.1580	.0693	.0205	.0035	.0009	.0003	.0000	.0000	.0000	.0000	.0000	.2029
.00 H2	2.1908	2.1421	2.1202	2.1190	2.1243	2.1264	2.1272	2.1279	2.1280	2.1280	2.1280	2.1280	2.1581
-57.80 H2*O	4.9778	5.1324	5.2374	5.2913	5.3090	5.3116	5.3122	5.3125	5.3125	5.3125	5.3125	5.3125	5.0769
59.56 C	.0193	.0076	.0019	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0114
.00 O2	.0174	.0073	.0019	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0107

PRESSURE PROFILE DATA
SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA

COMPONENT	TREF FORMULA DEG K	DENSITY GM/CC	HEAT FORM (KCAL/FORM.WT.)	WT. 0/0
LOX	90.2 02	1.14	-3.08	90.
LH2	20.4 H2	.071	-1.887	10.

BULK DENSITY = .455 GM/CC
MIXTURE RATIO = 9.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 354.89 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	396.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	562.4
TEMP, DEG K	3578.7	3074.3	2631.3	2242.1	1899.4	1719.2	1597.9	1332.7	1100.6	899.2	727.1	582.6	3255.9
ENTHALPY (-)	18.02	53.50	83.93	109.90	131.99	143.24	150.63	166.26	179.23	189.88	198.55	205.52	40.82
CP	.7105	.6954	.6774	.6562	.6317	.6158	.6039	.5737	.5434	.5151	.4918	.4737	.7013
IMPUL OPT		175.68	239.45	282.72	314.88	330.05	339.66	359.11	374.49	386.67	396.30	403.88	140.82
IMPUL VAC		263.98	294.89	322.74	345.32	356.33	363.40	377.84	389.32	398.40	405.56	411.16	257.48
EPSILON		1.069	1.687	3.057	5.841	8.622	11.443	22.675	45.103	89.655	177.678	350.881	1.000
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	576.4
TEMP, DEG K	3578.7	3292.4	3031.6	2787.6	2551.7	2414.0	2313.5	2063.8	1803.0	1546.5	1309.4	1096.8	3403.9
ENTHALPY (-)	18.02	54.30	87.01	116.54	143.21	157.48	167.19	188.57	207.34	223.57	237.58	249.02	40.17
X BAR	5.837	5.711	5.598	5.500	5.417	5.378	5.355	5.316	5.298	5.294	5.293	5.293	5.760
N	5.836	5.711	5.598	5.500	5.417	5.378	5.355	5.316	5.298	5.294	5.293	5.293	5.760
CP	2.1551	2.0314	1.8472	1.6117	1.3380	1.1726	1.0579	.8232	.6770	.6049	.5638	.5318	2.0897
IMPUL OPT		177.64	244.99	292.76	330.02	348.32	360.24	385.19	405.84	422.87	436.85	448.29	138.82
IMPUL VAC		269.16	304.88	338.03	366.22	380.54	389.97	409.81	428.19	439.61	450.57	459.48	260.93
EPSILON		1.085	1.784	3.387	6.804	10.349	14.032	29.193	60.607	125.202	257.710	528.421	1.000
	COMPOSITION SHIFTING (MOL/100 GM)												
52.10 H	.1386	.0985	.0648	.0380	.0188	.0108	.0067	.0014	.0001	.0000	.0000	.0000	.1738
9.33 H2O	.6294	.4991	.3802	.2739	.1809	.1339	.1039	.0472	.0152	.0032	.0004	.0000	.5501
.00 H2	.4572	.3616	.2701	.1854	.1112	.0750	.0532	.0175	.0033	.0003	.0000	.0000	.3996
-57.80 H2O	4.1192	4.3000	4.4677	4.6190	4.7494	4.8130	4.8519	4.9185	4.9493	4.9584	4.9601	4.9603	4.2288
59.56 O	.1080	.0787	.0542	.0343	.0191	.0124	.0086	.0027	.0005	.0000	.0000	.0000	.0899
.00 O2	.3843	.3736	.3614	.3489	.3378	.3329	.3303	.3283	.3300	.3317	.3322	.3323	.3781

SYSTEM AND/OR REFRIGERANT PS 1998, P1A

COMPONENT	TEMP FORMULA	DENSITY	HEAT FORM	WT. 8/8
DEL K		DE/CC	(KCAL/GRAM.WT.)	
L61	90.3 82	1.16	-3.00	96.
L62	29.5 82	1.07	-1.007	10.

REFRIGERANT

EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	OPT DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
			DEG F	KCAL/TOUCH	DEG			LVL	10000	50000		LVL	
1.000	1.000	1000.000	3578.7	-18.82	2.155	158.8	116.7	257.5	355.5	257.1	257.5	1.227	1.261
2.000	0.802	542.403	3255.9	-40.83	1.701	148.6	107.7	207.7	299.6	203.3	206.0	1.035	1.066
3.000	0.607	341.000	2932.3	-63.56	1.251	138.7	98.3	152.0	215.0	152.0	152.0	0.848	0.882
4.000	0.412	217.511	2611.6	-86.29	0.801	128.8	88.9	102.0	178.0	102.0	102.0	0.661	0.695
5.000	0.217	136.582	2290.9	-109.02	0.351	118.9	79.5	52.0	128.0	52.0	52.0	0.474	0.508
6.000	0.022	24.100	1968.3	-131.81	0.001	109.0	70.1	2.0	128.0	2.0	2.0	0.289	0.323
7.000	0.000	19.084	1645.6	-154.54	0.000	99.1	60.3	0.0	128.0	0.0	0.0	0.104	0.138
8.000	0.000	16.250	1322.9	-177.27	0.000	89.2	50.5	0.0	128.0	0.0	0.0	0.019	0.053
9.000	0.000	13.416	1000.2	-200.00	0.000	79.3	40.7	0.0	128.0	0.0	0.0	0.004	0.038
10.000	0.000	10.582	678.5	-222.73	0.000	69.4	30.9	0.0	128.0	0.0	0.0	0.000	0.023
11.000	0.000	7.748	356.8	-245.46	0.000	59.5	21.1	0.0	128.0	0.0	0.0	0.000	0.008
12.000	0.000	4.914	34.1	-268.19	0.000	49.6	11.3	0.0	128.0	0.0	0.0	0.000	0.000
13.000	0.000	2.080	10.0	-290.92	0.000	39.7	1.5	0.0	128.0	0.0	0.0	0.000	0.000
14.000	0.000	0.246	0.0	-313.65	0.000	29.8	0.0	0.0	128.0	0.0	0.0	0.000	0.000
15.000	0.000	0.000	0.0	-336.38	0.000	19.9	0.0	0.0	128.0	0.0	0.0	0.000	0.000
16.000	0.000	0.000	0.0	-359.11	0.000	10.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
17.000	0.000	0.000	0.0	-381.84	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
18.000	0.000	0.000	0.0	-404.57	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
19.000	0.000	0.000	0.0	-427.30	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
20.000	0.000	0.000	0.0	-450.03	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
21.000	0.000	0.000	0.0	-472.76	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
22.000	0.000	0.000	0.0	-495.49	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
23.000	0.000	0.000	0.0	-518.22	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
24.000	0.000	0.000	0.0	-540.95	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
25.000	0.000	0.000	0.0	-563.68	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
26.000	0.000	0.000	0.0	-586.41	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
27.000	0.000	0.000	0.0	-609.14	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
28.000	0.000	0.000	0.0	-631.87	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
29.000	0.000	0.000	0.0	-654.60	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
30.000	0.000	0.000	0.0	-677.33	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
31.000	0.000	0.000	0.0	-700.06	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
32.000	0.000	0.000	0.0	-722.79	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
33.000	0.000	0.000	0.0	-745.52	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
34.000	0.000	0.000	0.0	-768.25	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
35.000	0.000	0.000	0.0	-790.98	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
36.000	0.000	0.000	0.0	-813.71	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
37.000	0.000	0.000	0.0	-836.44	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
38.000	0.000	0.000	0.0	-859.17	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
39.000	0.000	0.000	0.0	-881.90	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
40.000	0.000	0.000	0.0	-904.63	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
41.000	0.000	0.000	0.0	-927.36	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
42.000	0.000	0.000	0.0	-950.09	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
43.000	0.000	0.000	0.0	-972.82	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
44.000	0.000	0.000	0.0	-995.55	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
45.000	0.000	0.000	0.0	-1018.28	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
46.000	0.000	0.000	0.0	-1041.01	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
47.000	0.000	0.000	0.0	-1063.74	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
48.000	0.000	0.000	0.0	-1086.47	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
49.000	0.000	0.000	0.0	-1109.20	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
50.000	0.000	0.000	0.0	-1131.93	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
51.000	0.000	0.000	0.0	-1154.66	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
52.000	0.000	0.000	0.0	-1177.39	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
53.000	0.000	0.000	0.0	-1200.12	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
54.000	0.000	0.000	0.0	-1222.85	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
55.000	0.000	0.000	0.0	-1245.58	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
56.000	0.000	0.000	0.0	-1268.31	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
57.000	0.000	0.000	0.0	-1291.04	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
58.000	0.000	0.000	0.0	-1313.77	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
59.000	0.000	0.000	0.0	-1336.50	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
60.000	0.000	0.000	0.0	-1359.23	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
61.000	0.000	0.000	0.0	-1381.96	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
62.000	0.000	0.000	0.0	-1404.69	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
63.000	0.000	0.000	0.0	-1427.42	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
64.000	0.000	0.000	0.0	-1450.15	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
65.000	0.000	0.000	0.0	-1472.88	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
66.000	0.000	0.000	0.0	-1495.61	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
67.000	0.000	0.000	0.0	-1518.34	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
68.000	0.000	0.000	0.0	-1541.07	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
69.000	0.000	0.000	0.0	-1563.80	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
70.000	0.000	0.000	0.0	-1586.53	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
71.000	0.000	0.000	0.0	-1609.26	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
72.000	0.000	0.000	0.0	-1631.99	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
73.000	0.000	0.000	0.0	-1654.72	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
74.000	0.000	0.000	0.0	-1677.45	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
75.000	0.000	0.000	0.0	-1700.18	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
76.000	0.000	0.000	0.0	-1722.91	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
77.000	0.000	0.000	0.0	-1745.64	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
78.000	0.000	0.000	0.0	-1768.37	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
79.000	0.000	0.000	0.0	-1791.10	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
80.000	0.000	0.000	0.0	-1813.83	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
81.000	0.000	0.000	0.0	-1836.56	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
82.000	0.000	0.000	0.0	-1859.29	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
83.000	0.000	0.000	0.0	-1882.02	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
84.000	0.000	0.000	0.0	-1904.75	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
85.000	0.000	0.000	0.0	-1927.48	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000
86.000	0.000	0.000	0.0	-1950.21	0.000	0.0	0.0	0.0	128.0	0.0	0.0	0.000	0.000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 68.
 LM2 20.4 H2 0.071 -1.887 32.

BULK DENSITY = .196 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 709.03 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.3
TEMP, DEG K	1918.8	1607.8	1336.5	1101.5	944.7	901.0	732.5	592.7	477.9	384.7	308.9	245.5	1680.9
ENTHALPY (-)	36.50	80.93	118.04	148.75	168.55	173.98	194.55	211.22	224.70	235.54	244.26	251.48	70.65
CP	1.4574	1.3981	1.3347	1.2803	1.2451	1.2366	1.2041	1.1825	1.1685	1.1560	1.1448	1.1347	1.4127
IMPUL OPT		196.61	266.35	312.51	338.95	345.84	370.81	389.87	404.64	416.12	425.14	432.47	172.38
IMPUL VAC		308.84	335.21	360.88	377.20	381.59	397.92	410.74	420.85	428.81	435.11	440.26	306.20
EPSILON		1.023	1.398	2.186	3.196	3.599	6.076	10.414	18.018	31.411	54.977	95.654	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	164.5
TEMP, DEG K	1918.8	1608.7	1337.3	1102.3	945.4	901.7	733.0	593.2	478.3	385.0	309.2	245.8	1682.3
ENTHALPY (-)	36.50	80.94	118.07	148.81	168.62	174.04	194.63	211.31	224.81	235.65	244.37	251.61	70.59
X BAR	15.874	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873
N	15.874	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873	15.873
CP	1.4691	1.3997	1.3349	1.2805	1.2451	1.2368	1.2044	1.1825	1.1683	1.1563	1.1445	1.1349	1.4157
IMPUL OPT		196.64	266.40	312.58	339.03	345.92	370.90	389.98	404.75	416.24	425.26	432.60	172.21
IMPUL VAC		308.90	335.29	360.97	377.30	381.69	398.02	410.85	420.97	428.93	435.24	440.39	306.27
EPSILON		1.023	1.398	2.186	3.196	3.599	6.077	10.415	18.020	31.414	54.985	95.674	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
52.10 H	.0027	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
9.33 H2O	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 H2	11.6217	11.6229	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6230	11.6228
-57.80 H2O	4.2499	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500	4.2500
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 73.
 LH2 20.4 H2 0.071 -1.887 27.

BULK DENSITY = .225 GM/CC
 MIXTURE RATIO = 2.704 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 641.54 EU/100GMS

	CHAMBER										THROAT												
	FROZEN EXPANSION																						
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.8										
TEMP, DEG K	2299.8	1951.3	1644.7	1375.9	1192.9	1141.3	939.3	767.8	624.1	505.3	407.9	328.8	2037.5										
ENTHALPY (-)	32.30	77.56	115.83	147.98	168.98	174.77	196.91	215.06	229.86	241.86	251.57	259.36	66.52										
CP	1.3208	1.2735	1.2221	1.1672	1.1275	1.1165	1.0742	1.0421	1.0183	1.0028	.9904	.9800	1.2868										
IMPUL OPT	198.43	269.58	317.24	344.83	352.06	378.42	398.74	414.57	426.98	436.76	444.45	453.03	309.39										
IMPUL VAC	312.39	340.28	367.51	384.92	389.63	407.19	421.06	432.02	440.70	447.58	453.03	309.39											
EPSILON	1.025	1.416	2.242	3.306	3.732	6.364	10.994	19.142	33.511	58.894	103.880	1.000											
	SHIFTING EXPANSION																						
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	165.8										
TEMP, DEG K	2299.8	1959.5	1653.8	1384.3	1200.6	1148.7	945.8	773.3	628.8	509.2	411.1	331.5	2044.7										
ENTHALPY (-)	32.30	77.65	116.08	148.39	169.49	175.32	197.58	215.84	230.73	242.82	252.59	260.44	66.57										
X BAR	13.405	13.395	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.393	13.397										
CP	1.3954	1.2928	1.2262	1.1688	1.1289	1.1178	1.0755	1.0429	1.0185	1.0029	.9901	.9806	1.3150										
IMPUL OPT	198.62	269.98	317.79	345.48	352.74	379.20	399.60	415.49	427.96	437.78	445.51	453.03	309.82										
IMPUL VAC	312.87	340.91	368.23	385.72	390.44	408.07	422.01	433.01	441.73	448.65	454.12	309.82											
EPSILON	1.025	1.418	2.245	3.311	3.738	6.375	11.016	19.184	33.590	59.041	104.163	1.000											
	COMPOSITION SHIFTING (MOL/100 GM)																						
52.10 H	.0232	.0044	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0071										
9.33 H2O	.0020	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004										
.00 H2	8.8198	8.8283	8.8301	8.8303	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8304	8.8270										
-57.80 H2O	4.5605	4.5623	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5625	4.5621										
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000										
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000										

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA									
COMPONENT										DENSITY									
REF FORMULA										HEAT FORM									
LOR										WT. 8/0									
LM2										3.08									
20.4 M2										0.071									
										-1.087									
										27.									
										</									

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 80.
 LM2 20.4 H2 0.071 -1.887 20.

BULK DENSITY = .284 GM/CC
 MIXTURE RATIO = 4.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 537.79 EU/100GMS

	CHAMBER										THROAT	
	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100 168.1
TEMP, DEG K	2926.6	2525.0	2168.9	1853.1	1635.3	1573.2	1325.7	1107.9	918.5	755.9	618.3	503.3 2631.3
ENTHALPY (-)	26.42	69.94	107.42	139.53	160.91	166.87	190.02	209.44	225.60	238.96	249.92	258.86 58.54
CP	1.0976	1.0685	1.0351	.9970	.9658	.9566	.9123	.8715	.8355	.8072	.7852	.7698 1.0769
IMPUL OPT	194.57	265.45	313.68	342.05	349.56	377.26	399.02	416.27	430.01	440.95	449.68	467.15
IMPUL VAC	307.34	336.45	365.02	383.59	388.67	407.79	423.15	435.45	445.28	453.13	459.41	303.94
EPSILON	1.029	1.443	2.323	3.475	3.941	6.852	12.057	21.339	37.860	67.250	119.540	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100 168.9
TEMP, DEG K	2926.6	2602.4	2279.7	1968.6	1745.9	1681.7	1424.7	1196.9	997.4	824.8	677.5	553.4 2694.0
ENTHALPY (-)	26.42	70.46	109.11	142.64	165.12	171.42	195.90	216.55	233.83	248.18	260.01	269.69 58.58
X BAR	10.051	9.976	9.938	9.924	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921 9.994
N	10.051	9.976	9.938	9.924	9.921	9.921	9.921	9.921	9.921	9.921	9.921	9.921 9.994
CP	1.6359	1.3528	1.1534	1.0397	.9882	.9760	.9284	.8849	.8471	.8157	.7901	.7725 1.4254
IMPUL OPT	195.73	268.20	317.98	347.37	355.17	383.98	406.70	424.79	439.23	450.79	460.04	167.25
IMPUL VAC	310.40	341.23	371.09	390.48	395.79	415.80	431.94	444.93	455.34	463.68	470.36	306.42
EPSILON	1.033	1.465	2.373	3.559	4.040	7.050	12.452	22.125	39.405	70.230	125.190	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
52.10 H	.1930	.0890	.0298	.0067	.0016	.0009	.0001	.0000	.0000	.0000	.0000	.1139
9.33 H2O	.0640	.0218	.0049	.0007	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0307
.00 H2	4.8589	4.8875	4.9082	4.9176	4.9199	4.9202	4.9206	4.9206	4.9206	4.9206	4.9206	4.8798
-57.80 H2O	4.9333	4.9777	4.9950	4.9993	4.9999	4.9999	5.0000	5.0000	5.0000	5.0000	5.0000	4.9685
59.56 O	.0015	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0004
.00 O2	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002

SYSTEM LIQUID BIPROPELLANT										PC 300, PSIA		HEAT FORM		WT. G/G	
COMPONENT										DENSITY		(KCAL/POUN.WT.)			
										G/CC					
										1/LB		-3.08		80.	
										20.4 W2		-1.007		20.	
										FROZEN EXPANSION					
										C STAR = 7053.0 FT/SEC					
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CP SEA	CF VAC	
			DEG F	KCAL/1000G	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL		
1.000	1.000	300.000	2926.6	-26.62	1.000										
1.000	1.784	168.136	2631.3	-58.54	1.077	167.2	136.8	.814	292.0	295.6	302.6	303.9	1.196	1.245	
2.000	9.267	32.372	1937.9	-131.06	1.008	302.4	54.8	1.691	332.3	339.8	354.3	357.2	1.362	1.443	
3.000	16.470	18.215	1710.9	-153.57	.977	332.6	46.7	2.452	361.2	352.1	373.1	377.3	1.398	1.546	
4.000	25.145	11.931	1566.0	-167.56	.955	350.4	38.8	3.255		355.8	383.7	389.2		1.595	
5.000	35.022	8.571	1461.9	-177.41	.938	362.5	35.0	4.088			390.5	397.5		1.629	
6.000	45.546	6.587	1381.6	-184.88	.923	371.3	32.3	4.908			395.3	403.6		1.656	
7.000	56.535	5.306	1316.8	-190.82	.911	378.2	30.3	5.702			398.7	408.4		1.673	
8.000	68.670	4.356	1262.7	-199.73	.901	383.8	28.6	6.481			401.2	412.4		1.690	
9.000	81.714	3.671	1216.5	-206.87	.892	388.5	27.2	7.249			403.0	415.7		1.703	
10.000	94.829	3.166	1176.4	-203.43	.884	392.4	26.0	8.231			404.4	418.5		1.714	
11.000	108.032	2.777	1141.1	-206.54	.878	395.9	25.0	9.018			405.5	420.9		1.724	
12.000	121.219	2.475	1109.6	-208.29	.872	398.9	24.2	9.768			406.4	423.0		1.733	
13.000	134.123	2.204	1081.2	-211.75	.866	401.5	23.4	10.416			406.8	424.9		1.741	
14.000	151.588	1.979	1055.5	-213.98	.861	403.9	22.7	11.471			407.1	426.6		1.748	
15.000	167.429	1.792	1032.0	-216.00	.857	406.1	22.1	12.321			407.2	428.2		1.754	
16.000	183.555	1.636	1010.4	-217.84	.853	408.1	21.5	13.161			407.6			1.760	
17.000	199.882	1.501	990.5	-219.54	.849	409.9	21.0	13.986			407.9			1.765	
18.000	216.390	1.387	971.9	-221.11	.846	411.4	20.5	14.796			408.1			1.770	
19.000	232.873	1.288	954.7	-222.57	.842	413.1	20.1	15.586			408.2			1.775	
20.000	249.440	1.203	938.6	-223.92	.839	414.5	19.7	16.358			408.2			1.779	
21.000	266.019	1.128	923.4	-225.19	.836	415.8	19.3	17.110			408.1			1.783	
22.000	282.857	1.057	909.2	-226.38	.834	417.1	18.9	17.842			408.0			1.786	
23.000	302.743	.991	895.7	-227.50	.831	418.3	18.6	18.578			407.9			1.790	
24.000	321.923	.932	883.0	-228.56	.829	419.4	18.3	19.332			407.7			1.793	
25.000	341.358	.879	870.9	-229.56	.827	420.4	18.0	20.484			407.4			1.796	
26.000	361.134	.831	859.5	-230.51	.825	421.4	17.7	21.133			407.1			1.799	
27.000	381.095	.787	848.6	-231.41	.823	422.3	17.5	22.178			406.8			1.802	
28.000	401.249	.748	838.2	-232.27	.821	423.2	17.2	23.016			406.4			1.804	
29.000	421.563	.712	828.2	-233.08	.819	424.0	17.0	23.847			406.0			1.807	
30.000	442.009	.679	818.7	-233.86	.818	424.8	16.7	24.671			405.6			1.809	
31.000	462.581	.649	809.6	-234.60	.816	425.6	16.5	25.481			405.1			1.811	
32.000	483.195	.621	800.9	-235.32	.815	426.3	16.3	26.290			404.6			1.813	
33.000	503.851	.595	792.5	-236.00	.813	427.0	16.1	27.085			404.1			1.816	
34.000	524.632	.572	784.4	-236.66	.812	427.7	15.9	27.870			403.6			1.817	
35.000	545.456	.550	776.6	-237.29	.811	428.3	15.8	28.649			403.1			1.819	
36.000	566.222	.530	769.2	-237.89	.809	428.9	15.6	29.408			402.5			1.821	
37.000	587.016	.511	761.9	-238.48	.808	429.5	15.4	30.162			402.0			1.823	
38.000	608.155	.493	755.0	-239.04	.807	430.1	15.3	30.921			401.5			1.825	
39.000	631.258	.475	748.2	-239.56	.806	430.6	15.1	31.773			400.9			1.826	
40.000	654.821	.458	741.7	-240.11	.805	431.2	14.9	32.626			400.4			1.828	
41.000	678.510	.442	735.4	-240.62	.804	431.7	14.8	33.479			400.0			1.829	
42.000	702.471	.427	729.3	-241.11	.803	432.2	14.7	34.332			400.0			1.831	
43.000	726.629	.413	723.3	-241.59	.802	432.7	14.5	35.185			400.2			1.832	
44.000	750.951	.399	717.4	-242.05	.801	433.1	14.4	36.038			400.3			1.833	
45.000	775.342	.387	712.0	-242.49	.800	433.6	14.3	36.886			400.4			1.835	
46.000	800.289	.375	706.6	-242.93	.799	434.0	14.1	37.734			400.1			1.836	
47.000	825.158	.364	701.3	-243.35	.798	434.4	14.0	38.579			400.4			1.837	
48.000	850.156	.353	696.1	-243.76	.797	434.8	13.9	39.421			400.6			1.839	
49.000	875.370	.343	691.2	-244.14	.796	435.2	13.8	40.260			400.9			1.840	
50.000	900.688	.333	686.3	-244.54	.795	435.6	13.7	41.096			400.3			1.841	
3.475	20.414	14.696	1635.3	-160.91	.966	362.0	41.5	2.827	342.0	354.6	378.8	383.6	1.401	1.572	

SHIFTING EXPANSION															
C STAR = 7955.0 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP DEG F	ENTHALPY KCAL/1000G	CP CAL/ GM DEG	I OPT	DEL VAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC LVL	CF SEA	CF VAC LVL		
1.000	1.000	300.000	2926.6	-26.62	1.000										
1.000	1.777	168.857	2694.0	-58.58	1.025	167.3	139.2	.824	294.3	298.0	305.0	306.4	1.239	1.190	
2.000	8.961	33.470	2067.4	-132.64	1.067	304.4	57.3	1.712	336.6	344.2	358.8	361.7	1.361	1.463	
3.000	15.949	18.859	1836.3	-156.19	1.007	336.0	46.8	2.464	366.3	357.3	378.8	382.8	1.401	1.568	
4.000	24.241	12.175	1684.7	-170.94	.977	356.4	40.8	3.297			389.8	395.4		1.599	
5.000	33.684	8.906	1578.7	-181.38	.957	367.2	36.9	4.139			397.0	406.0		1.634	
6.000	43.816	6.847	1495.2	-189.30	.941	376.5	34.1	4.974			402.0	410.5		1.660	
7.000	54.250	5.530	1427.7	-195.81	.929	385.7	31.9	5.771			405.7	415.6		1.681	
8.000	65.972	4.547	1371.2	-200.84	.918	389.5	30.2	6.637			408.4	419.7		1.698	
9.000	78.240	3.831	1322.9	-205.25	.909	394.4	28.8	7.500			410.4	423.2		1.712	
10.000	90.845	3.302	1280.9	-209.05	.901	398.6	27.5	8.342			411.9	426.2		1.724	
11.000	103.545	2.887	1243.8	-212.38	.894	402.2	26.5	9.151			413.1	428.7		1.736	
12.000	116.245	2.581	1210.6	-215.32	.888	405.4	25.6	9.935			414.1	431.0		1.743	
13.000	129.623	2.311	1181.0	-217.96	.882	408.2	24.8	10.737			414.7	433.0		1.751	
14.000	144.302	2.076	1153.9	-220.34	.877	410.7	24.1	11.604			415.0	434.8		1.759	
15.000	159.560	1.880	1129.1	-222.51	.872	413.0	23.4	12.467			415.2	436.5		1.765	
16.000	174.913	1.715	1106.3	-224.49	.868	415.1	22.9	13.324			415.2	438.0		1.771	
17.000	190.485	1.575	1085.3	-226.32	.864	417.0	22.3	14.168			415.0			1.777	
18.000	206.207	1.455	1065.7	-228.01	.860	418.8	21.8	14.999			404.6			1.782	
19.000	222.021	1.351	1047.5	-229.57	.857	420.4	21.4	15.812			401.8			1.787	
20.000	237.883	1.261	1030.4	-231.01	.853	421.9	20.9	16.607			402.9			1.791	
21.000	253.742	1.182	1014.4	-232.40	.850	423.3	20.6	17.383			403.9			1.795	
22.000	269.643	1.113	999.3	-233.68	.847	424.6	20.2	18.141			404.6			1.799	
23.000	285.505	1.057	984.9	-234.91	.845	425.9	19.8	18.899			405.7			1.803	
24.000	301.321	.987	971.5	-236.03	.842	427.0	19.5	19.655			406.5			1.806	
25.000	315.084	.927	958.7	-237.10	.840	428.1	19.2	20.719			407.3			1.809	
26.000	328.340	.876	946.5	-238.13	.838	429.2	18.9	21.582			408.1			1.812	
27.000	341.127	.831	934.9	-239.10	.836	430.3	18.6	22.445			408.8			1.815	
28.000	350.310	.789	923.8	-240.02	.834	431.1	18.4	23.297			409.5			1.818	
29.000	359.590	.751	913.2	-240.90	.832	432.2	18.1	24.146			410.1			1.820	
30.000	368.993	.716	903.1	-241.75	.830	432.8	17.9	24.989			410.7			1.823	
31.000	378.522	.686	893.4	-242.55	.828	433.6	17.7	25.824			411.3			1.825	
32.000	388.146	.658	884.0	-243.32	.826	434.3	17.5	26.651			411.9			1.827	
33.000	397.851	.628	875.1	-244.06	.825	435.1	17.2	27.469			412.4			1.830	
34.000	407.612	.603	866.4	-244.77	.823	435.8	17.0	28.277			412.9			1.832	
35.000	417.416	.580	858.1	-245.45	.822	436.5	16.9	29.074			413.4			1.834	
36.000	427.250	.557	850.1	-246.11	.820	437.2	16.7	29.862			413.9			1.836	
37.000	437.116	.536	842.4	-246.75	.819	437.8	16.5	30.643			414.3			1.837	
38.000	447.077	.520	834.9	-247.36	.817	438.4	16.3	31.411			414.7			1.839	
39.000	456.880	.503	827.7	-247.95	.816	439.0	16.2	32.171			415.2			1.841	
40.000	466.641	.485	820.7	-248.52	.815	439.6	16.0	32.988			415.6			1.843	
41.000	476.290	.469	813.9	-249.07	.814	440.1	15.9	33.811			416.0			1.845	
42.000	485.749	.453	807.3	-249.60	.812	440.6	15.7	34.715			416.4			1.846	
43.000	495.065	.438	801.0	-250.12	.811	441.1	15.6	35.579			416.7			1.847	
44.000	504.368	.424	794.8	-250.62	.810	441.6	15.4	36.463			417.1			1.848	
45.000	513.608	.411	788.9	-251.11	.809	442.1	15.3	37.362			417.5			1.849	
46.000	522.736	.397	783.0	-251.58	.808	442.6	15.2	38.167			417.8			1.851	
47.000	531.719	.384	777.3	-252.04	.807	443.0	15.0	39.028			418.1			1.853	
48.000	540.617	.374	771.8	-252.48	.806	443.5	14.9	39.886			418.4			1.854	
49.000	549.515	.363	766.4	-252.92	.805	444.0	14.8	40.769			418.7			1.856	
50.000	558.381	.353	761.1	-253.35	.804	444.5	14.7	41.595			419.0			1.857	
3.359	20.000	14.650	1745.9	-145.12	.988	364.7	43.1	2.933	347.4	360.4	385.3	390.5	1.403	1.536	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 85.
 LH2 20.4 H2 0.071 -1.887 15.

BULK DENSITY = .350 GM/CC
 MIXTURE RATIO = 5.667 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 456.69 EU/100GMS

CHAMBER													THROAT	
	FROZEN EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	168.9	
TEMP, DEG K	3322.1	2892.5	2510.3	2169.8	1933.8	1866.3	1595.8	1355.0	1141.3	953.6	790.4	650.5	3008.7	
ENTHALPY (-)	22.22	60.97	94.65	123.82	143.46	148.98	170.56	188.95	204.51	217.56	228.42	237.40	50.58	
CP	.9117	.8919	.8695	.8434	.8206	.8135	.7810	.7457	.7109	.6787	.6525	.6308	.8975	
IMPUL OPT		183.60	251.02	297.31	324.77	332.08	359.24	380.86	398.23	412.24	423.55	432.66	157.06	
IMPUL VAC		290.48	318.86	346.82	365.17	370.21	389.37	404.99	417.67	427.93	436.21	442.86	287.02	
EPSILON		1.031	1.457	2.368	3.572	4.062	7.149	12.751	22.876	41.117	73.873	132.542	1.000	
	SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100	172.5	
TEMP, DEG K	3322.1	3069.6	2821.2	2567.1	2363.6	2300.5	2026.0	1759.3	1513.1	1291.0	1092.8	917.6	3146.6	
ENTHALPY (-)	22.22	61.77	97.65	130.07	152.65	159.10	184.77	207.18	226.53	243.10	257.18	269.06	49.96	
X BAR	7.847	7.713	7.603	7.521	7.480	7.471	7.448	7.442	7.441	7.440	7.440	7.440	7.752	
N	7.847	7.713	7.603	7.521	7.480	7.471	7.448	7.442	7.441	7.440	7.440	7.440	7.752	
CP	2.4629	2.1034	1.7070	1.3362	1.1110	1.0561	.8918	.8107	.7651	.7272	.6940	.6621	2.2212	
IMPUL OPT		185.49	256.17	306.32	336.85	345.08	376.05	401.13	421.59	438.36	452.12	463.41	155.34	
IMPUL VAC		295.84	328.56	360.81	382.22	388.14	410.75	429.35	444.68	457.30	467.67	476.14	291.10	
EPSILON		1.041	1.521	2.549	3.923	4.485	8.048	14.578	26.562	48.540	88.713	161.844	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)													
52.10 H	.3542	.2608	.1738	.0979	.0528	.0422	.0126	.0024	.0003	.0000	.0000	.0000	.2891	
9.33 H2O	.3403	.2229	.1261	.0564	.0240	.0176	.0034	.0004	.0000	.0000	.0000	.0000	.2572	
.00 H2	2.2081	2.1550	2.1229	2.1123	2.1148	2.1164	2.1234	2.1269	2.1278	2.1280	2.1280	2.1280	2.1694	
-57.80 H2O	4.8851	5.0436	5.1676	5.2511	5.2872	5.2941	5.3090	5.3121	5.3125	5.3125	5.3125	5.3125	4.9980	
59.56 O	.0315	.0160	.0063	.0016	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0201	
.00 O2	.0278	.0150	.0062	.0017	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0186	

[illegible]

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 O2 1.14 -3.08 90.
 LM2 20.4 H2 0.071 -1.887 10.

BULK DENSITY = .455 GM/CC
 MIXTURE RATIO = 9.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTROPY 368.96 EU/100GMS

CHAMBER	FROZEN EXPANSION											THROAT
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100 167.9
TEMP, DEG K	3415.7	2984.7	2600.5	2257.8	2019.8	1951.6	1678.1	1434.1	1216.6	1024.0	855.0	708.4 3098.4
ENTHALPY (-)	18.02	48.20	74.52	97.41	112.88	117.25	134.35	149.01	161.50	172.06	180.90	188.27 40.30
CP	.7069	.6925	.6767	.6580	.6421	.6369	.6133	.5875	.5605	.5353	.5121	.4925 .6968
IMPUL OPT	162.03	221.70	262.80	287.28	293.81	318.12	337.58	353.30	366.07	376.43	384.85	394.29 139.22
IMPUL VAC	256.49	281.85	306.85	323.33	327.87	345.17	359.36	370.96	380.42	388.08	394.29	253.34
EPSILON	1.032	1.463	2.386	3.609	4.108	7.265	13.030	23.522	42.551	76.939	138.866	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	134.7	60.49	27.16	14.70	12.20	5.477	2.460	1.104	.496	.223	.100 173.8
TEMP, DEG K	3415.7	3193.3	2988.4	2796.5	2655.3	2613.1	2432.8	2249.1	2054.2	1843.8	1625.2	1413.5 3262.0
ENTHALPY (-)	18.02	48.89	77.19	103.18	121.71	127.09	149.06	169.18	187.51	204.00	218.62	231.41 39.35
X BAR	5.932	5.812	5.702	5.601	5.531	5.512	5.435	5.372	5.329	5.305	5.295	5.293 5.849
N	5.932	5.812	5.702	5.601	5.531	5.512	5.435	5.372	5.329	5.305	5.295	5.293 5.849
CP	2.5806	2.4567	2.2820	2.0646	1.8656	1.8014	1.5084	1.2063	.9337	.7393	.6342	.5828 2.5013
IMPUL OPT	163.87	226.88	272.19	300.34	308.04	337.63	362.64	383.99	402.24	417.75	430.86	436.22
IMPUL VAC	261.78	291.81	321.94	342.62	348.46	371.49	391.44	408.63	423.26	435.56	445.87	257.31
EPSILON	1.043	1.541	2.629	4.130	4.757	8.873	16.814	32.033	60.850	114.811	215.509	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
52.10 H	.1893	.1453	.1067	.0737	.0522	.0465	.0255	.0112	.0034	.0006	.0000	.0000 .1587
9.33 H ₂ O	.6611	.5482	.4435	.3477	.2800	.2606	.1831	.1161	.0622	.0257	.0076	.0015 .5832
.00 H ₂	.5275	.4412	.3572	.2763	.2173	.2001	.1309	.0727	.0308	.0086	.0014	.0001 .4685
-57.80 H ₂ O	4.0076	4.1725	4.3281	4.4733	4.5769	4.6067	4.7251	4.8240	4.8967	4.9385	4.9551	4.9594 4.1209
59.56 O	.1360	.1055	.0791	.0566	.0419	.0379	.0230	.0119	.0048	.0013	.0002	.0000 .1147
.00 O ₂	.4102	.3994	.3872	.3737	.3631	.3599	.3469	.3365	.3306	.3297	.3311	.3320 .4031

SYSTEM LIQUID PROPELLANT										PC 300, PSIA		HEAT FORM		WT. 0/8	
COMPONENT		TREF FORMULA		DENSITY		GM/CC		IKCAL/FORM.WT.		1.14		-3.08		90.	
LOX		90.2 OZ		1.14		0.71		-1.887		90.		10.			
LN2		20.4 HZ		0.71		-1.887		90.		10.					
FROZEN EXPANSION															
C STAR = 4561.4 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/1000M	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL		
1.000	1.000	100.000	3415.7	-18.02	2.501	139.2	114.1	.680	243.4	246.4	252.2	253.3	1.193	1.242	
2.000	1.787	107.888	3098.4	-40.30	.687	139.2	114.1	.680	243.4	246.4	252.2	253.3	1.193	1.242	
3.000	8.961	33.477	2364.9	-90.34	.665	291.5	47.4	1.416	278.1	280.5	298.9	1.363	1.465		
4.000	15.678	19.135	2121.7	-106.31	.649	277.2	39.2	2.050	286.3	295.3	316.4	1.404	1.551		
5.000	21.679	12.649	1965.4	-116.36	.638	292.5	34.5	2.720		295.0	322.3	327.0	1.603		
6.000	32.653	9.187	1852.7	-173.51	.629	302.9	31.4	3.413			328.5	334.3	1.639		
7.000	42.262	7.093	1765.4	-128.96	.621	310.7	29.1	4.104			332.8	339.8	1.666		
8.000	52.136	5.754	1694.8	-133.33	.615	316.7	27.4	4.768			336.0	344.2	1.688		
9.000	62.904	4.769	1635.6	-136.95	.609	321.7	26.1	5.400			338.4	347.7	1.705		
10.000	74.370	4.034	1584.8	-140.03	.604	325.8	24.9	6.181			340.2	350.7	1.720		
11.000	86.115	3.484	1540.6	-142.69	.599	329.3	24.0	6.883			341.6	353.3	1.733		
12.000	97.975	3.062	1501.5	-145.02	.595	332.4	23.2	7.562			342.7	355.6	1.744		
13.000	109.831	2.731	1466.6	-147.10	.591	335.1	22.6	8.215			343.5	357.5	1.753		
14.000	121.622	2.467	1435.0	-148.96	.588	337.5	21.8	8.839			344.2	359.3	1.762		
15.000	134.970	2.223	1406.2	-150.65	.584	339.7	21.2	9.550			344.6	360.9	1.770		
16.000	148.710	2.017	1379.7	-152.19	.581	341.6	20.7	10.264			344.8	362.4	1.777		
17.000	162.728	1.844	1355.4	-153.60	.578	343.4	20.2	10.975			345.0	363.7	1.783		
18.000	176.940	1.695	1332.8	-154.90	.575	345.1	19.8	11.680			345.0	364.9	1.789		
19.000	191.346	1.568	1311.7	-156.11	.573	346.6	19.4	12.375			346.0		1.795		
20.000	205.832	1.457	1292.1	-157.23	.570	348.0	19.0	13.060			347.1		1.800		
21.000	220.376	1.361	1273.6	-158.28	.568	349.3	18.7	13.737			348.0		1.805		
22.000	234.941	1.277	1256.3	-159.27	.566	350.5	18.4	14.400			348.9		1.809		
23.000	249.505	1.202	1239.9	-160.19	.564	351.7	18.1	15.055			349.7		1.813		
24.000	264.053	1.136	1224.4	-161.07	.562	352.8	17.8	15.665			350.6		1.817		
25.000	278.540	1.074	1209.7	-161.89	.560	353.8	17.5	16.329			351.3		1.821		
26.000	292.974	1.014	1195.7	-162.67	.558	354.7	17.3	17.042			352.0		1.824		
27.000	307.345	.951	1182.4	-163.42	.556	355.7	17.0	17.794			352.7		1.828		
28.000	321.633	.886	1169.6	-164.12	.554	356.5	16.8	18.466			353.3		1.831		
29.000	335.833	.825	1157.4	-164.80	.553	357.3	16.6	19.176			354.0		1.834		
30.000	349.943	.762	1145.8	-165.44	.551	358.1	16.4	19.886			354.5		1.837		
31.000	363.963	.702	1134.6	-166.04	.550	358.8	16.2	20.590			355.1		1.839		
32.000	377.893	.643	1123.9	-166.65	.549	359.4	16.0	21.289			355.6		1.842		
33.000	391.733	.587	1113.6	-167.21	.547	360.3	15.8	21.985			356.1		1.844		
34.000	405.483	.534	1103.6	-167.76	.546	360.9	15.7	22.677			356.6		1.847		
35.000	419.143	.484	1094.1	-168.28	.545	361.6	15.5	23.359			357.1		1.849		
36.000	432.713	.436	1084.8	-168.78	.543	362.2	15.4	24.036			357.6		1.851		
37.000	446.193	.391	1075.9	-169.27	.542	362.7	15.2	24.707			358.1		1.853		
38.000	459.583	.348	1067.3	-169.73	.541	363.3	15.1	25.371			358.4		1.855		
39.000	472.883	.307	1058.9	-170.18	.540	363.8	14.9	26.027			358.8		1.857		
40.000	486.093	.268	1050.8	-170.60	.539	364.4	14.8	26.677			359.1		1.859		
41.000	499.213	.231	1043.0	-171.04	.538	364.9	14.7	27.313			359.5		1.861		
42.000	512.243	.196	1035.4	-171.45	.537	365.3	14.5	27.954			359.9		1.863		
43.000	525.183	.163	1028.0	-171.85	.536	365.8	14.4	28.582			360.2		1.864		
44.000	538.033	.132	1020.8	-172.23	.535	366.3	14.3	29.203			360.6		1.866		
45.000	550.793	.103	1013.9	-172.60	.534	366.7	14.2	29.819			360.9		1.868		
46.000	563.463	.076	1007.1	-172.96	.533	367.1	14.1	30.435			361.2		1.869		
47.000	576.043	.051	1000.5	-173.31	.532	367.6	14.0	31.047			361.5		1.871		
48.000	588.533	.027	994.1	-173.66	.531	368.0	13.9	31.658			361.8		1.872		
49.000	600.943	.004	987.8	-173.99	.530	368.4	13.8	32.264			362.1		1.874		
50.000	613.263	.000	981.7	-174.31	.530	368.7	13.7	32.865			362.4		1.875		
51.000	625.493	.000	975.7	-174.63	.529	369.1	13.6	33.461			362.7		1.876		
52.000	637.643	.000	969.8	-174.95	.528	369.5	13.5	34.053			363.0		1.877		
3.062	20.414	16.670	2019.8	-112.88	.662	287.3	28.1	2.653	247.3	249.1	319.1	321.1	1.409	1.583	

SHIFTING EXPANSION															
C STAR = 4723.7 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KCAL/1000M	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL		
1.000	1.000	300.000	3415.0	-2.50	2.501										
2.000	1.726	173.829	3262.0	-30.35	2.501	136.2	121.1	.697	247.1	250.2	256.1	257.3	1.231	1.472	
3.000	7.931	37.827	2880.4	-51.11	2.175	252.9	54.8	1.449	286.4	292.8	305.2	307.7	1.371	1.682	
4.000	18.335	22.497	2753.9	-104.85	2.008	281.1	47.2	2.099	297.5	306.8	324.8	326.4	1.424	1.971	
5.000	19.588	15.316	2664.9	-120.47	1.880	298.5	42.7	2.789	300.3	312.6	336.5	341.3	1.437	1.633	
6.000	26.269	11.420	2598.4	-128.95	1.779	310.7	39.8	3.485		314.7	344.5	350.5	1.677		
7.000	33.411	8.974	2545.1	-135.59	1.694	319.8	37.7	4.198			350.4	357.5	1.711		
8.000	40.798	7.353	2500.6	-141.02	1.621	327.1	36.1	4.907			354.8	362.2	1.738		
9.000	48.264	6.216	2462.4	-146.59	1.558	333.1	34.8	5.598			358.4	367.9	1.761		
10.000	55.807	5.376	2428.7	-149.53	1.502	338.2	33.7	6.274			361.3	372.0	1.780		
11.000	64.085	4.681	2398.4	-152.99	1.451	342.7	32.8	7.007			363.5	375.5	1.797		
12.000	72.539	4.136	2371.4	-156.07	1.405	346.6	32.0	7.739			365.4	378.4	1.812		
13.000	81.092	3.699	2346.5	-158.83	1.364	350.0	31.3	8.462			366.9	381.3	1.825		
14.000	89.677	3.345	2323.5	-161.34	1.326	353.1	30.7	9.171			368.2	383.8	1.837		
15.000	98.241	3.054	2302.2	-163.63	1.291	355.9	30.1	9.864			369.2	386.1	1.847		
16.000	106.749	2.810	2282.3	-165.74	1.259	358.5	29.6	10.538			370.1	388.1	1.857		
17.000	115.179	2.605	2263.5	-167.70	1.229	360.9	29.2	11.193			370.9	390.0	1.866		
18.000	123.723	2.425	2245.8	-169.51	1.201	363.0	28.7	11.848			371.5	391.8	1.875		
19.000	132.188	2.252	2229.0	-171.21	1.175	365.1	28.3	12.576			371.9	393.4	1.882		
20.000	142.703	2.101	2213.0	-172.80	1.151	367.0	28.0	13.306			372.2	394.9	1.890		
21.000	152.490	1.967	2197.8	-174.30	1.128	368.7	27.6	14.036			372.4	396.3	1.897		
22.000	162.266	1.849	2183.3	-175.72	1.106	370.4	27.3	14.760			372.5	397.7	1.903		
23.000	172.150	1.743	2169.3	-177.05	1.088	372.0	27.0	15.482			372.5	398.9	1.909		
24.000	182.035	1.646	2156.0	-178.32	1.073	374.4	26.7	16.193			372.6	400.1	1.914		
25.000	192.005	1.562	2143.1	-179.53	1.049	374.9	26.4	16.908			401.3		1.920		
26.000	201.964	1.485	2130.7	-180.68	1.032	376.2	26.2	17.611			402.3		1.925		
27.000	211.926	1.416	2118.7	-181.78	1.016	377.5	25.9	18.306			403.4		1.930		
28.000	221.887	1.352	2107.2	-182.83	1.000	379.3	25.7	19.000			404.4		1.935		
29.000	231.818	1.294	2096.0	-183.84	.986	379.8	25.5	19.670			405.4		1.940		
30.000	241.732	1.241	2085.1	-184.80	.972	380.5	25.3	20.339			406.2		1.944		
31.000	251.620	1.192	2074.6	-185.73	.959	382.0	25.0	20.999			407.0		1.948		
32.000	261.479	1.147	2064.4	-186.62	.946	383.0	24.8	21.650			407.8		1.952		
33.000	271.310	1.107	2054.5	-187.48	.934	384.2	24.6	22.292			408.5		1.956		
34.000	281.211	1.063	2044.7	-188.31	.923	384.1	24.5	23.014			409.4		1.959		
35.000	291.244	1.023	2035.2	-189.11	.912	385.6	24.3	23.740			410.1		1.962		
36.000	301.368	.986	2025.0	-189.89	.902	386.7	24.1	24.467			410.8		1.966		
37.000	311.576	.950	2015.0	-190.65	.892	387.5	23.9	25.187			411.5		1.969		
38.000	321.850	.918	2000.1	-191.36	.883	388.3	23.8	25.919			412.1		1.972		
39.000	332.199	.887	1999.5	-192.07	.874	389.1	23.6	26.643			412.8		1.975		
40.000	342.610	.854	1991.1	-192.75	.865	389.8	23.5	27.367			413.4		1.978		
41.000	353.079	.821	1982.9	-193.41	.857	390.4	23.3	28.089			414.0		1.980		
42.000	363.595	.789	1973.9	-194.05	.849	391.3	23.2	28.809			414.5		1.982		
43.000	374.156	.761	1967.0	-194.68	.842	392.0	23.1	29.527			415.1		1.986		
44.000	384.759	.733	1959.3	-195.29	.834	392.7	22.9	30.243			415.6		1.989		
45.000	395.389	.703	1951.8	-195.88	.827	393.4	22.8	30.955			416.2		1.991		
46.000	406.051	.674	1943.6	-196.45	.819	394.1	22.7	31.667			416.7		1.994		
47.000	416.736	.646	1937.2	-197.02	.814	394.6	22.5	32.371			417.2		1.996		
48.000	427.441	.618	1930.1	-197.57	.808	395.2	22.4	33.073			417.7		1.999		
49.000	438.161	.581	1923.1	-198.11	.801	395.8	22.3	33.772			418.1		2.001		
50.000	448.892	.545	1916.3	-198.63	.796	396.4	22.2	34.468			418.6		2.003		
51.000	459.631	.509	1909.7	-199.13	.790	397.0	22.1	35.158			419.0		2.005		
4.1310	20.914	14.996	2655.3	-121.71	1.866	390.3	46.3	2.877	307.3	313.1	337.7	342.6	1.437	1.639	

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O₂ - RP - 1 SYSTEM

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 8/8
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 82 1.14 -3.08 60.
 RP-1 298 C+H1.953 0.80 -6.92 40.

BULK DENSITY = .974 GM/CC
 MIXTURE RATIO = 1.500 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 293.42 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	548.2
TEMP, DEG K	2449.2	2009.4	1638.4	1325.9	1063.7	931.9	845.8	666.7	521.6	405.9	314.8	241.0	2153.9
ENTHALPY (-)	25.58	48.61	67.45	82.75	95.09	101.10	104.95	112.75	118.88	123.66	127.37	130.34	41.12
CP	.5309	.5161	.4986	.4796	.4612	.4504	.4434	.4280	.4171	.4093	.4042	.4008	.5212
IMPUL OPT		141.56	190.86	223.03	245.91	256.32	262.77	275.39	284.90	292.11	297.58	301.89	116.27
IMPUL VAC		211.01	232.86	252.12	267.08	274.11	278.52	287.23	293.86	298.91	302.75	305.79	206.91
EPSILON		1.055	1.603	2.788	5.096	7.321	9.526	17.996	34.185	65.169	124.633	236.207	1.000

	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	549.6
TEMP, DEG K	2449.2	2020.5	1656.1	1354.4	1120.6	1029.4	981.2	915.2	861.5	813.6	770.1	729.8	2163.5
ENTHALPY (-)	25.58	48.67	67.64	83.17	95.89	102.29	106.56	115.97	124.55	132.43	139.69	146.40	41.08
X BAR	5.660	5.656	5.656	5.654	5.631	5.576	5.518	5.359	5.211	5.074	4.947	4.829	5.657
N	5.660	5.656	5.656	5.654	5.631	5.576	5.518	5.319	5.540	5.558	5.573	5.585	5.657
CP	.5572	.5283	.5159	.5202	.6853	1.1041	1.5308	4.5701	4.8153	4.8552	4.7081	4.4067	.5356
IMPUL OPT		141.74	191.30	223.83	247.32	258.34	265.42	280.42	293.44	304.89	315.08	324.21	116.14
IMPUL VAC		211.44	233.63	253.41	269.38	277.55	283.06	295.54	306.66	316.60	325.53	333.60	207.24
EPSILON		1.056	1.611	2.828	5.297	7.885	10.639	22.912	50.339	111.909	251.029	566.930	1.000

	COMPOSITION SHIFTING (MOL/100 GM)												
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0006	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0001	.0009	.0125	.0400	.0688	.0682	.0577	.0487	.0413	.0355	.0000
-26.42 C+O	2.7005	2.6688	2.6170	2.5350	2.4063	2.3005	2.2150	1.9135	1.6163	1.3386	1.0810	.8442	2.6818
-94.05 C+O2	.1603	.1925	.2444	.3256	.4428	.5210	.5777	.7194	.8577	.9894	1.1128	1.2261	.1794
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0083	.0012	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0026
9.33 H+O	.0006	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 H2	2.0619	2.0975	2.1498	2.2287	2.3112	2.3067	2.2770	2.2602	2.2605	2.2642	2.2682	2.2696	2.0838
-57.80 H2+O	.7276	.6960	.6442	.5637	.4582	.4075	.3796	.3976	.4183	.4327	.4434	.4536	.7089
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 C/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1604	.3299	.4849	.6264	.7557	.0000

SYSTEM LIQUID NITROGEN										PC 1000, PSIA										HEAT FORM										MT. D/O									
COMPONENT										DENSITY										(KCAL/POUN.WT.)										40.									
TEMP										G/CC										-1.00										40.									
90.2 82										1.14										-0.92										40.									
LX-1										0.80										-0.92										40.									
298 CMH.953										0.80										-0.92										40.									
FROZEN EXPANSION										C STAR = 5319.8 FT/SEC										I SEA										I AT									
EPSILON										PC/F										I VAC										CF SEA									
P PSIA										TEMP										I VAC										CF SEA									
DEG F										ENTHALPY										I VAC										CF SEA									
KCAL/100GP										CP CAL/ I OPT										DEL VAC										DEL VAC									
GN DEG										I SEA										I AT										I AT									
10000										10000										10000										10000									
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1.000																																							

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000, PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/S
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 65.
 RP-1 298 C₈H₁₈ 0.80 -6.92 35.

BULK DENSITY = .992 GM/CC
 MIXTURE RATIO = 1.857 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 286.27 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	554.4
TEMP, DEG K	3126.8	2614.2	2176.5	1802.5	1483.2	1319.4	1210.9	980.0	785.8	624.4	492.1	385.7	2789.4
ENTHALPY (-)	23.58	49.77	71.62	89.78	104.76	112.21	117.05	127.03	135.08	141.51	146.59	150.58	40.88
CP	.5159	.5051	.4924	.4775	.4605	.4493	.4416	.4229	.4056	.3904	.3789	.3706	.5095
IMPUL OPT	150.95	204.43	239.97	265.75	277.67	285.15	300.00	311.45	320.29	327.13	332.39	332.39	222.69
INPUL VAC	225.75	250.42	272.41	289.86	298.20	303.49	314.11	322.34	328.71	333.63	337.40	337.40	220.89
EPSILON	1.061	1.638	2.903	5.418	7.885	10.356	20.010	38.820	75.341	146.052	282.930	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	559.7
TEMP, DEG K	3126.8	2686.6	2272.0	1901.3	1584.0	1423.8	1319.2	1102.9	931.1	816.9	767.6	728.2	2847.1
ENTHALPY (-)	23.58	50.06	72.53	91.40	107.14	115.06	120.25	131.19	140.36	148.19	155.18	161.64	40.76
X BAR	4.996	4.965	4.952	4.949	4.949	4.949	4.949	4.949	4.944	4.892	4.775	4.660	4.974
N	4.996	4.965	4.952	4.949	4.949	4.949	4.949	4.949	4.944	4.892	4.883	4.892	4.974
CP	.6970	.5872	.5254	.5007	.4941	.4954	.4981	.5162	.5862	1.2259	4.7218	4.3974	.6222
IMPUL OPT	151.77	206.35	242.89	269.61	282.11	290.00	305.96	318.74	329.25	338.35	346.55	346.55	222.25
INPUL VAC	227.75	253.49	276.39	294.75	303.70	309.46	321.38	331.23	339.74	347.72	355.02	355.02	222.39
EPSILON	1.067	1.663	2.967	5.593	8.213	10.879	21.653	44.039	92.962	208.391	473.150	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+C	.0010	.0004	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0005
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0023	.0283	.0331	.0282	.0000
-26.42 C+O	2.1955	2.1701	2.1324	2.0754	1.9919	1.9281	1.8747	1.7195	1.5328	1.3309	1.0890	.8552	2.1804
-94.05 C+O2	.3073	.3334	.3713	.4284	.5119	.5757	.6292	.7842	.9687	1.1446	1.2738	1.3880	.3229
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0671	.0253	.0063	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0379
9.33 H+O	.0266	.0067	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0118
.00 H2	1.1744	1.2104	1.2548	1.3143	1.3982	1.4620	1.5154	1.6702	1.8483	1.9460	1.9528	1.9572	1.1963
-57.80 H2+O	1.2232	1.2184	1.1864	1.1302	1.0467	.9830	.9295	.7746	.5922	.4423	.4259	.4313	1.2236
59.56 O	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 O2	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
.00 C/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.1079	.2324	.0000

SYSTEM LIQUID BIPHROPPELLANT										PC 1000, PSIA										HEAT FOR										WT. 0/0									
COMPONENT										DENSITY										(KCAL/FORM.WT.)										BS.									
LOG										1.10										-3.08										35.									
RP-1										0.00										-6.92																			
										FROZEN EXPANSION																													
										C STAR = 5699.1 FT/SEC																													
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I AT	I VAC	CP SEA	CP VAC																								
					GM DEG		/P	/P	LVL	10000	50000		LVL																										
1.000	1.000	1000.000	3126.8	-40.78	.000																																		
2.000	1.000	1000.000	3126.8	-40.78	.000																																		
3.000	1.000	1000.000	3126.8	-40.78	.000																																		
4.000	1.000	1000.000	3126.8	-40.78	.000																																		
5.000	1.000	1000.000	3126.8	-40.78	.000																																		
6.000	1.000	1000.000	3126.8	-40.78	.000																																		
7.000	1.000	1000.000	3126.8	-40.78	.000																																		
8.000	1.000	1000.000	3126.8	-40.78	.000																																		
9.000	1.000	1000.000	3126.8	-40.78	.000																																		
10.000	1.000	1000.000	3126.8	-40.78	.000																																		
11.000	1.000	1000.000	3126.8	-40.78	.000																																		
12.000	1.000	1000.000	3126.8	-40.78	.000																																		
13.000	1.000	1000.000	3126.8	-40.78	.000																																		
14.000	1.000	1000.000	3126.8	-40.78	.000																																		
15.000	1.000	1000.000	3126.8	-40.78	.000																																		
16.000	1.000	1000.000	3126.8	-40.78	.000																																		
17.000	1.000	1000.000	3126.8	-40.78	.000																																		
18.000	1.000	1000.000	3126.8	-40.78	.000																																		
19.000	1.000	1000.000	3126.8	-40.78	.000																																		
20.000	1.000	1000.000	3126.8	-40.78	.000																																		
21.000	1.000	1000.000	3126.8	-40.78	.000																																		
22.000	1.000	1000.000	3126.8	-40.78	.000																																		
23.000	1.000	1000.000	3126.8	-40.78	.000																																		
24.000	1.000	1000.000	3126.8	-40.78	.000																																		
25.000	1.000	1000.000	3126.8	-40.78	.000																																		
26.000	1.000	1000.000	3126.8	-40.78	.000																																		
27.000	1.000	1000.000	3126.8	-40.78	.000																																		
28.000	1.000	1000.000	3126.8	-40.78	.000																																		
29.000	1.000	1000.000	3126.8	-40.78	.000																																		
30.000	1.000	1000.000	3126.8	-40.78	.000																																		
31.000	1.000	1000.000	3126.8	-40.78	.000																																		
32.000	1.000	1000.000	3126.8	-40.78	.000																																		
33.000	1.000	1000.000	3126.8	-40.78	.000																																		
34.000	1.000	1000.000	3126.8	-40.78	.000																																		
35.000	1.000	1000.000	3126.8	-40.78	.000																																		
36.000	1.000	1000.000	3126.8	-40.78	.000																																		
37.000	1.000	1000.000	3126.8	-40.78	.000																																		
38.000	1.000	1000.000	3126.8	-40.78	.000																																		
39.000	1.000	1000.000	3126.8	-40.78	.000																																		
40.000	1.000	1000.000	3126.8	-40.78	.000																																		
41.000	1.000	1000.000	3126.8	-40.78	.000																																		
42.000	1.000	1000.000	3126.8	-40.78	.000																																		
43.000	1.000	1000.000	3126.8	-40.78	.000																																		
44.000	1.000	1000.000	3126.8	-40.78	.000																																		
45.000	1.000	1000.000	3126.8	-40.78	.000																																		
46.000	1.000	1000.000	3126.8	-40.78	.000																																		
47.000	1.000	1000.000	3126.8	-40.78	.000																																		
48.000	1.000	1000.000	3126.8	-40.78	.000																																		
49.000	1.000	1000.000	3126.8	-40.78	.000																																		
50.000	1.000	1000.000	3126.8	-40.78	.000																																		
51.000	1.000	1000.000	3126.8	-40.78	.000																																		
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56.000	1.000	1000.000	3126.8	-40.78	.000																																		
57.000	1.000	1000.000	3126.8	-40.78	.000																																		
58.000	1.000	1000.000	3126.8	-40.78	.000																																		
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60.000	1.000	1000.000	3126.8	-40.78	.000																																		
61.000	1.000	1000.000	3126.8	-40.78	.000																																		
62.000	1.000	1000.000	3126.8	-40.78	.000																																		
63.000	1.000	1000.000	3126.8	-40.78	.000																																		
64.000	1.000	1000.000	3126.8	-40.78	.000																																		
65.000	1.000	1000.000	3126.8	-40.78	.000																																		
66.000	1.000	1000.000	3126.8	-40.78	.000																																		
67.000	1.000	1000.000	3126.8	-40.78	.000																																		
68.000	1.000	1000.000	3126.8	-40.78	.000																																		
69.000	1.000	1000.000	3126.8	-40.78	.000																																		
70.000	1.000	1000.000	3126.8	-40.78	.000																																		
71.000	1.000	1000.000	3126.8	-40.78	.000																																		
72.000	1.000	1000.000	3126.8	-40.78	.000																																		
73.000	1.000	1000.000	3126.8	-40.78	.000																																		
74.000	1.000	1000.000	3126.8	-40.78	.000																																		
75.000	1.000	1000.000	3126.8	-40.78	.000																																		
76.000	1.000	1000.000	3126.8	-40.78	.000																																		
77.000	1.000	1000.000	3126.8	-40.78	.000																																		
78.000	1.000	1000.000	3126.8	-40.78	.000																																		
79.000	1.000	1000.000	3126.8	-40.78	.000																																		
80.000	1.000	1000.000	3126.8	-40.78	.000																																		
81.000	1.000	1000.000	3126.8	-40.78	.000																																		
82.000	1.000	1000.000	3126.8	-40.78	.000																																		
83.000	1.000	1000.000	3126.8	-40.78	.000																																		
84.000	1.000	1000.000	3126.8	-40.78	.000																																		
85.000	1.000	1000.000	3126.8	-40.78	.000																																		
86.000	1.000	1000.000	3126.8	-40.78	.000																																		
87.000	1.000	1000.000	3126.8	-40.78	.000																																		
88.000	1.000	1000.000	3126.8	-40.78	.000																																		
89.000	1.000	1000.000	3126.8	-40.78	.000																																		
90.000	1.000	1000.000	3126.8	-40.78	.000																																		
91.000	1.000	1000.000	3126.8	-40.78	.000																																		
92.000	1.000	1000.000	3126.8	-40.78	.000																																		
93.000	1.000	1000.000	3126.8	-40.78	.000																																		
94.000	1.000	1000.000	3126.8	-40.78	.000																																		
95.000	1.000	1000.000	3126.8	-40.78	.000																																		
96.000	1.000	1000.000	3126.8	-40.78	.000																																		
97.000	1.000	1000.000	3126.8	-40.78	.000																																		
98.000	1.000	1000.000	3126.8	-40.78	.000																																		
99.000	1.000	1000.000	3126.8	-40.78	.000																																		
100.000	1.000	1000.000	3126.8	-40.78	.000																																		

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. 0/0
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 68.
 RP-1 298 C₈H₁₈ 0.80 -6.92 32.

BULK DENSITY = 1.004 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 279.74 EU/100GMS

	CHAMBER											THROAT	
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	557.1
TEMP, DEG K	3440.0	2900.8	2437.7	2039.8	1697.7	1521.3	1404.0	1151.9	936.8	754.9	602.8	477.2	3088.1
ENTHALPY (-)	22.39	49.30	71.96	90.97	106.83	114.79	119.99	130.83	139.69	146.87	152.62	157.20	40.01
CP	.5035	.4942	.4836	.4711	.4559	.4465	.4391	.4208	.4025	.3857	.3708	.3590	.4979
IMPUL OPT	153.03	207.67	244.26	271.04	283.53	291.39	307.15	319.46	329.08	336.60	342.47	348.07	224.04
IMPUL VAC	229.20	254.84	277.81	296.21	305.09	310.75	322.22	331.24	338.30	343.79	348.07	354.04	224.04
EPSILON	1.064	1.654	2.956	5.570	8.156	10.763	21.042	41.332	81.209	159.246	311.262	1.000	

	CHAMBER											THROAT	
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	568.3
TEMP, DEG K	3440.0	3054.3	2668.3	2289.0	1938.8	1755.1	1633.1	1374.4	1159.8	984.8	843.6	737.8	3202.9
ENTHALPY (-)	22.39	49.81	73.72	94.28	111.78	120.67	126.53	138.96	149.42	158.28	165.82	172.33	39.65
X BAR	4.648	4.584	4.546	4.530	4.526	4.525	4.525	4.525	4.525	4.525	4.524	4.503	4.606
N	4.648	4.584	4.546	4.530	4.526	4.525	4.525	4.525	4.525	4.525	4.524	4.503	4.606
CP	.9503	.7589	.6071	.5227	.4891	.4819	.4800	.4820	.4952	.5191	.5596	.8824	.8309
IMPUL OPT	154.47	211.31	250.10	278.86	292.41	301.00	310.45	332.44	343.83	353.25	361.17	369.13	226.62
IMPUL VAC	232.83	260.94	285.94	306.07	315.89	322.23	335.33	346.08	355.03	362.59	369.13	376.62	226.62
EPSILON	1.075	1.710	3.102	5.913	8.724	11.588	23.156	47.014	96.955	203.027	434.219	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)											
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C ₂ H ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C ₂ H ₆ O	.0010	.0004	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006
67.00 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C ₂ H ₂ O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C ₂ H ₃	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C ₂ H ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C ₂ O	1.8451	1.8129	1.7814	1.7418	1.6848	1.6413	1.6043	1.4944	1.3514	1.1777	.9836	.7885
-94.05 C ₂ O ₂	.4431	.4759	.5077	.5473	.6044	.6480	.6849	.7948	.9378	1.1115	1.3051	1.4899
199.00 C ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C ₂ H ₂	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C ₂ H ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C ₃	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C ₄	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1146	.0658	.0287	.0085	.0016	.0005	.0002	.0000	.0000	.0000	.0000	.0037
9.33 H ₂ O	.1015	.0456	.0137	.0024	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0646
.00 H ₂	.7334	.7463	.7755	.8189	.8783	.9223	.9595	1.0694	1.2124	1.3860	1.5783	1.7323
-57.80 H ₂ O	1.3934	1.4332	1.4386	1.4110	1.3562	1.3128	1.2758	1.1660	1.0230	.8493	.6562	.4816
59.56 O	.0091	.0024	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0043
.00 O ₂	.0068	.0018	.0002	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0033

SYSTEM LIQUID BIPROPELLANT										PC 1000. PSIA		HEAT FORM		WT. G/G	
COMPONENT		TREF FORMULA		DENSITY		GM/C		IN/KAL/FORM.WT.1		LVL		LVL		LVL	
LOX		90.2 02		1.14		-9.08		69.		LVL		LVL		LVL	
RP-1		246 CHL. 99.3		0.80		-6.72		32.		LVL		LVL		LVL	
PROZEN EXPANSION															
C STAR = 5787.9 FT/SEC															
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/G	I OPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
			DEG K	KAL/1000G	GM DEG		/P	/P	LVL	10000	50000	LVL	LVL	LVL	
1.000	1.000	1000.000	3440.0	-40.01	.498	123.8	100.2	.180	221.4	222.2	223.7	224.0	1.231	1.245	
2.000	1.755	557.093	3088.1	-70.18	.479	222.8	40.6	.376	257.9	259.6	262.8	263.4	1.434	1.464	
3.000	9.266	107.624	2288.0	-91.38	.471	249.0	38.5	.340	270.4	272.8	277.4	278.3	1.503	1.567	
4.000	25.414	39.368	1867.0	-60.05	.464	258.3	29.0	.734	276.5	279.7	286.0	287.1	1.537	1.597	
5.000	34.683	28.833	1751.0	-104.40	.459	267.1	26.3	.912	280.0	284.1	291.9	293.4	1.557	1.631	
6.000	44.330	22.558	1661.8	-108.47	.454	273.7	24.4	1.082	282.2	286.9	296.2	298.1	1.568	1.657	
7.000	55.153	18.132	1589.7	-111.72	.450	278.8	22.9	1.264	283.1	288.7	299.5	301.7	1.574	1.677	
8.000	66.285	15.086	1529.8	-114.41	.447	282.9	21.7	1.440	283.5	289.9	302.2	304.7	1.576	1.694	
9.000	78.144	12.787	1478.8	-116.89	.444	286.4	20.7	1.621	284.0	291.9	304.4	307.2	1.578	1.708	
10.000	90.444	11.056	1434.2	-118.86	.441	289.4	19.9	1.801	284.0	292.8	306.2	309.3	1.579	1.719	
11.000	103.129	9.697	1395.1	-120.38	.439	292.0	19.2	1.980	284.0	293.0	307.0	311.2	1.579	1.730	
12.000	116.640	8.573	1360.1	-121.91	.436	294.2	18.6	2.164	284.0	293.1	307.1	312.8	1.579	1.734	
13.000	130.635	7.695	1328.8	-123.28	.434	296.3	18.0	2.354	284.0	293.2	307.2	314.3	1.579	1.747	
14.000	145.027	6.895	1300.0	-124.52	.432	298.1	17.5	2.541	284.0	293.3	307.3	315.6	1.579	1.754	
15.000	159.730	6.261	1273.8	-125.64	.430	299.7	17.1	2.727	284.0	293.4	307.4	316.8	1.579	1.761	
16.000	174.664	5.725	1249.8	-126.68	.428	301.2	16.7	2.911	284.0	293.5	307.5	317.9	1.579	1.767	
17.000	189.753	5.270	1227.5	-127.63	.427	302.6	16.3	3.093	284.0	293.6	307.6	318.9	1.579	1.773	
18.000	204.933	4.880	1206.9	-128.51	.425	303.8	16.0	3.270	284.0	293.7	307.7	319.8	1.579	1.778	
19.000	220.152	4.542	1187.6	-129.33	.424	305.0	15.6	3.444	284.0	293.8	307.8	320.7	1.579	1.782	
20.000	235.368	4.249	1169.5	-130.09	.422	306.1	15.4	3.613	284.0	293.9	307.9	321.5	1.579	1.787	
21.000	250.555	3.991	1152.6	-130.80	.421	307.1	15.1	3.778	284.0	294.0	308.0	322.2	1.579	1.791	
22.000	265.803	3.734	1136.6	-131.48	.420	308.1	14.8	3.940	284.0	294.1	308.1	322.9	1.579	1.795	
23.000	281.078	3.503	1121.4	-132.11	.418	309.0	14.6	4.103	284.0	294.2	308.2	323.5	1.579	1.799	
24.000	296.342	3.295	1107.1	-132.71	.417	309.8	14.4	4.257	284.0	294.3	308.3	324.2	1.579	1.802	
25.000	311.577	3.108	1093.5	-133.28	.416	310.6	14.1	4.411	284.0	294.4	308.4	324.7	1.579	1.805	
26.000	326.766	2.919	1080.5	-133.81	.415	311.4	13.9	4.563	284.0	294.5	308.5	325.3	1.579	1.808	
27.000	341.951	2.768	1068.2	-134.33	.414	312.2	13.6	4.713	284.0	294.6	308.6	325.8	1.579	1.811	
28.000	357.142	2.647	1056.5	-134.81	.413	312.7	13.4	4.860	284.0	294.7	308.7	326.3	1.579	1.814	
29.000	372.319	2.521	1045.2	-135.28	.412	313.4	13.4	5.005	284.0	294.8	308.8	326.8	1.579	1.817	
30.000	387.450	2.405	1034.4	-135.72	.411	314.0	13.2	5.150	284.0	294.9	308.9	327.2	1.579	1.819	
31.000	402.542	2.289	1024.1	-136.15	.410	314.6	13.0	5.292	284.0	295.0	309.0	327.7	1.579	1.821	
32.000	417.593	2.202	1014.1	-136.55	.409	315.2	12.9	5.430	284.0	295.1	309.1	328.1	1.579	1.824	
33.000	432.604	2.113	1004.6	-136.95	.409	315.7	12.8	5.565	284.0	295.2	309.2	328.5	1.579	1.826	
34.000	447.572	2.031	995.4	-137.32	.408	316.2	12.6	5.700	284.0	295.3	309.3	328.9	1.579	1.828	
35.000	462.500	1.955	986.5	-137.68	.407	316.7	12.5	5.832	284.0	295.4	309.4	329.2	1.579	1.830	
36.000	477.380	1.885	977.9	-138.03	.406	317.2	12.4	5.963	284.0	295.5	309.5	329.6	1.579	1.832	
37.000	492.224	1.819	969.7	-138.37	.405	317.6	12.3	6.091	284.0	295.6	309.6	329.9	1.579	1.834	
38.000	507.034	1.759	961.7	-138.69	.405	318.1	12.1	6.217	284.0	295.7	309.7	330.2	1.579	1.836	
39.000	521.800	1.702	954.0	-139.00	.404	318.5	12.0	6.340	284.0	295.8	309.8	330.6	1.579	1.837	
40.000	536.524	1.650	946.5	-139.31	.403	318.9	11.9	6.462	284.0	295.9	309.9	330.9	1.579	1.839	
41.000	551.204	1.601	939.2	-139.60	.403	319.3	11.8	6.584	284.0	296.0	310.0	331.1	1.579	1.841	
42.000	565.840	1.549	932.2	-139.88	.402	319.7	11.7	6.704	284.0	296.1	310.1	331.4	1.579	1.842	
43.000	580.434	1.498	925.3	-140.16	.402	320.1	11.6	6.824	284.0	296.2	310.2	331.7	1.579	1.844	
44.000	594.986	1.449	918.5	-140.43	.401	320.5	11.5	6.944	284.0	296.3	310.3	331.9	1.579	1.845	
45.000	609.498	1.403	912.2	-140.68	.400	320.8	11.4	7.063	284.0	296.4	310.4	332.2	1.579	1.847	
46.000	623.970	1.360	905.9	-140.94	.400	321.1	11.3	7.181	284.0	296.5	310.5	332.5	1.579	1.848	
47.000	638.402	1.319	899.8	-141.18	.399	321.5	11.2	7.297	284.0	296.6	310.6	332.7	1.579	1.850	
48.000	652.794	1.280	893.8	-141.42	.398	321.8	11.2	7.412	284.0	296.7	310.7	333.0	1.579	1.851	
49.000	667.146	1.243	888.0	-141.65	.398	322.1	11.1	7.526	284.0	296.8	310.8	333.2	1.579	1.852	
50.000	681.458	1.208	882.3	-141.88	.398	322.4	11.0	7.639	284.0	296.9	310.9	333.4	1.579	1.853	
8.156	68.046	16.696	1521.3	-114.79	.447	283.5	21.6	1.467	283.5	290.0	302.6	305.1	1.576	1.696	

SHIPPING EXPANSION															
C STAR = 5892.4 FT/SEC															
EPSILON	PC/F	P PSIA	TEMP DEG K	ENTHALPY BTHAL/1000GP	CP CAL/G DEG	I OPT	DELVAC	DELVAC /P	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL	
1.000	1.000	1000.000	3440.0	-22.39	.950										
2.000	1.760	568.283	3202.9	-39.65	.931	122.5	104.1	.183	223.9	224.7	226.3	226.6	1.237	1.223	
3.000	9.273	116.651	2558.6	-70.98	.915	224.3	44.2	.379	262.9	264.6	267.9	268.5	1.436	1.466	
4.000	25.433	65.016	2308.1	-93.32	.925	244.5	36.3	.558	276.6	279.0	283.8	284.8	1.510	1.555	
5.000	34.693	42.439	2133.9	-107.68	.904	257.7	31.9	.767	283.8	286.9	293.3	294.6	1.540	1.608	
6.000	44.349	31.124	2024.2	-107.61	.894	272.3	29.0	.933	287.7	291.8	299.8	301.4	1.571	1.644	
7.000	54.009	24.601	1931.5	-112.13	.889	279.4	27.0	1.099	290.3	295.2	304.6	306.9	1.585	1.673	
8.000	63.672	19.805	1856.7	-115.77	.885	285.0	25.5	1.264	291.6	297.3	308.3	310.5	1.592	1.695	
9.000	73.335	16.502	1793.3	-118.94	.883	289.4	24.2	1.428	292.2	298.7	311.3	313.5	1.596	1.714	
10.000	82.998	14.078	1741.2	-121.36	.880	293.4	23.2	1.589	293.7	299.7	313.8	316.0	1.598	1.729	
11.000	92.661	12.187	1695.7	-123.55	.876	296.7	22.4	1.744	294.7	300.2	315.9	319.0	1.599	1.742	
12.000	102.324	10.717	1654.7	-125.50	.873	299.5	21.6	1.897	295.4	301.7	317.7	321.1	1.599	1.753	
13.000	111.987	9.531	1618.8	-127.22	.870	302.0	21.0	2.050	296.0	302.2	319.2	323.0	1.599	1.763	
14.000	121.650	8.534	1586.4	-128.77	.867	304.2	20.4	2.199	296.5	302.9	320.5	324.6	1.599	1.773	
15.000	131.313	7.709	1558.7	-129.88	.864	306.0	19.6	2.341	297.0	303.7	321.7	326.5	1.599	1.780	
16.000	142.674	7.009	1530.0	-131.44	.860	308.0	19.0	2.472	297.4	304.3	322.7	327.5	1.599	1.788	
17.000	155.783	6.419	1506.0	-132.63	.857	309.7	19.0	2.593	297.8	304.9	323.7	328.7	1.599	1.795	
18.000	169.048	5.915	1483.4	-133.71	.854	311.2	19.0	2.713	298.1	305.5	324.5	329.9	1.599	1.801	
19.000	182.465	5.472	1462.5	-134.72	.851	312.6	19.0	2.827	298.4	306.1	325.2	330.9	1.599	1.806	
20.000	195.916	5.107	1443.0	-135.65	.848	313.9	18.0	3.020	298.6	306.6	325.9	331.9	1.599	1.812	
21.000	209.224	4.780	1424.9	-136.53	.845	315.1	17.7	3.100	298.8	307.1	326.5	332.8	1.599	1.817	
22.000	222.556	4.492	1407.8	-137.35	.842	316.2	17.4	3.176	299.0	307.6	327.0	333.5	1.599	1.822	
23.000	235.907	4.234	1391.8	-138.12	.839	317.3	17.2	3.247	299.2	308.1	327.6	334.5	1.599	1.826	
24.000	249.196	4.000	1376.9	-138.84	.836	318.3	17.0	3.313	299.4	308.6	328.0	335.4	1.599	1.830	
25.000	263.594	3.780	1362.4	-139.53	.833	319.2	16.7	3.407	299.6	309.1	328.4	335.9	1.599	1.834	
26.000	279.380	3.579	1348.9	-140.19	.830	320.1	16.5	3.494	299.8	309.6	328.8	336.8	1.599	1.838	
27.000	296.476	3.390	1336.0	-140.81	.827	321.0	16.3	3.602	299.9	310.1	329.1	337.3	1.599	1.842	
28.000	314.753	3.141	1324.0	-141.39	.824	321.9	16.1	3.693	300.0	310.6	329.5	338.0	1.599	1.846	
29.000	334.288	3.061	1312.2	-141.97	.822	322.5	15.9	3.788	300.1	311.1	329.8	338.4	1.599	1.849	
30.000	354.754	2.916	1301.1	-142.50	.820	323.3	15.7	3.895	300.2	311.6	329.9	339.0	1.599	1.851	
31.000	376.177	2.786	1290.5	-143.02	.818	324.0	15.6	3.991	300.3	312.1	330.0	339.5	1.599	1.854	
32.000	398.177	2.665	1280.3	-143.51	.816	324.6	15.4	4.086	300.4	312.6	330.2	340.0	1.599	1.857	
33.000	421.484	2.551	1270.5	-143.99	.814	325.1	15.3	4.179	300.5	313.1	330.3	340.5	1.599	1.860	
34.000	447.824	2.452	1261.2	-144.44	.812	325.6	15.1	4.272	300.6	313.6	330.5	341.0	1.599	1.862	
35.000	476.114	2.358	1252.2	-144.88	.810	326.3	15.0	4.363	300.7	314.1	330.6	341.5	1.599	1.864	
36.000	506.915	2.270	1243.5	-145.30	.808	327.0	14.9	4.451	300.8	314.6	330.7	341.9	1.599	1.867	
37.000	540.827	2.187	1235.1	-145.71	.806	327.6	14.8	4.537	300.9	315.1	330.8	342.3	1.599	1.869	
38.000	578.094	2.114	1227.2	-146.11	.804	328.1	14.6	4.620	301.0	315.6	330.9	342.7	1.599	1.871	
39.000	619.299	2.044	1219.4	-146.48	.802	328.6	14.5	4.701	301.1	316.1	331.0	343.1	1.599	1.873	
40.000	665.429	1.979	1211.9	-146.85	.800	329.1	14.4	4.780	301.2	316.6	331.1	343.5	1.599	1.875	
41.000	716.473	1.918	1204.7	-147.21	.798	329.6	14.3	4.855	301.3	317.1	331.2	343.8	1.599	1.877	
42.000	772.437	1.857	1197.7	-147.55	.796	330.1	14.2	4.928	301.4	317.6	331.3	344.1	1.599	1.879	
43.000	833.321	1.807	1190.9	-147.89	.794	330.4	14.1	4.999	301.5	318.1	331.4	344.5	1.599	1.881	
44.000	899.142	1.757	1184.3	-148.21	.792	330.9	14.0	5.064	301.6	318.6	331.5	344.9	1.599	1.883	
45.000	970.007	1.711	1177.9	-148.52	.790	331.3	13.9	5.130	301.7	319.1	331.6	345.2	1.599	1.885	
46.000	1045.926	1.666	1171.7	-148.81	.788	331.6	13.8	5.193	301.8	319.6	331.7	345.6	1.599	1.887	
47.000	1126.900	1.624	1165.8	-149.09	.786	331.9	13.7	5.255	301.9	320.1	331.8	345.9	1.599	1.889	
48.000	1212.938	1.585	1159.8	-149.72	.784	332.4	13.6	5.308	302.0	320.6	331.9	346.1	1.599	1.890	
49.000	1304.040	1.541	1154.2	-149.70	.782	332.8	13.6	5.364	302.1	321.1	332.0	346.4	1.599	1.891	
50.000	1400.207	1.498	1148.6	-149.97	.780	333.2	13.5	5.400	302.2	321.6	332.1	346.6	1.599	1.892	
51.000	1502.540	1.456	1143.1	-150.23	.778	333.6	13.5	5.438	302.3	322.1	332.2	346.9	1.599	1.893	
52.000	1611.048	1.414	1137.7	-150.47	.776	334.0	13.4	5.477	302.4	322.6	332.3	347.1	1.599	1.894	
53.000	1726.731	1.372	1132.4	-150.67	.774	334.4	13.4	5.517	302.5	323.1	332.4	347.4	1.599	1.895	
54.000	1850.588	1.330	1127.1	-150.84	.772	334.8	13.3	5.558	302.6	323.6	332.5	347.6	1.599	1.896	
55.000	1982.620	1.288	1121.9	-150.98	.770	335.2	13.3	5.599	302.7	324.1	332.6	347.9	1.599	1.897	
56.000	2123.837	1.246	1116.7	-151.10	.768	335.6	13.2	5.641	302.8	324.6	332.7	348.1	1.599	1.898	
57.000	2274.250	1.204	1111.5	-151.19	.766	336.0	13.2	5.683	302.9	325.1	332.8	348.4	1.599	1.899	
58.000	2434.858	1.162	1106.3	-151.26	.764	336.4	13.1	5.726	303.0	325.6	332.9	348.6	1.599	1.900	
59.000	2605.671	1.120	1101.1	-151.31	.762	336.8	13.1	5.769	303.1	326.1	333.0	348.9	1.599	1.901	
60.000	2786.698	1.078	1095.9	-151.34	.760	337.2	13.0	5.813	303.2	326.6	333.1	349.1	1.599	1.902	
61.000	2978.049	1.036	1090.7	-151.36	.758	337.6	13.0	5.857	303.3	327.1	333.2	349.4	1.599	1.903	
62.000	3180.834	0.994	1085.5	-151.37	.756	338.0	12.9	5.901	303.4	327.6	333.3	349.6	1.599	1.904	
63.000	3396.163	0.952	1080.3	-151.37	.754	338.4	12.9	5.946	303.5	328.1	333.4	349.9	1.599	1.905	
64.000	3624.146	0.910	1075.1	-151.36	.752	338.8	12.8	5.991	303.6	328.6	333.5	350.1	1.599	1.906	
65.000	3865.893	0.868	1069.9	-151.34	.750	339.2	12.8	6.036	303.7	329.1	333.6	350.4	1.599	1.907	
66.000	4121.414	0.826	1064.7	-151.31	.748	339.6	12.7	6.081	303.8	329.6	333.7	350.6	1.599	1.908	
67.000	4390.719	0.784	1059.5	-151.27	.746	340.0	12.7	6.126	303.9	330.1	333.8	350.9	1.599	1.909	
68.000	4674.908	0.742	1054.3	-151.22	.744	340.4	12.6	6.171	304.0	330.6	333.9	351.1	1.599	1.910	
69.000	4974.081	0.699	1049.1	-151.16	.742	340.8	12.6	6.216	304.1	331.1	334.0	351.4	1.599	1.911	
70.000	5288.248	0.657	1043.9	-151.09	.740	341.2	12.5	6.261	304.2	331.6	334.1	351.6	1.599	1.912	
71.000	5617.509	0.615	1038.7	-151.01	.738	341.6	12.5	6.306	304.3	332.1	334.2	351.9	1.599	1.913	
72.000	5961.974	0.573	1033.5	-150.92	.736	342.0	12.4	6.351	304.4	332.6	334.3	352.1	1.599	1.914	
73.000	6331.753	0.531	1028.3	-150.82	.734	342.4	12.4	6.396	304.5	333.1	334.4	352.4	1.599	1.915	
74.000	6727.856	0.489	1023.1	-150.71	.732	342.8	12.3	6.441	304.6	333.6	334.5	352.6	1.599	1.916	
75.000	7150.293	0.447	1017.9	-150.59	.730	343.2	12.3	6.486	304.7	334.1	334.6	352.9	1.599	1.917	
76.000	7599.074	0.405	1012.7	-150.46	.728	343.6	12.2	6.531	304.8	334.6	334.7	353.1	1.599	1.918	
77.000	8074.209	0.363	1007.5	-150.32	.726	344.0									

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 7C.
 RP-1 298 C₈H₁₈ 0.80 -6.92 3C.

BULK DENSITY = 1.011 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 274.68 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	561.8
TEMP, DEG K	3577.6	3029.7	2557.7	2151.0	1800.3	1618.9	1497.9	1237.5	1013.9	823.3	662.3	528.1	3225.1
ENTHALPY (-)	21.59	48.42	71.12	90.23	106.28	114.38	119.68	130.78	139.92	147.38	153.41	158.24	38.91
CP	.4938	.4855	.4758	.4641	.4505	.4415	.4349	.4174	.3998	.3824	.3664	.3534	.4886
IMPUL OPT		152.79	207.57	244.37	271.44	284.11	292.12	308.21	320.85	330.80	338.64	344.78	122.75
IMPUL VAC		229.02	254.95	278.21	296.94	306.02	311.83	323.65	333.00	340.37	346.16	350.67	223.76
EPSILON		1.065	1.662	2.983	5.646	8.291	10.965	21.566	42.635	84.344	166.499	327.543	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	572.4
TEMP, DEG K	3577.6	3238.7	2905.3	2561.0	2212.7	2018.6	1886.6	1599.9	1355.6	1151.3	983.2	846.0	3370.5
ENTHALPY (-)	21.59	49.05	73.40	94.82	113.40	122.96	129.30	142.80	154.25	163.96	172.22	179.31	38.61
X BAR	4.447	4.363	4.300	4.262	4.247	4.244	4.243	4.242	4.242	4.242	4.242	4.242	4.394
N	4.447	4.363	4.300	4.262	4.247	4.244	4.243	4.242	4.242	4.242	4.242	4.242	4.394
CP	1.2200	1.0183	.7865	.6054	.5117	.4872	.4774	.4688	.4702	.4818	.5032	.5308	1.1051
IMPUL OPT		154.58	212.32	252.41	282.61	296.97	306.11	324.73	339.72	351.93	362.00	370.41	121.70
IMPUL VAC		233.61	263.19	289.80	311.36	321.91	328.71	342.80	354.35	363.93	371.96	378.79	226.91
EPSILON		1.080	1.746	3.224	6.226	9.232	12.299	24.691	50.230	103.442	215.724	455.661	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C+O	1.5998	1.5498	1.5078	1.4722	1.4322	1.4025	1.3769	1.2998	1.1965	1.0634	.9029	.7234	1.5686
-94.05 C+O2	.5455	.5960	.6382	.6739	.7139	.7436	.7692	.8463	.9497	1.0827	1.2432	1.4227	.5770
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1283	.0887	.0527	.0238	.0072	.0030	.0014	.0002	.0000	.0000	.0000	.0000	.1040
9.33 H+O	.1783	.1070	.0503	.0157	.0028	.0008	.0003	.0000	.0000	.0000	.0000	.0000	.1338
.00 H2	.5166	.5081	.5143	.5381	.5786	.6094	.6355	.7130	.8165	.9496	1.1101	1.2895	.5100
-57.80 H2+O	1.4253	1.4895	1.5298	1.5378	1.5121	1.4844	1.4594	1.3826	1.2792	1.1461	.9856	.8062	1.4665
59.56 O	.0251	.0109	.0031	.0004	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0157
.00 O2	.0273	.0127	.0038	.0005	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0179

SYSTEM LIQUID BIPROPELLANT
COMPONENT TREF FORMULA
LOX 90.2 02
RP-1 298 C=0.14933

PC 1000. PSIA
DENSITY
G/CC
1.14
0.80

HEAT FORM
(KCAL/FORM.WT.)
-3.08
-6.92

WT. 0/0
7C.
3C.

PROZEN EXPANSION
C STAR 5913.0 FT/SEC

EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I OPT G/CC DEG	DELVAC DELVAC DELVAC	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
1.000	1.000	1000.000	3577.6	-21.53	496	101.0	221.1	221.9	221.9	221.9	1.230	1.245
2.000	1.740	561.182	3225.8	-38.91	489	101.0	221.1	221.9	221.9	221.9	1.434	1.465
3.000	9.157	109.211	2409.5	-78.15	472	101.0	221.1	221.9	221.9	221.9	1.504	1.540
4.000	15.964	62.523	2147.5	-90.40	464	101.0	221.1	221.9	221.9	221.9	1.539	1.599
5.000	25.003	39.905	1980.1	-98.12	458	101.0	221.1	221.9	221.9	221.9	1.559	1.636
6.000	34.113	29.314	1861.5	-103.52	453	101.0	221.1	221.9	221.9	221.9	1.572	1.660
7.000	43.448	23.016	1770.3	-107.63	448	101.0	221.1	221.9	221.9	221.9	1.578	1.681
8.000	54.000	18.518	1696.4	-110.94	445	101.0	221.1	221.9	221.9	221.9	1.580	1.698
9.000	66.842	15.422	1634.9	-113.67	442	101.0	221.1	221.9	221.9	221.9	1.580	1.712
10.000	81.301	13.106	1582.4	-115.98	440	101.0	221.1	221.9	221.9	221.9	1.578	1.724
11.000	98.244	11.332	1536.8	-117.98	437	101.0	221.1	221.9	221.9	221.9	1.575	1.735
12.000	118.449	9.811	1490.6	-119.74	435	101.0	221.1	221.9	221.9	221.9	1.570	1.744
13.000	142.942	8.488	1444.8	-121.29	433	101.0	221.1	221.9	221.9	221.9	1.564	1.752
14.000	171.419	7.398	1399.8	-122.69	431	101.0	221.1	221.9	221.9	221.9	1.558	1.760
15.000	204.000	6.499	1357.9	-123.96	429	101.0	221.1	221.9	221.9	221.9	1.550	1.767
16.000	241.458	5.760	1317.1	-125.16	427	101.0	221.1	221.9	221.9	221.9	1.540	1.773
17.000	284.000	5.132	1278.2	-126.16	425	101.0	221.1	221.9	221.9	221.9	1.528	1.779
18.000	331.758	4.608	1241.0	-127.13	424	101.0	221.1	221.9	221.9	221.9	1.514	1.786
19.000	384.650	4.172	1206.5	-127.87	422	101.0	221.1	221.9	221.9	221.9	1.498	1.790
20.000	442.657	3.809	1174.8	-128.47	421	101.0	221.1	221.9	221.9	221.9	1.481	1.794
21.000	505.819	3.501	1145.7	-128.93	420	101.0	221.1	221.9	221.9	221.9	1.462	1.798
22.000	574.192	3.246	1119.9	-129.26	419	101.0	221.1	221.9	221.9	221.9	1.441	1.802
23.000	647.819	3.031	1097.2	-129.48	418	101.0	221.1	221.9	221.9	221.9	1.418	1.806
24.000	726.758	2.851	1077.5	-129.61	417	101.0	221.1	221.9	221.9	221.9	1.393	1.809
25.000	811.051	2.701	1060.9	-129.66	416	101.0	221.1	221.9	221.9	221.9	1.366	1.812
26.000	900.758	2.571	1047.2	-129.68	415	101.0	221.1	221.9	221.9	221.9	1.338	1.816
27.000	995.919	2.461	1036.5	-129.68	414	101.0	221.1	221.9	221.9	221.9	1.309	1.819
28.000	1096.581	2.361	1028.7	-129.65	413	101.0	221.1	221.9	221.9	221.9	1.279	1.822
29.000	1202.819	2.271	1023.9	-129.59	412	101.0	221.1	221.9	221.9	221.9	1.248	1.824
30.000	1314.681	2.191	1021.9	-129.44	411	101.0	221.1	221.9	221.9	221.9	1.216	1.827
31.000	1432.192	2.121	1021.4	-129.26	410	101.0	221.1	221.9	221.9	221.9	1.183	1.829
32.000	1555.419	2.061	1022.7	-128.93	409	101.0	221.1	221.9	221.9	221.9	1.149	1.832
33.000	1684.419	2.011	1025.0	-128.47	408	101.0	221.1	221.9	221.9	221.9	1.114	1.834
34.000	1819.192	1.971	1028.7	-127.87	407	101.0	221.1	221.9	221.9	221.9	1.078	1.836
35.000	1959.758	1.941	1033.9	-127.13	406	101.0	221.1	221.9	221.9	221.9	1.041	1.838
36.000	2106.192	1.921	1039.8	-126.16	405	101.0	221.1	221.9	221.9	221.9	1.003	1.840
37.000	2258.419	1.911	1047.2	-125.16	404	101.0	221.1	221.9	221.9	221.9	0.964	1.842
38.000	2416.419	1.901	1056.0	-124.03	403	101.0	221.1	221.9	221.9	221.9	0.924	1.844
39.000	2580.192	1.891	1066.5	-122.69	402	101.0	221.1	221.9	221.9	221.9	0.883	1.846
40.000	2749.758	1.881	1078.7	-121.29	401	101.0	221.1	221.9	221.9	221.9	0.841	1.848
41.000	2925.192	1.871	1092.9	-119.74	400	101.0	221.1	221.9	221.9	221.9	0.798	1.849
42.000	3106.419	1.861	1109.2	-117.98	399	101.0	221.1	221.9	221.9	221.9	0.754	1.851
43.000	3293.419	1.851	1127.5	-115.98	398	101.0	221.1	221.9	221.9	221.9	0.709	1.853
44.000	3486.192	1.841	1147.2	-113.67	397	101.0	221.1	221.9	221.9	221.9	0.663	1.854
45.000	3684.657	1.831	1168.2	-110.94	396	101.0	221.1	221.9	221.9	221.9	0.616	1.856
46.000	3888.819	1.821	1190.9	-107.63	395	101.0	221.1	221.9	221.9	221.9	0.568	1.857
47.000	4098.758	1.811	1215.0	-103.52	394	101.0	221.1	221.9	221.9	221.9	0.519	1.859
48.000	4314.419	1.801	1240.9	-98.12	393	101.0	221.1	221.9	221.9	221.9	0.469	1.860
49.000	4535.758	1.791	1268.2	-90.40	392	101.0	221.1	221.9	221.9	221.9	0.418	1.861
50.000	4762.819	1.781	1297.5	-78.15	391	101.0	221.1	221.9	221.9	221.9	0.366	1.863
8.291	28.046	14.496	1618.7	-114.38	441	284.1	290.7	303.5	306.0	1.580	1.702	

SHIFTING EXPANSION
C STAR 5913.0 FT/SEC

EPSILON	PC/CF	P PSIA	TEMP DEG K	ENTHALPY KCAL/100GM	CP CAL/ I OPT G/CC DEG	DELVAC DELVAC DELVAC	I SEA LVL	I AT 10000	I AT 50000	I VAC	CF SEA LVL	CF VAC LVL
1.000	1.000	1000.000	3577.6	-21.59	1.270							
2.000	1.747	572.393	3370.5	-38.61	1.105	121.7	105.2	104.4	224.2	225.0	226.6	1.234
3.000	2.417	322.241	3170.5	-56.43	737	121.7	105.2	104.4	224.2	225.0	226.6	1.438
4.000	3.026	149.261	2908.9	-72.66	621	248.9	30.5	567	278.8	281.3	286.2	1.517
5.000	3.585	67.540	2644.0	-81.34	565	248.9	36.1	748	286.5	289.6	293.5	1.559
6.000	4.085	33.336	2325.7	-87.62	534	273.6	41.2	938	291.0	295.2	303.2	1.583
7.000	4.527	26.622	2111.5	-91.74	515	281.1	45.1	1129	296.0	299.9	307.9	1.600
8.000	4.910	21.850	1900.1	-95.03	503	281.1	47.5	1290	295.7	301.4	312.5	1.607
9.000	5.235	17.783	1687.7	-97.61	494	292.0	50.2	1475	296.4	303.1	315.7	1.613
10.000	5.517	15.196	1503.8	-100.28	488	296.1	52.2	1656	299.3	310.4	318.2	1.616
11.000	5.758	13.181	1348.1	-102.78	484	299.6	54.3	1840	305.0	320.7	323.9	1.782
12.000	6.054	11.332	1206.5	-105.04	478	307.7	56.5	2027	307.7	324.9	327.9	1.765
13.000	6.422	10.128	1077.5	-107.77	478	305.4	58.0	2207	305.3	324.4	328.2	1.762
14.000	6.766	9.271	962.0	-110.47	478	307.0	59.3	2393	305.0	323.0	330.0	1.795
15.000	7.191	8.577	862.9	-112.00	478	309.9	61.6	2586	327.2	327.2	331.6	1.804
16.000	7.610	7.914	775.0	-113.40	478	312.5	63.9	2783	312.5	327.5	333.4	1.819
17.000	8.026	7.277	697.7	-114.70	478	313.7	66.2	2987	329.4	334.4		1.819
18.000	8.437	6.633	631.5	-115.89	478	315.3	68.3	3198	330.3	335.7		1.826
19.000	8.842	6.055	572.6	-116.99	478	316.9	70.9	3467	331.1	336.8		1.832
20.000	9.242	5.518	518.1	-117.99	478	318.0	73.2	3742	331.8	337.8		1.838
21.000	9.637	5.009	468.5	-118.98	478	318.6	75.3	4019	332.5	338.6		1.844
22.000	10.028	4.671	424.2	-119.89	478	320.8	77.0	4300	333.2	339.8		1.849
23.000	10.414	4.392	384.4	-120.74	478	322.0	78.7	4578	333.7	340.7		1.853
24.000	10.796	4.146	348.9	-121.54	478	323.0	80.5	4852	334.3	341.5		1.858
25.000	11.174	3.921	317.0	-122.30	478	323.8	82.0	5122	334.7	342.0		1.860
26.000	11.548	3.613	289.2	-123.02	478	325.0	83.0	5399	335.0	342.5		1.866
27.000	11.918	3.307	265.5	-123.71	478	325.9	84.0	5679	335.3	343.7		1.870
28.000	12.284	3.015	245.6	-124.37	478	326.8	84.8	5955	335.9	344.6		1.874
29.000	12.646	2.738	228.2	-124.99	478	327.6	85.2	6228	336.2	345.2		1.878
30.000	13.004	2.475	213.0	-125.59	478	328.4	85.4	6498	336.4	345.6		1.880
31.000	13.358	2.226	199.0	-126.16	478	329.2	85.6	6765	336.7	346.2		1.884
32.000	13.709	2.000	186.1	-126.71	478	329.9	85.7	7029	336.9	346.8		1.887
33.000	14.057	1.793	174.3	-127.23	478	330.6	85.8	7291	337.1	347.3		1.890
34.000	14.402	1.603	163.5	-127.72	478	331.3	85.9	7549	337.3	347.8		1.892
35.000	14.744	1.427	153.6	-128.19	478	331.9	86.0	7805	337.4	348.3		1.895
36.000	15.083	1.265	144.6	-128.63	478	332.5	86.1	8060	337.6	348.8		1.898
37.000	15.419	1.115	136.5	-129.05	478	333.1	86.1	8314	337.7	349.3		1.901
38.000	15.751	1.000	129.0	-129.44	478	333.7	86.2	8567	337.8	349.7		1.902
39.000	16.080	0.900	122.0	-129.81	478	334.2	86.3	8819	337.9	350.1		1.905
40.000	16.407	0.812	115.4	-130.16	478	334.8	86.4	9070	338.0	350.5		1.907
41.000	16.731	0.736	109.0	-130.49	478	335.3	86.5	9319	338.1	350.9		1.909
42.000	17.052	0.670	102.8	-130.80	478	335.8	86.5	9567	338.2	351.3		1.911
43.000	17.370	0.610	96.8	-131.09	478	336.3	86.6	9814	338.3	351.7		1.913
44.000	17.685	0.556	91.0	-131.37	478	336.7	86.7	10060	338.3	352.0		1.915
45.000	18.000	0.505	85.3	-131.62	478	337.2	86.7	10305	338.4	352.4		1.917
46.000	18.312	0.459	80.0	-131.87	478	337.6	86.8	10549	338.4	352.8		1.919
47.000	18.622	0.416	75.0	-132.10	478	338.0	86.8	10792	338.5	353.1		1.921
48.000	18.930	0.375	70.0	-132.32	478	338.4	86.9	11034	338.5	353.4		1.923
49.000	19.236	0.336	65.0	-132.53	478	338.8	86.9	11275	338.5	353.7		1.925
50.000	19.540	0.299	60.0	-132.74	478	339.2	86.9	11515	338.6	354.0		1.927
51.000	19.842	0.264	55.0	-132.94	478	339.6	87.0	11754	338.6	354.3		1.929
52.000	20.143	0.230	50.0	-133.14	478	340.0	87.0	11992	338.7	354.6		1.931
53.000	20.442	0.197	45.0	-133.33	478	340.4	87.0	12229	338.7	354.9		1.933
54.000	20.740	0.166	40.0	-133.52	478	340.8	87.0	12465	338.8	355.2		1.935
55.000	21.037	0.136	35.0	-133.70	478	341.2	87.0	12700	338.8	355.5		1.937
56.000	21.333	0.107	30.0	-133.88	478	341.6	87.0	12934	338.9	355.8		1.939
57.000	21.628	0.080	25.0	-134.05	478	342.0	87.0	13167	338.9	356.1		1.941
58.000	21.922	0.054	20.0	-134.22	478	342.4	87.0	13400	339.0	356.4		1.943
59.000	22.215	0.030	15.0	-134.39	478	342.8	87.0	13632	339.0	356.7		1.945
60.000	22.507	0.006	10.0	-134.56	478	343.2	87.0	13864	339.1	357.0		1.947
61.000	22.799	0.000	5.0	-134.73	478	343.6	87.0	14095	339.1	357.3		1.949
62.000	23.090	0.000	0.0	-134.90	478	344.0	87.0	14326	339.2	357.6		1.951
63.000	23.381	0.000	0.0	-135.07	478	344.4	87.0	14556	339.2	357.9		1.953
64.000	23.672	0.000	0.0	-135.24	478	344.8	87.0	14786	339.3	358.2		1.955
65.000	23.963	0.000	0.0	-135.41	478	345.2	87.0	15016	339.3	358.5		1.957
66.000	24.254	0.000	0.0	-135.58	478	345.6	87.0	15245	339.4	358.8		1.959
67.000	24.545	0.000	0.0	-135.75	478	346.0	87.0	15475	339.4	359.1		1.961
68.000	24.836	0.000	0.0	-135.92	478	346.4	87.0	15704	339.5	359.4		1.963
69.000	25.127	0.000	0.0	-136.09	478	346.8	87.0	15934	339.5	359.7		1.965
70.000	25.418	0.000	0.0	-136.26	478	347.2	87.0	16163	339.6	360.0		1.967
71.000	25.709	0.000	0.0	-136.43	478	347.6	87.0	16393	339.6	360.3		1.969
72.000	26.000	0.000	0.0	-136.60	478	348.0	87.0	16622	339.7	360.6		1.971
73.000	26.291	0.000	0.0	-136.77	478	348.4	87.0	16852	339.7	360.9		1.973
74.000	26.582	0.000	0.0	-136.94	478	348.8	87.0	17081	339.8	361.2		1.975
75.000	26.873	0.000	0.0	-137.11	478	349.2	87.0	17311	339.8	361.5		1.977
76.000	27.164	0.000	0.0	-137.28	478	349.6	87.0	17540	339.9	361.8		1.979
77.000	27.455	0.000	0.0	-137.45	478	350.0	87.0	17770	339.9	362.1		1.981
78.000	27.746	0.000	0.0	-137.62	478	350.4	87.0	18000	340.0	362.4		1.983
79.000	28.037	0.000	0.0	-137.79	478	350.8	87.0	18229	340.0	362.7		1.985
80.000	28.328	0.000	0.0	-137.96	478	351.2	87.0	18459	340.1	363.0		1.987
81.000	28.619	0.000	0.0	-138.13	478	351.6	87.0	18688	340.1	363.3		1.989
82.000	28.910	0.000	0.0	-138.30	478	352.0	87.0	18918	340.2	363.6		1.991
83.000	29.201	0.000	0.0	-138.47	478	352.4	87.0	19147	340.2	363.9		1.993
84.000	29.492	0.000	0.0	-138.64	478	352.8	87.0	19377	340.3	364.2		1.995
85.000	29.783	0.000	0.0	-138.81	478	353.2	87.0	19606	340.3	364.5		1.997
86.000	30.074	0.000	0.0	-138.98	478	353.6	87.0	19836	340.4	364.8		1.999
87.000	30.365	0.000	0.0	-139.15	478	354.0	87.0	20065	340.4	365.1		2.001
88.000	30.656	0.000	0.0	-139.32	478	354.4	87.0	20295	340.5	365.4		2.003
89.000	30.947	0.000	0.0	-139.49	478	354.8	87.0	20524	340.5	365.7		2.005
90.000	31.238	0.000	0.0	-139.66	478	355.2	87.0	20754	340.6	366.0		2.007
91.000	31.529	0.000	0.0	-139.83	478	355.6	87.0	20983	340.6	366.3		2.009
92.000	31.820	0.000	0.0	-140.00	478	356.0	87.0	21213	340.7	366.6		2.011
93.000	32.111	0.000	0.0	-140.17	478	356.4	87.0	21442	340.7	366.9		2.013
94.000	32.402	0.000	0.0	-140.34	478	356.8	87.0	21672	340.8	367.2		2.015
95.000	32.693	0.000	0.0	-140.51	478	357.2	87.0	21901	340.8	367.5		2.017
96.000	32.984	0.000	0.0	-140.68	478	357.6	87.0	22131	340.9	367.8		2.019
97.000	33.27											

SYSTEM LIQUID BIPROPELLANT COMPONENT		LEG K	90.2 02	29H C=H1.953
PRESSURE PROFILE DATA		PC 100C, PSIA	DEENSITY	HEAT FUNK
PE 0.1 PSIA		WT. O/O	GM/CC	(KCAL /ICRM.WT.)
TRF FORMULA				
			1.14	-3.0P
			0.8C	-6.92
				72.5
				27.5

BULK DENSITY = 1.021 GM/CC
MIXTURE RATIO = 2.636 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAPHER ENTROPY 267.73 EU/100GMS

CHAMBER													THROAT														
FROZEN													EXPANSION														
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	59.4	368.8	336.9	309.2	283.8	257.9	238.5	225.8	195.3	167.5	142.9	122.0	104.5	349.1	
TEMP, DEG K	20.59	46.81	69.08	87.91	103.79	111.84	117.11	128.22	137.42	144.97	151.13	156.09	176.2	20.59	46.81	69.08	87.91	103.79	111.84	117.11	128.22	137.42	144.97	151.13	156.09	176.2	
ENTHALPY (-)	4.804	4.726	4.646	4.530	4.408	4.325	4.264	4.102	3.935	3.763	3.643	3.475	3.262	4.804	4.726	4.646	4.530	4.408	4.325	4.264	4.102	3.935	3.763	3.643	3.475	3.262	
CP																											
IMPUL OPT	151.03	205.38	242.00	269.04	281.74	289.78	306.00	318.80	328.95	336.99	343.33	347.62	359.95	151.03	205.38	242.00	269.04	281.74	289.78	306.00	318.80	328.95	336.99	343.33	347.62	359.95	
IMPUL VAC	226.55	252.45	275.74	295.56	303.72	309.66	321.60	331.15	338.74	344.71	349.43	352.24	369.20	226.55	252.45	275.74	295.56	303.72	309.66	321.60	331.15	338.74	344.71	349.43	352.24	369.20	
EPSILON	1.000	1.069		3.006	5.711	8.408	11.142	22.025	43.794	67.179	173.214	342.910	1.000	1.000	1.069		3.006	5.711	8.408	11.142	22.025	43.794	67.179	173.214	342.910	1.000	
SHIFTING EXPANSION																											
PRESSURE, PSIA	1000	398.1	158.5	65.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	57.0	368.8	336.9	309.2	283.8	257.9	238.5	225.8	195.3	167.5	142.9	122.0	104.5	349.1	
TEMP, DEG K	20.59	47.50	71.68	93.44	112.92	123.24	130.17	145.17	156.06	169.08	178.48	186.53	37.07	20.59	47.50	71.68	93.44	112.92	123.24	130.17	145.17	156.06	169.08	178.48	186.53	37.07	
X BAR	4.230	4.133	4.047	3.975	3.924	3.906	3.858	3.890	3.889	3.888	3.888	3.888	4.171	4.230	4.133	4.047	3.975	3.924	3.906	3.858	3.890	3.889	3.888	3.888	3.888	4.171	
N	1.5468	1.4554	1.2761	1.0110	.7256	.6011	.5416	.4735	.4542	.4503	.4545	1.5020	1.5468	1.4554	1.2761	1.0110	.7256	.6011	.5416	.4735	.4542	.4503	.4545	1.5020	1.5468	1.4554	
IMPUL OPT	153.00	210.82	251.74	281.42	298.83	308.75	329.21	345.82	359.41	370.62	379.95	389.75	399.20	153.00	210.82	251.74	281.42	298.83	308.75	329.21	345.82	359.41	370.62	379.95	389.75	399.20	
IMPUL VAC	231.68	267.19	290.40	318.04	325.79	331.43	340.16	346.09	352.09	357.28	361.69	369.20	231.68	267.19	290.40	318.04	325.79	331.43	340.16	346.09	352.09	357.28	361.69	369.20	231.68	267.19	
EPSILON	1.004	1.778		3.361	6.686	10.066	13.522	27.495	56.298	116.203	241.700	507.350	1.000	1.004	1.778		3.361	6.686	10.066	13.522	27.495	56.298	116.203	241.700	507.350	1.000	
COMPOSITION SHIFTING (PCL/100 GM)																											
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-2.90 C+H+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
67.00 C+H+2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-27.70 C+H+2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
31.94 C+H+3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-17.89 C+H+4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
-26.42 C+O	1.3022	1.2288	1.1572	1.0947	1.0466	1.0250	1.0108	.9722	.9190	.8459	.7496	.6293	1.2575	1.3022	1.2288	1.1572	1.0947	1.0466	1.0250	1.0108	.9722	.9190	.8459	.7496	.6293	1.2575	
-94.05 C+O2	.6645	.7391	.8100	.8725	.9207	.9423	.9564	.9651	1.0683	1.1214	1.2177	1.3380	.7094	.6645	.7391	.8100	.8725	.9207	.9423	.9564	.9651	1.0683	1.1214	1.2177	1.3380	.7094	
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
54.19 C2+H+2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
12.50 C2+H+4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
242.50 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	
52.10 H+	.1218	.0941	.0694	.0469	.0263	.0161	.0104	.0026	.0004	.0000	.0000	.0000	.1048	.1218	.0941	.0694	.0469	.0263	.0161	.0104	.0026	.0004	.0000	.0000	.0000	.1048	
9.33 H+O	.2691	.1977	.1336	.0774	.0331	.0160	.0083	.0011	.0001	.0000	.0000	.0000	.2256	.2691	.1977	.1336	.0774	.0331	.0160	.0083	.0011	.0001	.0000	.0000	.0000	.2256	
.00 H+2	.3329	.3112	.2949	.2869	.2916	.3023	.3135	.3514	.4052	.4785	.5748	.6951	.3194	.3329	.3112	.2949	.2869	.2916	.3023	.3135	.3514	.4052	.4785	.5748	.6951	.3194	
-57.80 H+2+O	1.3924	1.4638	1.5246	1.5720	1.5997	1.6027	1.5982	1.5678	1.5156	1.4425	1.3462	1.2259	1.4363	1.3924	1.4638	1.5246	1.5720	1.5997	1.6027	1.5982	1.5678	1.5156	1.4425	1.3462	1.2259	1.4363	
59.50 H	.0554	.0344	.0186	.0077	.0019	.0006	.0002	.0000	.0000	.0000	.0000	.0000	.0422	.0554	.0344	.0186	.0077	.0019	.0006	.0002	.0000	.0000	.0000	.0000	.0000	.0422	
.00 O2	.0913	.0644	.0386	.0172	.0043	.0012	.0004	.0000	.0000	.0000	.0000	.0000	.0750	.0913	.0644	.0386	.0172	.0043	.0012	.0004	.0000	.0000	.0000	.0000	.0000	.0750	

		SYSTEM LIQUID AIR PROPELLANT				PC ICDD, PSIA		PC 0.1 PSIA	
		COMPONENT		TEMP FORMULA		DENSITY		HEAT FLOW	
		CPU K		90.2 82		W/CC		ICAL/CFM/WT.1	
		LDA		208 CONT.955		1.14		-3.0H	
		RW-1				0.0C		-6.92	
				FROZEN EXPANSION		C STAR = 5724.0 FT/SEC			
				CP CAL / I OPT DELTAC		I SEA		I AT	
				LVL		LVL		LVL	

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 9C.2 O2 1.14 -3.08 75.
 RP-1 298 C#H1.953 0.80 -6.92 25.

BULK DENSITY = 1.031 GM/CC
 MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 260.23 EU/100GMS

CHAMBER THROAT

	10CO	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	560.2
PRESSURE, PSIA	3694.3	3148.2	2675.5	2266.2	1911.6	1727.5	1604.5	1338.5	1108.6	910.8	741.7	598.6	3341.7
TEMP, DEG K	19.59	44.85	66.35	84.59	100.01	107.84	112.99	123.85	132.88	140.33	146.42	151.37	35.95
ENTHALPY (-)	4.660	.4587	.4502	.4403	.4288	.4213	.4155	.4006	.3845	.3680	.3526	.3382	.4617
CP	148.24	201.68	237.78	264.50	277.07	285.04	301.16	313.93	324.09	332.17	338.58	344.76	119.30
IMPUL OPT	222.44	248.03	271.08	289.75	298.86	304.71	316.69	326.27	333.91	339.97	344.76	344.76	217.16
IMPUL VAC	1.067	1.674	3.021	5.754	8.485	11.258	22.328	44.562	89.078	177.780	353.602	1.000	
EPSILON													

	10CO	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	577.0
PRESSURE, PSIA	3694.3	3141.8	2675.5	2266.2	1911.6	1727.5	1604.5	1338.5	1108.6	910.8	741.7	598.6	3341.7
TEMP, DEG K	19.59	45.52	68.96	90.21	109.55	120.01	127.17	143.20	157.61	170.30	181.29	190.76	35.40
ENTHALPY (-)	4.041	3.943	3.851	3.767	3.691	3.651	3.625	3.573	3.544	3.536	3.535	3.535	3.981
X BAR	4.041	3.943	3.851	3.767	3.691	3.651	3.625	3.573	3.544	3.536	3.535	3.535	3.981
N	1.7108	1.7240	1.6500	1.5998	1.4380	1.3018	1.1830	.8389	.5502	.4537	.4320	.4253	1.7239
CP	150.17	207.23	247.86	279.74	295.56	305.93	327.91	346.51	362.09	375.06	385.88	396.61	220.62
IMPUL OPT	227.61	258.03	286.46	310.90	323.50	331.88	349.85	365.00	377.51	387.91	396.61	396.61	220.62
IMPUL VAC	1.086	1.790	3.416	6.926	10.615	14.492	30.769	65.143	136.457	285.461	599.083	1.000	
EPSILON													

	10CO	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	577.0
PRESSURE, PSIA	3694.3	3141.8	2675.5	2266.2	1911.6	1727.5	1604.5	1338.5	1108.6	910.8	741.7	598.6	3341.7
TEMP, DEG K	19.59	45.52	68.96	90.21	109.55	120.01	127.17	143.20	157.61	170.30	181.29	190.76	35.40
ENTHALPY (-)	4.041	3.943	3.851	3.767	3.691	3.651	3.625	3.573	3.544	3.536	3.535	3.535	3.981
X BAR	4.041	3.943	3.851	3.767	3.691	3.651	3.625	3.573	3.544	3.536	3.535	3.535	3.981
N	1.7108	1.7240	1.6500	1.5998	1.4380	1.3018	1.1830	.8389	.5502	.4537	.4320	.4253	1.7239
CP	150.17	207.23	247.86	279.74	295.56	305.93	327.91	346.51	362.09	375.06	385.88	396.61	220.62
IMPUL OPT	227.61	258.03	286.46	310.90	323.50	331.88	349.85	365.00	377.51	387.91	396.61	396.61	220.62
IMPUL VAC	1.086	1.790	3.416	6.926	10.615	14.492	30.769	65.143	136.457	285.461	599.083	1.000	
EPSILON													

COMPOSITION SHIFTING (MOL/100 GM)

170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C#H#C	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
67.00 C#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C#H2#O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C#H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C#O	1.0294	.9420	.8539	.7671	.6839	.6386	.6082	.5469	.5088	.4836	.4522	.4081	.9773
-94.05 C#O2	.7587	.8463	.9345	1.0214	1.1045	1.1499	1.1802	1.2415	1.2797	1.3048	1.3363	1.3804	.8109
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1012	.0807	.0631	.0482	.0354	.0287	.0243	.0144	.0061	.0016	.0003	.0000	.0885
9.33 H#O	.3285	.2618	.2023	.1500	.1044	.0807	.0649	.0318	.0091	.0012	.0001	.0000	.2878
.00 H2	.2149	.1951	.1752	.1577	.1427	.1354	.1311	.1256	.1318	.1521	.1836	.2277	.2036
-57.80 H2#O	1.3145	1.3800	1.4384	1.4896	1.5339	1.5563	1.5707	1.5977	1.6070	1.5930	1.5627	1.5187	1.3545
59.56 O	.0861	.0621	.0427	.0275	.0159	.0107	.0076	.0024	.0003	.0000	.0000	.0000	.0712
.00 O2	.2057	.1745	.1406	.1053	.0702	.0508	.0378	.0128	.0015	.0000	.0000	.0000	.1874

SYSTEM LIQUID BIPROPELLANT										PC 1000, PSIA									
COMPONENT										DENSITY									
LOX										HEAT FORM									
RP-1										WT. 0/0									
298 C/HI-953										75.									
FROZEN EXPANSION										25.									
C STAR = 5620.7 FT/SEC																			
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC					
			DEG K	KCAL/100GM	GM DEG		/P	/P	LVL	10000	50000								
1.000	1.000	1000.000	3694.3	-19.59	1.466														
1.000	1.785	160.205	1941.7	-35.95	.462	119.3	97.9	.175	214.6	215.4	216.9	217.2	1.228	1.243					
2.000	9.002	111.087	2533.2	-72.75	.447	215.5	40.4	.364	250.6	252.2	255.4	256.0	1.435	1.465					
3.000	15.760	63.456	2270.2	-84.41	.440	237.5	33.4	.526	263.1	265.5	270.0	270.9	1.506	1.550					
4.000	26.441	40.915	2102.2	-91.77	.435	250.7	29.2	.715	269.4	272.6	278.7	279.9	1.542	1.602					
5.000	31.335	29.958	1982.8	-96.95	.431	259.5	26.7	.889	273.1	277.0	284.6	286.1	1.568	1.638					
6.000	42.255	23.666	1890.9	-100.90	.428	266.0	24.8	1.049	275.4	280.0	289.0	290.8	1.576	1.665					
7.000	52.442	19.669	1814.3	-104.08	.425	271.1	23.4	1.227	276.5	281.9	292.4	294.5	1.583	1.686					
8.000	62.854	15.900	1754.2	-106.71	.422	275.3	22.3	1.400	277.0	283.2	295.2	297.6	1.586	1.703					
9.000	73.618	13.347	1701.1	-108.95	.420	278.8	21.3	1.574		284.0	297.4	300.1	1.588	1.718					
10.000	85.272	11.727	1655.0	-110.88	.418	281.8	20.5	1.749		284.4	299.3	302.3	1.589	1.731					
11.000	96.963	10.313	1614.2	-112.50	.416	284.4	19.8	1.923		284.5	301.0	304.2	1.589	1.742					
12.000	109.253	9.153	1577.8	-114.09	.414	286.7	19.2	2.100			302.4	305.9	1.589	1.751					
13.000	122.053	8.190	1545.0	-115.45	.412	288.8	18.7	2.282			303.6	307.5	1.589	1.760					
14.000	135.322	7.391	1515.2	-116.62	.411	290.6	18.2	2.464			304.6	308.8	1.589	1.768					
15.000	148.009	6.720	1487.8	-117.60	.409	292.3	17.8	2.646			305.6	310.1	1.589	1.775					
16.000	162.544	6.152	1462.7	-118.43	.408	293.8	17.4	2.826			306.4	311.2	1.589	1.781					
17.000	176.442	5.668	1439.4	-119.18	.407	295.2	17.0	3.005			307.1	312.3	1.589	1.787					
18.000	190.444	5.251	1417.7	-119.85	.405	296.5	16.7	3.181			307.8	313.2	1.589	1.793					
19.000	204.459	4.890	1397.5	-120.48	.404	297.7	16.4	3.353			308.4	314.1	1.589	1.798					
20.000	218.545	4.575	1378.5	-121.24	.403	298.8	16.1	3.522			308.9	314.9	1.589	1.803					
21.000	232.609	4.299	1360.7	-122.04	.402	299.9	15.9	3.687			309.4	315.7	1.589	1.807					
22.000	246.611	4.055	1345.9	-122.84	.401	300.9	15.6	3.849			309.9	316.5	1.589	1.811					
23.000	261.456	3.848	1327.9	-123.64	.400	301.9	15.4	4.006			310.4	317.1	1.589	1.815					
24.000	276.061	3.596	1312.8	-124.48	.399	302.4	15.2	4.214			310.6	317.8	1.589	1.819					
25.000	290.484	3.396	1298.5	-125.45	.398	303.5	14.9	4.402			310.9	318.4	1.589	1.823					
26.000	311.135	3.214	1284.8	-125.99	.397	304.2	14.8	4.590			311.2	319.0	1.589	1.826					
27.000	327.966	3.040	1271.7	-126.51	.396	305.1	14.6	4.771			311.4	319.5	1.589	1.829					
28.000	345.007	2.898	1259.3	-127.00	.395	305.7	14.4	4.945			311.6	320.1	1.589	1.832					
29.000	362.171	2.761	1247.3	-127.47	.395	306.4	14.2	5.151			311.8	320.6	1.589	1.835					
30.000	379.450	2.635	1235.9	-127.93	.394	307.0	14.1	5.336			312.0	321.1	1.589	1.838					
31.000	396.816	2.520	1224.9	-128.36	.393	307.6	13.9	5.519			312.1	321.5	1.589	1.840					
32.000	414.246	2.414	1214.6	-128.77	.392	308.2	13.8	5.696			312.2	322.0	1.589	1.843					
33.000	431.715	2.316	1204.2	-129.17	.392	308.8	13.6	5.881			312.3	322.4	1.589	1.845					
34.000	449.200	2.226	1194.4	-129.55	.391	309.3	13.5	6.059			312.4	322.8	1.589	1.848					
35.000	466.642	2.143	1185.0	-129.92	.390	309.8	13.4	6.235			312.5	323.2	1.589	1.850					
36.000	484.142	2.066	1175.9	-130.28	.390	310.3	13.2	6.408			312.6	323.5	1.589	1.852					
37.000	501.583	1.994	1167.0	-130.62	.389	310.8	13.1	6.579			312.7	323.9	1.589	1.854					
38.000	518.932	1.927	1158.5	-130.95	.388	311.3	13.0	6.747			312.7	324.3	1.589	1.856					
39.000	536.236	1.865	1150.3	-131.27	.388	311.7	12.9	6.913			312.8	324.6	1.589	1.858					
40.000	553.466	1.807	1142.3	-131.58	.387	312.1	12.8	7.076			312.8	324.9	1.589	1.860					
41.000	570.613	1.753	1134.5	-131.89	.387	312.5	12.7	7.236			312.9	325.2	1.589	1.862					
42.000	587.672	1.702	1127.0	-132.17	.386	313.0	12.6	7.393			312.9	325.5	1.589	1.863					
43.000	604.640	1.654	1119.7	-132.45	.385	313.3	12.5	7.548			312.9	325.8	1.589	1.865					
44.000	621.516	1.609	1112.5	-132.73	.385	313.7	12.4	7.700			312.9	326.1	1.589	1.867					
45.000	638.337	1.563	1105.6	-132.99	.384	314.1	12.3	7.846			312.9	326.4	1.589	1.869					
46.000	655.082	1.516	1098.9	-133.25	.384	314.5	12.2	7.986			312.9	326.7	1.589	1.870					
47.000	671.754	1.471	1092.3	-133.50	.383	314.8	12.1	8.124			312.9	326.9	1.589	1.871					
48.000	688.355	1.429	1085.9	-133.75	.383	315.1	12.0	8.257			312.9	327.2	1.589	1.873					
49.000	704.846	1.388	1079.7	-133.99	.382	315.5	12.0	8.414			312.9	327.4	1.589	1.874					
50.000	721.049	1.349	1073.6	-134.22	.382	315.8	11.9	8.571			312.9	327.7	1.589	1.876					
8.485	68.046	14.696	1727.5	-107.84	.421	277.1	21.8	1.482	277.1	283.6	296.3	298.9	1.586	1.711					

SHIFTING EXPANSION														
C STAR = 5742.9 FT/SEC														
COMPONENT														
DENSITY														
LOX														
RP-1														
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PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 1000. PSIA PE 0.1 PSIA
 COMPONENT IREF FORMULA DENSITY HEAT FORM WT. O/C
 CEG K GM/CC (KCAL/FORM.WT.)
 LCX 90.2 02 1.14 -3.08 77.5
 RP-1 298 C-H1.953 0.80 -0.42 22.5

BULK DENSITY = 1.041 GM/CC
 MIXTURE RATIO = 3.444 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 252.28 EU/100GMS

CHAMBER	THROAT												
	FROZEN EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	560.7
TEMP, DEG K	3676.2	3138.2	2671.6	2267.0	1915.9	1733.5	1611.5	1347.6	1119.2	922.4	753.7	610.4	3329.4
ENTHALPY (-)	18.58	47.68	63.22	80.67	95.46	102.98	107.53	118.39	127.11	134.33	140.25	145.07	34.16
CP	.4511	.4440	.4358	.4264	.4156	.4085	.4031	.3891	.3740	.3583	.3434	.3290	.4470
IMPUL OPT	144.78	197.05	232.42	258.62	270.97	278.10	294.67	307.27	317.32	325.34	331.72	331.72	116.41
IMPUL VAC	217.31	242.42	265.05	283.41	297.38	298.15	309.98	319.46	327.05	333.69	337.87	337.87	212.11
EPSILON	1.067	1.677	3.031	5.782	8.534	11.332	22.521	45.056	90.315	180.401	360.757	1.000	
	SHIFTING EXPANSION												
PRESSURE, PSIA	1000	398.1	158.5	63.10	25.12	14.70	10.00	3.981	1.585	.631	.251	.100	577.4
TEMP, DEG K	3676.2	3400.9	3159.0	2943.7	2749.4	2643.8	2571.0	2404.4	2245.3	2088.5	1927.8	1753.8	3507.5
ENTHALPY (-)	18.58	43.32	65.71	86.05	104.62	114.70	121.63	137.23	151.55	164.70	176.72	187.63	33.64
X BAR	3.871	3.776	3.687	3.605	3.528	3.487	3.459	3.395	3.339	3.290	3.251	3.224	3.813
N	3.871	3.776	3.687	3.605	3.528	3.487	3.459	3.395	3.339	3.290	3.251	3.224	3.813
CP	1.7048	1.7416	1.7455	1.7156	1.6504	1.5949	1.5477	1.4064	1.2333	1.0310	.8146	.6063	1.7309
IMPUL OPT	146.70	202.48	242.27	273.59	289.17	299.41	321.27	340.11	356.53	370.91	383.49	383.49	114.45
IMPUL VAC	222.37	252.21	280.14	304.25	316.73	325.08	343.24	359.17	373.19	385.52	396.24	396.24	215.48
EPSILON	1.086	1.793	3.429	6.974	10.717	14.672	31.534	68.710	150.921	332.338	728.389	1.000	
	COMPOSITION SHIFTING (MOL/100 GM)												
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C-H-H	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
67.00 C-H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C-H2-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C-H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.85 C-H-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C-H	.7850	.6948	.6039	.5135	.4248	.3746	.3392	.2581	.1831	.1162	.0609	.0219	.7313
-94.05 C-H2	.8244	.9147	1.0057	1.0961	1.1848	1.2350	1.2704	1.3515	1.4265	1.4934	1.5487	1.5877	.8781
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2-H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2-H-H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0770	.0611	.0476	.0363	.0268	.0221	.0190	.0126	.0076	.0040	.0016	.0004	.0672
9.33 H-H	.3520	.2882	.2317	.1824	.1399	.1182	.1039	.0738	.0492	.0299	.0157	.0065	.3131
.00 H2	.1411	.1231	.1062	.0905	.0756	.0674	.0617	.0486	.0362	.0246	.0143	.0060	.1303
-57.80 H2-H	1.2160	1.2740	1.3259	1.3720	1.4127	1.4342	1.4486	1.4800	1.5072	1.5302	1.5489	1.5624	1.2513
59.56 O	.1080	.0821	.0609	.0439	.0305	.0241	.0202	.0124	.0069	.0033	.0013	.0003	.0920
.00 O2	.3669	.3376	.3050	.2699	.2331	.2113	.1956	.1583	.1222	.0887	.0598	.0346	.3498

SWITCHING DEFORMATION													
S STAB = 300C2 F1/SEC													
EPSILON	PC/P	P POS1A	TEMP	ENTHALPY	CP CAL	1 ENT	ELV CAL	ELV CAL	1 SFA	1 AT	1 VAC	CP NEA	CF VAC
			ELU = CAL/1000M	CP ELU					LVL	1000U	7000U	LVL	
1.00C	1.00C	1000.000	55C7.5	-55.04	1.751	114.4	101.0	.175	215.7	215.7	215.2	1.241	1.027
2.00C	1.024	577.100	55C7.5	-55.04	1.751	114.4	101.0	.175	215.7	215.7	215.2	1.241	1.027
3.00C	1.047	511.201	206C2.4	-82.12	.0	235.9	39.9	.450	207.0	206.4	218.1	275.1	1.027
4.00C	1.174	511.201	206C2.4	-82.12	.0	235.9	39.9	.450	207.0	206.4	218.1	275.1	1.027
5.00C	1.245	511.201	206C2.4	-82.12	.0	235.9	39.9	.450	207.0	206.4	218.1	275.1	1.027
6.00C	1.329	254.257	216C2.9	-100.25	.1	208.7	26.7	.114	1.004	215.7	218.1	275.1	1.027
7.00C	1.404	244.246	278C3.5	-104.74	1.630	273.7	75.0	.0	1.225	206.4	218.1	275.1	1.027
8.00C	1.479	211.266	2714.4	-111.93	1.634	274.9	75.0	1.404	207.1	206.4	208.7	1.004	1.027
9.00C	1.554	191.255	2714.4	-111.93	1.634	274.9	75.0	1.404	207.1	206.4	208.7	1.004	1.027
10.00C	1.629	155.377	260C3.5	-115.15	1.605	246.4	26.0	1.753	206.4	211.2	218.1	1.652	1.027
11.00C	1.704	121.276	2612.7	-115.24	1.591	245.1	27.4	1.926	206.7	211.2	218.1	1.652	1.027
12.00C	1.780	101.276	2612.7	-115.24	1.591	245.1	27.4	2.100	206.7	211.2	218.1	1.652	1.027
13.00C	1.855	81.276	2612.7	-115.24	1.591	245.1	27.4	2.274	206.7	211.2	218.1	1.652	1.027
14.00C	1.930	61.276	2612.7	-115.24	1.591	245.1	27.4	2.448	206.7	211.2	218.1	1.652	1.027
15.00C	1.00.00	41.276	2612.7	-115.24	1.591	245.1	27.4	2.622	206.7	211.2	218.1	1.652	1.027
16.00C	1.114.00	21.276	2612.7	-115.24	1.591	245.1	27.4	2.796	206.7	211.2	218.1	1.652	1.027
17.00C	1.228.00	1.276	2612.7	-115.24	1.591	245.1	27.4	2.970	206.7	211.2	218.1	1.652	1.027
18.00C	1.342.00	0.276	2612.7	-115.24	1.591	245.1	27.4	3.144	206.7	211.2	218.1	1.652	1.027
19.00C	1.456.00	0.276	2612.7	-115.24	1.591	245.1	27.4	3.318	206.7	211.2	218.1	1.652	1.027
20.00C	1.570.00	0.276	2612.7	-115.24	1.591	245.1	27.4	3.492	206.7	211.2	218.1	1.652	1.027
21.00C	1.684.00	0.276	2612.7	-115.24	1.591	245.1	27.4	3.666	206.7	211.2	218.1	1.652	1.027
22.00C	1.798.00	0.276	2612.7	-115.24	1.591	245.1	27.4	3.840	206.7	211.2	218.1	1.652	1.027
23.00C	1.912.00	0.276	2612.7	-115.24	1.591	245.1	27.4	4.014	206.7	211.2	218.1	1.652	1.027
24.00C	2.026.00	0.276	2612.7	-115.24	1.591	245.1	27.4	4.188	206.7	211.2	218.1	1.652	1.027
25.00C	2.140.00	0.276	2612.7	-115.24	1.591	245.1	27.4	4.362	206.7	211.2	218.1	1.652	1.027
26.00C	2.254.00	0.276	2612.7	-115.24	1.591	245.1	27.4	4.536	206.7	211.2	218.1	1.652	1.027
27.00C	2.368.00	0.276	2612.7	-115.24	1.591	245.1	27.4	4.710	206.7	211.2	218.1	1.652	1.027
28.00C	2.482.00	0.276	2612.7	-115.24	1.591	245.1	27.4	4.884	206.7	211.2	218.1	1.652	1.027
29.00C	2.596.00	0.276	2612.7	-115.24	1.591	245.1	27.4	5.058	206.7	211.2	218.1	1.652	1.027
30.00C	2.710.00	0.276	2612.7	-115.24	1.591	245.1	27.4	5.232	206.7	211.2	218.1	1.652	1.027
31.00C	2.824.00	0.276	2612.7	-115.24	1.591	245.1	27.4	5.406	206.7	211.2	218.1	1.652	1.027
32.00C	2.938.00	0.276	2612.7	-115.24	1.591	245.1	27.4	5.580	206.7	211.2	218.1	1.652	1.027
33.00C	3.052.00	0.276	2612.7	-115.24	1.591	245.1	27.4	5.754	206.7	211.2	218.1	1.652	1.027
34.00C	3.166.00	0.276	2612.7	-115.24	1.591	245.1	27.4	5.928	206.7	211.2	218.1	1.652	1.027
35.00C	3.280.00	0.276	2612.7	-115.24	1.591	245.1	27.4	6.102	206.7	211.2	218.1	1.652	1.027
36.00C	3.394.00	0.276	2612.7	-115.24	1.591	245.1	27.4	6.276	206.7	211.2	218.1	1.652	1.027
37.00C	3.508.00	0.276	2612.7	-115.24	1.591	245.1	27.4	6.450	206.7	211.2	218.1	1.652	1.027
38.00C	3.622.00	0.276	2612.7	-115.24	1.591	245.1	27.4	6.624	206.7	211.2	218.1	1.652	1.027
39.00C	3.736.00	0.276	2612.7	-115.24	1.591	245.1	27.4	6.798	206.7	211.2	218.1	1.652	1.027
40.00C	3.850.00	0.276	2612.7	-115.24	1.591	245.1	27.4	6.972	206.7	211.2	218.1	1.652	1.027
41.00C	3.964.00	0.276	2612.7	-115.24	1.591	245.1	27.4	7.146	206.7	211.2	218.1	1.652	1.027
42.00C	4.078.00	0.276	2612.7	-115.24	1.591	245.1	27.4	7.320	206.7	211.2	218.1	1.652	1.027
43.00C	4.192.00	0.276	2612.7	-115.24	1.591	245.1	27.4	7.494	206.7	211.2	218.1	1.652	1.027
44.00C	4.306.00	0.276	2612.7	-115.24	1.591	245.1	27.4	7.668	206.7	211.2	218.1	1.652	1.027
45.00C	4.420.00	0.276	2612.7	-115.24	1.591	245.1	27.4	7.842	206.7	211.2	218.1	1.652	1.027
46.00C	4.534.00	0.276	2612.7	-115.24	1.591	245.1	27.4	8.016	206.7	211.2	218.1	1.652	1.027
47.00C	4.648.00	0.276	2612.7	-115.24	1.591	245.1	27.4	8.190	206.7	211.2	218.1	1.652	1.027
48.00C	4.762.00	0.276	2612.7	-115.24	1.591	245.1	27.4	8.364	206.7	211.2	218.1	1.652	1.027
49.00C	4.876.00	0.276	2612.7	-115.24	1.591	245.1	27.4	8.538	206.7	211.2	218.1	1.652	1.027
50.00C	4.990.00	0.276	2612.7	-115.24	1.591	245.1	27.4	8.712	206.7	211.2	218.1	1.652	1.027
51.00C	5.104.00	0.276	2612.7	-115.24	1.591	245.1	27.4	8.886	206.7	211.2	218.1	1.652	1.027
52.00C	5.218.00	0.276	2612.7	-115.24	1.591	245.1	27.4	9.060	206.7	211.2	218.1	1.652	1.027
53.00C	5.332.00	0.276	2612.7	-115.24	1.591	245.1	27.4	9.234	206.7	211.2	218.1	1.652	1.027
54.00C	5.446.00	0.276	2612.7	-115.24	1.591	245.1	27.4	9.408	206.7	211.2	218.1	1.652	1.027
55.00C	5.560.00	0.276	2612.7	-115.24	1.591	245.1	27.4	9.582	206.7	211.2	218.1	1.652	1.027
56.00C	5.674.00	0.276	2612.7	-115.24	1.591	245.1	27.4	9.756	206.7	211.2	218.1	1.652	1.027
57.00C	5.788.00	0.276	2612.7	-115.24	1.591	245.1	27.4	9.930	206.7	211.2	218.1	1.652	1.027
58.00C	5.902.00	0.276	2612.7	-115.24	1.591	245.1	27.4	10.104	206.7	211.2	218.1	1.652	1.027
59.00C	6.016.00	0.276	2612.7	-115.24	1.591	245.1	27.4	10.278	206.7	211.2	218.1	1.652	1.027
60.00C	6.130.00	0.276	2612.7	-115.24	1.591	245.1	27.4	10.452	206.7	211.2	218.1	1.652	1.027
61.00C	6.244.00	0.276	2612.7	-115.24	1.591	245.1	27.4	10.626	206.7	211.2	218.1	1.652	1.027
62.00C	6.358.00	0.276	2612.7	-115.24	1.591	245.1	27.4	10.800	206.7	211.2	218.1	1.652	1.027
63.00C	6.472.00	0.276	2612.7	-115.24	1.591	245.1	27.4	10.974	206.7	211.2	218.1	1.652	1.027
64.00C	6.586.00	0.276	2612.7	-115.24	1.591	245.1	27.4	11.148	206.7	211.2	218.1	1.652	1.027
65.00C	6.700.00	0.276	2612.7	-115.24	1.591	245.1	27.4	11.322	206.7	211.2	218.1	1.652	1.027
66.00C	6.814.00	0.276	2612.7	-115.24	1.591	245.1	27.4	11.496	206.7	211.2	218.1	1.652	1.027
67.00C	6.928.00	0.276	2612.7	-115.24	1.591	245.1	27.4	11.670	206.7	211.2	218.1	1.652	1.027
68.00C	7.042.00	0.276	2612.7	-115.24	1.591	245.1	27.4	11.844	206.7	211.2	218.1	1.652	1.027
69.00C	7.156.00	0.276	2612.7	-115.24	1.591	245.1	27.4	12.018	206.7	211.2	218.1	1.652	1.027
70.00C	7.270.00	0.276	2612.7	-115.24	1.591	245.1	27.4	12.192	206.7	211.2	218.1	1.652	1.027
71.00C	7.384.00	0.276	2612.7	-115.24	1.591	245.1	27.4	12.366	206.7	211.2	218.1	1.652	1.027
72.00C	7.498.00	0.276	2612.7	-115.24	1.591	245.1	27.4	12.540	206.7	211.2	218.1	1.652	1.027
73.00C	7.612.00	0.276	2612.7	-115.24	1.591	245.1	27.4	12.714	206.7	211.2	218.1	1.652	1.027
74.00C	7.726.00	0.276	2612.7	-115.24	1.591	245.1	27.4	12.888	206.7	211.2	218.1	1.652	1.027
75.00C	7.840.00	0.276	2612.7	-115.24	1.591	245.1	27.4	13.062	206.7	211.2	218.1	1.652	1.027
76.00C	7.954.00	0.276	2612.7	-115.24	1.591	245.1	27.4	13.236	206.7	211.2	218.1	1.652	1.027
77.00C	8.068.00	0.276	2612.7	-115.24	1.591	245.1	27.4	13.410	206.7	211.2	218.1	1.652	1.027
78.00C	8.182.00	0.276	2612.7	-115.24	1.591	245.1	27.4	13.584	206.7	211.2	218.1	1.652	1.027
79.00C	8.296.00	0.276	2612.7	-115.24	1.591	245.1	27.4	13.758	206.7	211.2	218.1	1.652	1.027
80.00C	8.410.00	0.276	2612.7	-115.24	1.591	245.1	27.4	13.932	206.7	211.2	218.1	1.652	1.027
81.00C	8.524.00	0.276	2612.7	-115.24	1.591	245.1	27.4	14.106	206.7	211.2	218.1	1.652	1.027
82.00C	8.638.00	0.276	2612.7	-115.24	1.591	245.1	27.4	14.280</					

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 60.
 RP-1 298 C-H1.953 0.80 -6.92 4C.

BULK DENSITY = .974 GM/CC
 MIXTURE RATIO = 1.500 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 306.97 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	165.1
TEMP, DEG K	2442.3	2025.8	1671.1	1369.5	1244.7	1113.8	898.7	719.4	571.7	451.8	356.0	278.8	2149.3
ENTHALPY (-)	25.58	47.40	65.45	80.29	86.27	92.41	102.24	110.13	116.43	121.42	125.34	128.47	40.99
CP	.5308	.5168	.5003	.4826	.4744	.4647	.4478	.4328	.4208	.4123	.4065	.4026	.5211
IMPUL OPT	137.78	186.25	218.18	229.78	241.13	258.24	271.22	281.13	288.76	294.60	299.18	115.79	
IMPUL VAC	209.77	230.18	248.91	256.30	263.75	275.28	284.20	291.09	296.42	300.52	303.74	208.67	
EPSILON	1.040	1.515	2.530	3.278	4.444	7.992	14.538	26.606	48.854	90.068	165.769	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	165.8
TEMP, DEG K	2442.3	2041.8	1693.6	1400.2	1280.9	1158.4	976.4	887.3	839.7	797.1	758.3	722.4	2164.1
ENTHALPY (-)	25.58	47.40	65.70	80.78	86.89	93.24	103.60	112.49	120.60	128.08	135.02	141.47	40.93
X BAR	5.663	5.657	5.656	5.656	5.655	5.654	5.626	5.504	5.359	5.225	5.101	4.985	5.658
N	5.663	5.657	5.656	5.656	5.655	5.654	5.626	5.568	5.582	5.594	5.604	5.612	5.658
CP	.5750	.5335	.5166	.5125	.5153	.5273	.7919	4.7704	5.0959	5.2189	5.1606	4.9390	.5428
IMPUL OPT	138.03	186.83	219.14	230.96	242.62	260.53	274.98	287.51	298.62	308.56	317.53	115.56	
IMPUL VAC	210.38	231.15	250.38	258.08	265.96	278.76	290.33	301.04	310.68	319.40	327.33	207.17	
EPSILON	1.042	1.523	2.563	3.339	4.569	8.519	17.124	36.021	76.614	164.338	354.869	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0003	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.83 C+H4	.0000	.0000	.0000	.0001	.0002	.0007	.0148	.0437	.0369	.0310	.0261	.0221	.0000
-26.42 C+O	2.7004	2.6711	2.6242	2.5519	2.5072	2.4466	2.3009	2.0728	1.7868	1.5175	1.2651	1.0300	2.6819
-94.05 C+O2	.1608	.1904	.2373	.3095	.3541	.4142	.5458	.6802	.8151	.9445	1.0674	1.1824	.1794
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.0146	.0025	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0047
9.33 H+O	.0010	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
.00 H2	2.0596	2.0949	2.1429	2.2151	2.2594	2.3177	2.4072	2.3903	2.3874	2.3887	2.3919	2.3948	2.0829
-57.80 H2+O	.7266	.6980	.6512	.5790	.5346	.4751	.3575	.3167	.3330	.3435	.3502	.3552	.7088
59.56 O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
.00 C/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0648	.2227	.3685	.5029	.6270	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA									
COMPONENT										DENSITY									
TREF FORMULA										HEAT FLOW									
DEG K										16CAL/FORM.WT.									
LQX										1.14									
RP-1										-3.08									
298 CHL.953										0.80									
FROZEN EXPANSION										-6.42									
C STAR = 5313.3 FT/SEC																			
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/	GM DEG	DEG K	100GP	GM DEG	CALY/	1 DPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
														LVL	10000	50000	LVL		
1.000	1.000	300.000	2442.3	-25.58	.531					115.8	90.9	.950	190.6	201.0	205.7	206.7	1.202	1.251	
2.000	1.817	165.094	2149.3	-40.99	.521					206.5	36.8	1.166	224.4	229.5	239.3	241.3	1.359	1.461	
3.000	9.886	30.345	1491.6	-74.37	.490					229.1	27.8	1.455	236.9	251.1	253.9	255.9	1.390	1.537	
4.000	27.746	10.813	1157.3	-90.38	.468					237.4	23.9	2.206	238.6	257.5	261.3	263.3	1.582	1.682	
5.000	38.938	7.705	1066.9	-94.59	.461					245.0	21.3	2.766		261.6	266.3	268.3	1.613	1.713	
6.000	51.416	5.835	998.1	-97.74	.456					250.6	19.7	3.340		264.4	270.1	271.1	1.635	1.735	
7.000	64.436	4.656	943.4	-100.22	.451					254.8	18.7	3.891		266.3	273.0	273.0	1.653	1.753	
8.000	77.585	3.967	898.3	-102.25	.448					258.3	17.0	4.406		267.8	275.3	275.3	1.667	1.767	
9.000	92.839	3.228	860.1	-103.96	.445					261.1	16.1	4.994		268.7	277.3	277.3	1.679	1.779	
10.000	109.028	2.752	827.1	-105.42	.442					263.6	15.4	5.582		269.4	278.9	278.9	1.689	1.789	
11.000	125.587	2.389	798.4	-106.69	.439					265.6	14.7	6.157		269.8	280.4	280.4	1.698	1.798	
12.000	142.375	2.107	772.9	-107.80	.437					267.5	14.1	6.712		270.2	281.6	281.6	1.705	1.805	
13.000	159.198	1.884	750.1	-108.80	.435					269.1	13.6	7.241		270.4	282.7	282.7	1.712	1.812	
14.000	175.931	1.705	729.6	-109.69	.434					270.5	13.2	7.744			283.7		1.718	1.818	
15.000	193.817	1.548	710.9	-110.49	.432					271.8	12.8	8.274			284.6		1.723	1.823	
16.000	213.439	1.404	693.9	-111.23	.431					273.0	12.4	8.881			285.4		1.728	1.828	
17.000	234.016	1.282	678.1	-111.91	.429					274.1	12.1	9.445			286.2		1.733	1.833	
18.000	254.852	1.177	663.6	-112.53	.428					275.0	11.8	10.033			286.9		1.737	1.837	
19.000	276.052	1.087	650.2	-113.11	.427					276.0	11.5	10.612			287.5		1.741	1.841	
20.000	297.526	1.008	637.6	-113.64	.426					276.8	11.3	11.182			288.1		1.744	1.844	
21.000	319.119	.940	625.9	-114.14	.425					277.5	11.0	11.743			288.6		1.748	1.848	
22.000	340.947	.880	614.9	-114.61	.424					278.3	10.8	12.291			289.1		1.751	1.851	
23.000	362.755	.827	604.5	-115.05	.423					279.0	10.6	12.827			289.6		1.756	1.856	
24.000	384.623	.780	594.8	-115.46	.423					279.6	10.4	13.349			290.0		1.759	1.859	
25.000	406.412	.738	585.5	-115.85	.422					280.2	10.2	13.858			290.5		1.764	1.864	
26.000	428.141	.701	576.8	-116.21	.421					280.8	10.1	14.353			290.9		1.761	1.861	
27.000	451.055	.665	568.5	-116.56	.421					281.3	9.9	14.876			291.2		1.764	1.864	
28.000	474.341	.630	560.6	-116.90	.420					281.9	9.7	15.462			291.6		1.766	1.866	
29.000	498.021	.598	553.1	-117.21	.419					282.3	9.6	16.008			291.9		1.768	1.868	
30.000	522.122	.568	545.9	-117.51	.419					282.5	9.4	16.535			292.3		1.770	1.870	
31.000	545.547	.541	539.0	-117.80	.418					283.3	9.3	17.021			292.4		1.772	1.872	
32.000	569.320	.516	532.4	-118.08	.418					283.7	9.2	17.485			292.9		1.773	1.873	
33.000	593.386	.493	526.1	-118.34	.417					284.1	9.1	18.007			293.1		1.775	1.875	
34.000	617.710	.472	520.1	-118.59	.417					284.6	9.0	18.466			293.4		1.777	1.877	
35.000	643.237	.452	514.3	-118.83	.417					284.8	8.8	18.941			293.7		1.778	1.878	
36.000	669.955	.434	508.7	-119.07	.416					285.2	8.7	19.412			293.9		1.780	1.880	
37.000	696.852	.417	503.3	-119.29	.416					285.5	8.6	19.879			294.2		1.781	1.881	
38.000	724.817	.402	498.1	-119.51	.415					285.9	8.5	20.339			294.4		1.783	1.883	
39.000	752.043	.387	493.1	-119.71	.415					286.2	8.4	20.794			294.6		1.784	1.884	
40.000	779.541	.373	488.3	-119.91	.415					286.5	8.3	21.242			294.8		1.785	1.885	
41.000	807.311	.361	483.7	-120.11	.414					286.8	8.3	21.684			295.0		1.786	1.886	
42.000	835.355	.349	479.2	-120.29	.414					287.1	8.2	22.119			295.2		1.788	1.888	
43.000	863.674	.338	474.8	-120.47	.414					287.4	8.1	22.547			295.4		1.789	1.889	
44.000	892.267	.327	470.4	-120.65	.414					287.6	8.0	22.967			295.6		1.790	1.890	
45.000	921.132	.318	466.5	-120.82	.413					287.8	7.9	23.381			295.8		1.791	1.891	
46.000	950.278	.308	462.5	-120.98	.413					288.1	7.9	23.787			296.0		1.792	1.892	
47.000	979.704	.300	458.6	-121.14	.413					288.3	7.8	24.186			296.1		1.793	1.893	
48.000	1009.421	.291	454.9	-121.30	.413					288.4	7.7	24.578			296.3		1.794	1.894	
49.000	1039.423	.284	451.3	-121.45	.412					288.6	7.7	24.979			296.4		1.795	1.895	
50.000	1069.708	.275	447.7	-121.59	.412					288.9	7.6	25.363			296.6		1.796	1.896	
3.278	20.414	14.496	1244.7	-86.27	.474					229.8	26.5	1.805	229.8	237.0	253.2	256.3	1.351	1.552	
SHIFTING EXPANSION										C STAR = 5313.3 FT/SEC									
EPSILON	PC/F	P PSIA	TEMP	ENTHALPY	CP CAL/	GM DEG	DEG K	100GP	GM DEG	CALY/	1 DPT	DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC
														LVL	10000	50000	LVL		
1.000	1.000	300.000	2442.3	-25.58	.575					115.6	91.6	.953	199.0	201.5	206.2	207.2	1.250	1.201	
2.000	9.755	30.354	1522.9	-74.50	.543					206.8	35.4	1.151	225.3	230.4	240.2	242.2	1.359	1.461	
3.000	17.407	17.236	1327.1	-84.52	.516					226.5	28.4	1.462	230.7	252.3	255.1	257.1	1.392	1.539	
4.000	26.784	11.201	1207.8	-90.44	.488					238.0	24.8	2.215		240.7	259.0	262.8	1.585	1.685	
5.000	37.127	8.080	1126.8	-94.91	.461					245.6	22.4	2.774		263.3	268.0	268.0	1.617	1.717	
6.000	48.528	6.182	1068.1	-98.11	.451					251.2	20.7	3.358		266.2	272.0	272.0	1.641	1.741	
7.000	60.916	4.602	1026.2	-100.47	.442					255.9	19.5	3.921		268.4	275.1	275.1	1.659	1.759	
8.000	71.454	4.184	990.7	-102.67	.437					259.0	18.6	4.450		270.0	277.6	277.6	1.675	1.775	
9.000	83.729	3.583	965.9	-104.38	.434					261.8	17.9	5.000		271.2	279.8	279.8	1.688	1.788	
10.000	96.950	3.093	947.9	-105.84	.432					264.3	17.4	5.514		272.0	281.6		1.699	1.799	
11.000	110.370	2.718	933.6	-106.71	.431					266.3	16.9	6.022		272.6	283.3		1.710	1.810	
12.000	123.465	2.425	922.1	-107.45	.430					268.2	16.4	6.527		273.1	284.7		1.718	1.818	
13.000	136.677	2.190	912.7	-108.03	.429					269.8	16.2	7.037		273.4	286.0		1.726	1.826	
14.000	149.175	2.011	904.9	-110.13	.427					271.2	16.0	7.545		273.7	287.2		1.733	1.833	
15.000	161.156	1.861	898.3	-110.98	.426					272.5	15.8	8.053		273.9	288.3		1.739	1.839	
16.000	172.459	1.737	892.7	-111.71	.425					273.7	15.6	8.550		274.0	289.3		1.745	1.845	
17.000	183.564	1.633	887.9	-112.41	.424					274.8	15.4	9.047			290.2		1.751	1.851	
18.000	197.028	1.523	883.0	-113.07	.423					275.9	15.2	9.583			291.1		1.756	1.856	
19.000	211.023	1.422	878.7	-113.70	.422					276.9	15.0	10.081			291.9		1.761	1.861	
20.000	225.144	1.332	874.7	-114.28	.421					277.8	14.9	11.100			292.7		1.766	1.866	
21.000	239.319	1.254	871.1	-114.83	.420					278.7	14.8	11.777			293				

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/G
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 65.
 RP-1 298 C+H1.953 0.80 -6.92 35.

BULK DENSITY = .992 GM/CC
 MIXTURE RATIO = 1.857 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA
 CHAMBER ENTRAPY 298.25 EU/100GMS

CHAMBER	FROZEN EXPANSION												THROAT
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	166.9
TEMP, DEG K	3068.2	2587.9	2174.6	1818.7	1669.8	1512.3	1248.9	1023.5	831.8	670.5	536.4	426.5	2736.8
ENTHALPY (-)	23.58	48.09	68.72	86.02	93.09	100.45	112.41	122.25	130.28	136.78	142.00	146.17	40.55
CP	.5153	.5050	.4927	.4787	.4712	.4628	.4450	.4277	.4106	.3955	.3838	.3745	.5086
IMPUL OPT	146.01	198.15	233.06	245.90	258.59	277.98	292.97	304.66	313.81	320.97	326.57	328.23	121.48
IMPUL VAC	222.97	245.80	266.94	275.39	283.98	297.49	308.14	316.52	323.09	328.23	332.24	332.24	219.30
EPSILON	1.045	1.544	2.621	3.424	4.686	8.596	15.952	29.758	55.585	103.769	193.543	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	170.3
TEMP, DEG K	3068.2	2688.7	2314.2	1963.5	1813.4	1654.3	1391.7	1173.1	994.6	850.9	754.1	719.0	2821.1
ENTHALPY (-)	23.58	48.46	69.92	88.21	95.76	103.66	116.65	127.60	136.84	144.71	151.50	157.67	40.17
X BAR	5.023	4.978	4.957	4.950	4.949	4.949	4.949	4.949	4.949	4.946	4.901	4.789	4.990
N	5.023	4.978	4.957	4.950	4.949	4.949	4.949	4.949	4.949	4.946	4.905	4.912	4.990
CP	.8046	.6492	.5516	.5083	.4999	.4950	.4959	.5079	.5303	.5904	3.2582	4.9001	.6979
IMPUL OPT	147.10	200.78	237.12	250.58	263.94	284.55	300.81	313.90	324.62	333.59	341.54	341.54	120.13
IMPUL VAC	225.76	250.17	272.56	281.54	290.75	305.47	317.49	327.45	335.82	343.17	350.26	350.26	221.45
EPSILON	1.052	1.576	2.699	3.541	4.875	9.080	17.280	33.509	66.125	134.865	292.915	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001	.0015	.0217	.0183	.0000
-26.42 C+O	2.1941	2.1701	2.1371	2.0872	2.0565	2.0145	1.9129	1.7778	1.6116	1.4260	1.2379	1.0083	2.1791
-94.05 C+O2	.3092	.3335	.3667	.4166	.4473	.4893	.5910	.7261	.8922	1.0763	1.2395	1.3536	.3244
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1034	.0454	.0136	.0026	.0010	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0628
9.33 H+O	.0390	.0120	.0022	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0191
.00 H2	1.1668	1.2035	1.2473	1.3017	1.3332	1.3754	1.4773	1.6124	1.7783	1.9581	2.0560	2.0615	1.1899
-57.80 H2+O	1.2068	1.2127	1.1897	1.1419	1.1113	1.0694	.9677	.8326	.6666	.4839	.3456	.3469	1.2140
59.56 O	.0020	.0003	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0006
.00 O2	.0009	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
.00 C/C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0047	.1236	.0000

SYSTEM LIQUID BIPROPELLANT										PC 300, PSIA		HEAT FORM		WT. D/F	
COMPONENT										DENSITY		[KCAL/FORM.WT.]			
REF. FORMULA										G/CC		1.00		65.	
LGR										96.2 02		-1.00		35.	
RP-1										288 C=H1.953		0.00			
										FROZEN EXPANSION					
										C STAR = 5656.3 FT/SEC					
										CP CAL / I OPT DELVAC DELVAC		I SEA		I AT	
										GM DEG		LVL		10000	

PRESSURE PROFILE DATA
 SYSTEM LIQUID 81PROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 68.
 RP-1 298 C#H1.953 0.80 -6.92 32.

BULK DENSITY = 1.004 GM/CC
 MIXTURE RATIO = 2.125 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 290.92 EU/100GMS

CHAMBER													THROAT
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	167.6
TEMP, DEG K	3325.8	2825.2	2392.2	2017.6	1860.4	1693.4	1413.1	1170.9	962.7	785.0	634.8	509.6	2982.7
ENTHALPY (-)	22.39	47.30	68.44	86.30	93.65	101.34	113.92	124.38	133.02	140.10	145.84	150.47	39.51
CP	.5021	.4931	.4827	.4707	.4642	.4562	.4405	.4232	.4060	.3900	.3753	.3638	.4960
IMPUL OPT	147.22	200.16	235.81	248.99	262.08	282.18	297.88	310.24	320.00	327.72	333.81	322.05	122.05
IMPUL VAC	225.13	248.68	270.54	279.32	288.31	302.51	313.84	322.84	329.96	335.59	340.01	340.01	221.26
EPSILON	1.047	1.556	2.659	3.487	4.794	8.868	16.614	31.304	59.066	111.323	209.373	1.000	
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	172.5
TEMP, DEG K	3325.8	3008.9	2686.1	2352.3	2196.9	2024.3	1725.2	1466.1	1247.0	1065.3	916.2	794.0	3124.1
ENTHALPY (-)	22.39	47.88	70.49	90.31	98.64	107.44	122.09	134.54	145.13	154.15	161.88	168.55	38.95
X BAR	4.696	4.619	4.566	4.538	4.531	4.527	4.525	4.525	4.525	4.525	4.525	4.524	4.645
N	4.696	4.619	4.566	4.538	4.531	4.527	4.525	4.525	4.525	4.525	4.525	4.524	4.645
CP	1.1667	.9283	.7121	.5704	.5319	.5049	.4831	.4804	.4883	.5066	.5324	.5629	1.0158
IMPUL OPT	148.93	204.57	243.09	257.55	272.02	294.51	312.37	326.77	338.57	348.36	356.59	356.59	120.03
IMPUL VAC	229.61	256.40	281.05	290.97	301.15	317.43	330.72	341.70	350.88	358.64	365.30	365.30	224.54
EPSILON	1.059	1.624	2.840	3.753	5.200	9.765	18.674	36.239	71.313	142.271	287.463	1.000	
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C#H#C	.0005	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0003
67.00 C#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C#H2#O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C#H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C#O	1.8499	1.8152	1.7839	1.7492	1.7289	1.7013	1.6329	1.5393	1.4172	1.2655	1.0903	.9034	1.8273
-94.05 C#O2	.4388	.4738	.5053	.5400	.5603	.5879	.6563	.7499	.8720	1.0237	1.1989	1.3856	.4616
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1597	.1024	.0531	.0196	.0107	.0047	.0007	.0001	.0000	.0000	.0000	.0000	.1227
9.33 H#O	.1278	.0674	.0259	.0062	.0026	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0876
.00 H2	.7367	.7447	.7490	.8081	.8309	.8606	.9306	1.0245	1.1467	1.2983	1.4735	1.6597	.7400
-57.80 H2#O	1.3547	1.4057	1.4269	1.4144	1.3979	1.3721	1.3044	1.2109	1.0888	.9371	.7619	.5754	1.3902
59.56 O	.0160	.0055	.0011	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0085
.00 O2	.0117	.0042	.0008	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0064

SYSTEM LIQUID BIPROPELLANT
 COMPONENT TREF FORMULA PC 300. PSIA
 DEG K DENSITY GR/CC HEAT FORM. (KCAL/FORM.WT.)
 LOR 90.2 82 1.14 -3.08 48.
 RP-1 298 C+H1.953 0.80 -6.92 32.

SHIFTING EXPANSION																		
C STAR = 5713.7 FT/SEC																		
EPSILON	PC/P	P PSIA	TEMP DEG K	ENTHALPHY K CAL/100GM	CP CAL/100GM DEG	I OPT	DEL VAC	DEL VAC	I SEA	I AT	I AT	I VAC	CP SEA	CP VAC				
										10000	50000							
1.000	1.000	300.000	3325.8	-22.39	.502	122.0	99.2	.592	212.6	215.2	220.3	221.3	1.197	1.244				
2.000	1.250	187.605	2982.7	-39.51	.496	220.1	39.9	1.231	241.9	247.3	257.0	260.0	1.362	1.464				
3.000	1.500	16.371	18.325	1945.5	-89.48	.460	242.0	32.6	1.780	248.4	256.3	271.6	1.399	1.546				
4.000	25.027	11.987	1786.2	-57.08	.461	254.9	28.4	2.373	259.0	270.3	283.4			1.596				
5.000	36.537	8.686	1672.5	-102.29	.455	263.7	25.8	2.965		286.3	288.4			1.630				
6.000	45.155	6.444	1585.2	-106.25	.451	270.1	23.8	3.586		287.8	293.9			1.655				
7.000	56.317	5.327	1515.0	-109.40	.447	275.1	22.3	4.194		290.3	297.5			1.675				
8.000	67.659	4.434	1456.7	-111.99	.443	279.2	21.2	4.775		292.2	300.4			1.691				
9.000	79.159	3.790	1406.9	-114.19	.440	282.6	20.2	5.333		293.7	302.8			1.705				
10.000	92.340	3.249	1363.6	-116.09	.437	285.5	19.4	5.966		294.7	304.9			1.717				
11.000	106.007	2.830	1325.4	-117.75	.435	288.0	18.7	6.598		295.5	306.7			1.727				
12.000	119.977	2.500	1291.4	-119.23	.432	290.3	18.1	7.220		296.0	308.3			1.736				
13.000	134.113	2.237	1260.8	-120.55	.430	292.2	17.5	7.827		296.4	309.7			1.744				
14.000	148.282	2.023	1233.0	-121.74	.428	294.0	17.0	8.413		296.7	311.0			1.751				
15.000	162.588	1.867	1207.7	-122.82	.426	295.6	16.6	8.976		296.9	312.2			1.758				
16.000	176.372	1.701	1184.3	-123.81	.424	297.0	16.2	9.515			313.2			1.764				
17.000	191.102	1.570	1162.8	-124.73	.423	298.4	15.8	10.077			314.2			1.769				
18.000	207.484	1.466	1142.7	-125.57	.421	299.6	15.5	10.707			315.1			1.774				
19.000	224.228	1.388	1124.0	-126.36	.420	300.8	15.2	11.338			315.9			1.779				
20.000	241.279	1.324	1106.4	-127.12	.418	301.9	14.9	11.967			316.7			1.783				
21.000	258.563	1.260	1090.0	-127.78	.417	302.8	14.6	12.593			317.4			1.787				
22.000	276.086	1.207	1074.5	-128.43	.416	303.7	14.4	13.213			318.1			1.791				
23.000	293.740	1.161	1059.8	-129.04	.414	304.6	14.1	13.827			318.7			1.795				
24.000	311.458	1.121	1046.0	-129.61	.413	305.4	13.9	14.433			319.3			1.798				
25.000	329.319	1.081	1032.8	-130.15	.412	306.2	13.7	15.029			319.9			1.801				
26.000	347.164	1.044	1020.3	-130.67	.411	306.9	13.5	15.614			320.4			1.804				
27.000	365.008	1.012	1008.4	-131.16	.410	307.4	13.3	16.189			320.9			1.807				
28.000	382.820	0.984	997.0	-131.63	.409	308.3	13.1	16.762			321.4			1.810				
29.000	400.581	0.959	986.1	-132.07	.408	309.0	13.0	17.327			321.9			1.812				
30.000	418.286	0.937	975.7	-132.50	.407	309.5	12.8	17.883			322.3			1.815				
31.000	435.923	0.916	965.7	-132.90	.406	310.1	12.6	18.432			322.7			1.817				
32.000	453.559	0.896	956.1	-133.29	.405	310.6	12.5	18.967			323.1			1.819				
33.000	471.075	0.876	946.8	-133.67	.404	311.1	12.4	19.496			323.5			1.822				
34.000	488.572	0.856	937.9	-134.03	.404	311.6	12.2	20.023			323.9			1.824				
35.000	517.549	0.830	929.4	-134.37	.403	312.1	12.1	20.552			324.2			1.826				
36.000	538.750	0.807	921.1	-134.71	.402	312.6	12.0	21.080			324.6			1.828				
37.000	560.156	0.786	913.1	-135.03	.402	313.0	11.8	21.608			324.9			1.829				
38.000	581.747	0.764	905.4	-135.34	.401	313.5	11.7	22.135			325.2			1.831				
39.000	603.507	0.742	897.9	-135.64	.400	313.9	11.6	22.659			325.5			1.833				
40.000	625.417	0.720	890.7	-135.93	.400	314.3	11.5	23.181			325.8			1.835				
41.000	647.461	0.698	883.6	-136.21	.399	314.7	11.4	23.699			326.1			1.836				
42.000	669.620	0.676	876.8	-136.48	.398	315.0	11.3	24.216			326.3			1.838				
43.000	691.880	0.654	870.2	-136.74	.398	315.4	11.2	24.729			326.6			1.839				
44.000	714.225	0.632	863.8	-137.00	.397	315.7	11.1	25.243			326.9			1.841				
45.000	736.639	0.610	857.4	-137.24	.397	316.1	11.0	25.749			327.1			1.842				
46.000	759.109	0.588	851.5	-137.48	.396	316.4	10.9	26.246			327.4			1.843				
47.000	781.627	0.566	845.7	-137.72	.396	316.8	10.8	26.743			327.6			1.845				
48.000	804.186	0.544	839.9	-137.94	.395	317.1	10.8	27.242			327.8			1.846				
49.000	826.729	0.522	834.3	-138.16	.395	317.4	10.7	27.740			328.0			1.848				
50.000	849.302	0.500	828.9	-138.38	.394	317.7	10.6	28.245			328.3			1.849				
5.487	20.414	14.496	1800.4	-63.65	.464	249.0	30.3	7.064	249.0	258.1	275.8	276.3	1.402	1.573				

EPSILON	PC/P	P PSIA	TEMP CEG K	ENTHALPY K CAL/100GM	CP CAL/100GM DEG	SHIFTING EXPANSION												
						C STAR = 5864.9 FT/SEC												
						CP CAL/100GM DEG	I OPT	DEL VAC DEL VAC	I SEA LVL	I AT 10000	I AT 50000	I VAC	CP SEA LVL	CP VAC				
								/P										
1.000	1.000	300.000	3325.8	-22.39	1.147	1.016	120.0	104.4	.406	215.6	218.3	223.5	224.5	1.235	1.186			
2.000	1.250	172.605	2982.7	-39.55	1.016	221.9	44.7	.251	248.3	253.8	264.5	266.0	1.386	1.467				
3.000	1.500	16.371	18.311	2321.1	-92.02	.561	246.1	37.0	1.820	256.4	264.4	280.0	281.1	1.410	1.550			
4.000	22.356	13.395	2162.3	-100.43	.525	260.6	32.5	2.426	268.2	286.9	293.1				1.612			
5.000	30.744	9.758	2046.5	-106.43	.507	270.4	29.6	3.033		294.8	300.0				1.650			
6.000	39.862	7.522	1952.4	-111.03	.487	277.7	27.3	3.636		299.0	305.2				1.679			
7.000	49.661	6.041	1877.5	-114.71	.491	283.4	25.9	4.288		302.0	309.3				1.702			
8.000	59.712	5.024	1814.9	-117.76	.487	288.1	24.6	4.903		304.3	312.7				1.720			
9.000	69.801	4.298	1761.4	-120.35	.484	291.9	23.6	5.490		306.2	315.5				1.736			
10.000	80.150	3.746	1714.9	-122.59	.480	295.3	22.7	6.050		307.4	318.0				1.749			
11.000	91.776	3.269	1676.1	-124.56	.476	298.1	22.0	6.718		308.6	320.1				1.761			
12.000	103.757	2.891	1637.7	-126.31	.472	300.7	21.3	7.366		309.4	322.0				1.771			
13.000	115.954	2.587	1605.1	-127.88	.469	303.0	20.7	8.007		310.0	323.7				1.781			
14.000	128.260	2.339	1575.5	-129.30	.465	305.0	20.2	8.635		310.5	325.2				1.789			
15.000	140.915	2.134	1548.4	-130.60	.462	306.8	19.7	9.266		310.8	326.6				1.797			
16.000	152.822	1.963	1523.6	-131.79	.459	308.5	19.3	9.898		311.0	327.8				1.804			
17.000	164.946	1.819	1500.7	-132.88	.456	310.0	18.9	10.408		311.2	329.0				1.810			
18.000	176.913	1.696	1479.5	-133.90	.453	311.5	18.6	10.956			330.0				1.816			
19.000	189.387	1.584	1459.8	-134.85	.450	312.8	18.3	11.523			331.0				1.821			
20.000	201.372	1.475	1441.4	-135.73	.447	314.0	18.0	12.170			332.0				1.826			
21.000	217.553	1.379	1424.1	-136.56	.444	315.2	17.7	12.818			332.8				1.831			
22.000	232.015	1.293	1407.8	-137.35	.441	316.2	17.4	13.465			333.7				1.836			
23.000	246.600	1.217	1392.9	-138.09	.438	317.3	17.2	14.110			334.4				1.840			
24.000	261.317	1.148	1378.0	-138.78	.435	318.2	16.9	14.751			335.2				1.844			
25.000	276.118	1.086	1364.3	-139.44	.432	319.1	16.7	15.388			335.8				1.848			
26.000	290.924	1.031	1351.3	-140.07	.430	320.0	16.5	16.018			336.5				1.851			
27.000	305.881	.981	1338.9	-140.67	.427	320.7	16.3	16.645			337.1				1.854			
28.000	320.781	.935	1327.1	-141.24	.424	321.6	16.1	17.297			337.7				1.858			
29.000	335.681	.894	1315.8	-141.79	.421	322.3	16.0	17.864			338.3				1.861			
30.000	350.458	.856	1305.1	-142.31	.418	323.0	15.8	18.461			338.8				1.864			
31.000	365.275	.821	1294.5	-142.81	.415	323.7	15.6	19.084			339.3				1.867			
32.000	379.927	.789	1284.9	-143.29	.412	324.3	15.5	19.651			339.8				1.869			
33.000	394.552	.760	1275.4	-143.75	.410	324.9	15.4	20.192			340.3				1.872			
34.000	409.114	.733	1266.3	-144.19	.407	325.5	15.2	20.748			340.7				1.875			
35.000	423.536	.708	1257.5	-144.62	.404	326.1	15.1	21.294			341.2				1.878			
36.000	437.859	.683	1249.0	-145.03	.401	326.7	15.0	21.820			341.6				1.880			
37.000	452.012	.661	1240.9	-145.43	.398	327.2	14.8	22.446			342.0				1.882			
38.000	466.066	.637	1233.0	-145.82	.395	327.7	14.7	23.091			342.4				1.884			
39.000	480.566	.615	1225.4	-146.19	.392	328.2	14.6	23.736			342.8				1.886			
40.000	495.458	.594	1218.1	-146.55	.389	328.7	14.5	24.381			343.2				1.888			
41.000	510.753	.575	1210.9	-146.90	.386	329.1	14.4	25.028			343.6				1.890			
42.000	526.019	.557	1204.1	-147.24	.384	329.6	14.3	25.674			343.9				1.892			
43.000	540.386	.539	1197.4	-147.56	.381	330.0	14.2	26.320			344.2				1.894			
44.000	554.647	.523	1190.9	-147.88	.378	330.4	14.1	26.964			344.5				1.895			
45.000	568.854	.508	1184.4	-148.19	.375	330.8	14.0	27.607			344.8				1.897			
46.000	583.078	.493	1178.0	-148.49	.372	331.2	13.9	28.248			345.1				1.899			
47.000	596.638	.479	1172.6	-148.79	.370	331.6	13.8	28.887			345.4				1.900			
48.000	610.430	.466	1166.8	-149.07	.367	332.0	13.7	29.524			345.7				1.902			
49.000	624.052	.452	1161.2	-149.35	.364	332.4	13.6	30.159			346.0				1.903			
50.000	637.667	.441	1155.8	-149.62	.362	332.7	13.5	30.789			346.3				1.903			
3.753	20.414	14.696	2198.9	-98.64	.532	297.6	33.4	2.274	257.4	267.6	287.1	291.0	1.417	1.601				

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. O/O
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 70.
 RP-1 298 C-H1.953 0.80 -6.92 30.

BULK DENSITY = 1.011 GM/CC
 MIXTURE RATIO = 2.333 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 285.39 EU/100GMS

	CHAMBER										THROAT	
	FROZEN EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	3429.7	2923.2	2484.4	2103.7	1943.6	1773.5	1487.1	1238.9	1024.5	840.4	683.7	551.8
ENTHALPY (-)	21.59	46.30	67.32	85.16	92.52	100.24	112.91	123.51	132.31	139.55	145.47	150.28
CP	.4917	.4834	.4741	.4629	.4588	.4497	.4349	.4184	.4019	.3854	.3701	.3576
IMPUL OPT	146.61	199.46	235.17	248.41	261.57	281.87	297.77	310.35	320.35	328.29	334.59	341.23
IMPUL VAC	224.30	247.99	270.02	278.90	287.99	302.42	313.98	323.22	330.57	336.41	341.02	344.36
EPSILON	1.048	1.562	2.678	3.517	4.845	8.998	16.936	32.071	60.833	115.268	217.843	1.000
	SHIFTING EXPANSION											
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050
TEMP, DEG K	3429.7	3151.3	2880.3	2599.1	2460.7	2298.1	1993.0	1710.3	1462.8	1251.9	1075.1	928.7
ENTHALPY (-)	21.59	46.96	69.77	90.20	98.94	108.28	124.04	137.61	149.22	159.15	167.66	174.99
X BAR	4.507	4.415	4.339	4.285	4.269	4.256	4.245	4.242	4.242	4.242	4.242	4.242
N	4.507	4.415	4.339	4.285	4.269	4.256	4.245	4.242	4.242	4.242	4.242	4.242
CP	1.4978	1.2842	1.0105	.7467	.6522	.5730	.4968	.4723	.4687	.4751	.4904	.5131
IMPUL OPT	148.55	204.74	244.32	259.41	274.63	298.54	317.69	333.21	345.93	356.48	365.31	371.92
IMPUL VAC	229.52	257.52	283.73	294.41	305.41	323.04	337.44	349.31	359.20	367.54	374.63	379.10
EPSILON	1.064	1.655	2.949	3.933	5.499	10.443	20.088	39.097	76.921	153.005	307.845	1.000
	COMPOSITION SHIFTING (MOL/100 GM)											
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0004	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.09 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C+O	1.6152	1.5631	1.5170	1.4789	1.4625	1.4432	1.3977	1.3339	1.2475	1.1358	.9976	.8375
-94.05 C+O2	.5305	.5828	.6290	.6672	.6836	.7029	.7485	.8122	.8986	1.0103	1.1485	1.3087
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1710	.1266	.0849	.0470	.0321	.0187	.0049	.0008	.0001	.0000	.0000	.0000
9.33 H+O	.2057	.1368	.0771	.0322	.0184	.0084	.0012	.0001	.0000	.0000	.0000	.0000
.00 H2	.5306	.5182	.5175	.5327	.5459	.5652	.6135	.6787	.7654	.8772	1.0154	1.1755
-57.80 H2+O	1.3766	1.4457	1.4971	1.5234	1.5246	1.5170	1.4792	1.4165	1.3303	1.2185	1.0803	.9202
59.56 O	.0380	.0196	.0076	.0018	.0007	.0002	.0000	.0000	.0000	.0000	.0000	.0000
.00 O2	.0391	.0219	.0090	.0021	.0008	.0002	.0000	.0000	.0000	.0000	.0000	.0000

[illegible]

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300, PSIA
 COMPONENT REF FORMULA DENSITY HEAT FLOW WT. O/O
 DEG K GM/CC (KCAL/HR.MT.)
 LEX 90.2 02 1.14 -3.08 12.5
 RP-1 298 C-H1.953 0.80 -6.92 27.5

BULK DENSITY = 1.021 GM/CC
 MIXTURE RATIO = 2.636 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTRUPY 277.93 EU/100GMS

CHAMBER	THROAT												
FROZEN EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	5.873	1.623	.680	.285	.119	.050	167.3
TEMP, DEG K	3495.1	2988.2	2547.9	2165.2	2003.9	1832.3	1545.0	1291.6	1073.6	885.6	724.6	588.0	3146.9
ENTHALPY (-)	20.59	44.64	65.17	82.64	89.88	97.47	109.98	120.49	129.26	136.52	142.49	147.55	37.15
CP	.4780	.4703	.4617	.4512	.4459	.4392	.4254	.4100	.3942	.3780	.3630	.3495	.4722
IMPUL OPT		144.64	196.93	232.34	245.51	258.61	278.87	294.41	307.47	317.98	325.65	332.08	120.00
IMPUL VAC		221.41	245.00	266.97	275.84	284.94	299.43	311.07	320.45	327.94	333.92	338.66	217.45
EPSILON		1.049	1.568	2.695	3.544	4.890	9.115	17.226	32.769	62.463	118.954	225.961	1.000
SHIFTING EXPANSION													
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	5.873	1.623	.680	.285	.119	.050	173.4
TEMP, DEG K	3495.1	3244.2	3015.4	2799.3	2699.3	2582.9	2347.2	2081.8	1811.4	1563.6	1346.9	1161.2	3354.0
ENTHALPY (-)	20.59	45.33	67.79	88.23	97.14	106.82	123.63	148.59	151.68	161.01	172.78	181.19	36.46
X BAR	4.298	4.199	4.108	4.029	3.996	3.961	3.918	3.896	3.890	3.889	3.888	3.888	4.234
N	4.298	4.199	4.108	4.029	3.996	3.961	3.918	3.896	3.890	3.889	3.888	3.888	4.234
CP	1.8449	1.7644	1.6038	1.3508	1.2023	1.0200	.7037	.5271	.4679	.4525	.4505	.4572	1.8027
IMPUL OPT		146.70	202.64	242.57	258.05	273.90	299.59	320.40	337.70	351.99	363.86	373.78	117.48
IMPUL VAC		226.97	255.49	282.77	294.19	306.71	325.94	342.24	355.74	365.93	374.40	381.23	221.37
EPSILON		1.066	1.675	3.041	4.165	5.835	11.445	22.515	44.291	87.516	174.036	348.670	1.000
COMPOSITION SHIFTING (MOL/100 GM)													
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C+H+O	.0003	.0001	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0002
67.00 C+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C+H2+O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
51.94 C+H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C+O	1.5330	1.2614	1.1910	1.1250	1.0971	1.0682	1.0247	.9901	.9441	.8900	.8127	.7136	1.2879
-94.05 C+O2	.6319	.7058	.7762	.8422	.8702	.8991	.9424	.9772	1.0192	1.0773	1.1546	1.2537	.6792
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2+H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2+H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2+H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1586	.1269	.0987	.0750	.0615	.0487	.0261	.0095	.0022	.0003	.0000	.0000	1.382
9.33 H+O	.2901	.2238	.1642	.1087	.0854	.0609	.0242	.0054	.0006	.0000	.0000	.0000	.2476
.00 H2	.3537	.3513	.3129	.3003	.2970	.2962	.3058	.3324	.3755	.4342	.5117	.6108	.3392
-57.80 H2+O	1.3429	1.4144	1.4772	1.5300	1.5506	1.5701	1.5911	1.5809	1.5441	1.4867	1.4094	1.3103	1.3884
59.56 O	.0741	.0499	.0306	.0161	.0109	.0063	.0014	.0001	.0000	.0000	.0000	.0000	.0582
.00 O2	.1115	.0851	.0584	.0335	.0234	.0158	.0030	.0002	.0000	.0000	.0000	.0000	.0950

SYSTEM LIQUID NITROGEN/PROPANE										PC SCO. PSIA									
COMPONENT										DENSITY									
REF. FORMULA										HEAT FLOW									
LEG. R										KCAL/HR/IN. L									
200.000										1.00									
200.000										-0.02									
PROF. EXPANSION										C. STAR. 5.0214N RE/SEC									
C. STAR. 5.0214N RE/SEC										I. SEA I. AT I. AT I. VAC									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
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TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
CP CAL/ I										50.00									
OPT DELVAL										50.00									
EPIILON										LVL									
PC/P										10.00									
P. PSIA										50.00									
TEMP										50.00									
ENTHALPY										50.00									
KCAL/1000G										50.00									
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PC/P																			

PRESSURE PROFILE DATA
 SYSTEM LIQUID BIPROPELLANT PC 300. PSIA
 COMPONENT TREF FORMULA DENSITY HEAT FORM WT. G/G
 DEG K GM/CC (KCAL/FORM.WT.)
 LOX 90.2 02 1.14 -3.08 75.
 RP-1 298 C#H1.953 0.80 -6.92 25.

BULK DENSITY = 1.031 GM/CC
 MIXTURE RATIO = 3.000 LB OXIDIZER / LB OF FUEL

PRESSURE PROFILE DATA

CHAMBER ENTROPY 269.98 EU/100GMS

CHAMBER	FROZEN EXPANSION										THROAT		
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	167.2
TEMP, DEG K	3511.4	3008.7	2571.2	2190.3	2029.6	1858.5	1569.5	1318.1	1099.6	910.6	748.1	609.7	3166.1
ENTHALPY (-)	19.59	42.72	62.51	79.39	86.40	93.76	105.91	116.15	124.72	131.85	137.73	142.54	35.52
CP	.4635	.4563	.4481	.4382	.4332	.4269	.4141	.3997	.3846	.3690	.3545	.3407	.4587
IMPUL OPT	141.85	193.22	228.08	241.08	254.00	274.03	289.83	302.42	312.50	320.58	327.04	327.04	117.71
IMPUL VAC	217.22	240.51	262.21	276.99	280.00	294.38	305.99	315.34	322.85	328.87	333.67	333.67	213.29
EPSILON	1.049	1.571	2.706	3.562	4.921	9.195	17.426	33.253	63.606	121.583	231.839	1.000	

	SHIFTING EXPANSION												
PRESSURE, PSIA	300.0	125.7	52.66	22.06	14.70	9.244	3.873	1.623	.680	.285	.119	.050	173.1
TEMP, DEG K	3511.4	3272.4	3055.6	2867.3	2783.2	2690.7	2524.6	2361.9	2189.5	1983.3	1746.2	1518.9	3357.1
ENTHALPY (-)	19.59	43.39	65.08	84.93	93.64	103.16	119.93	135.36	149.51	162.37	173.78	183.75	34.87
X BAR	4.110	4.011	3.919	3.834	3.797	3.756	3.685	3.622	3.573	3.545	3.536	3.535	4.047
N	4.110	4.011	3.919	3.834	3.797	3.756	3.685	3.622	3.573	3.545	3.536	3.535	4.047
CP	1.9993	2.0156	1.9511	1.9180	1.8637	1.7841	1.5762	1.2728	.8827	.5599	.4533	.4313	2.0142
IMPUL OPT	143.88	198.93	238.42	253.80	269.62	295.44	317.34	336.19	352.43	366.25	377.90	377.90	115.26
IMPUL VAC	222.76	251.04	278.28	289.79	302.02	322.66	340.65	356.31	369.68	380.83	390.19	390.19	217.17
EPSILON	1.066	1.481	3.069	4.160	5.954	11.938	24.398	50.262	102.830	207.447	417.268	1.000	

	COMPOSITION SHIFTING (MOL/100 GM)												
170.89 C	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
142.00 C#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-2.90 C#H#C	.0002	.0001	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0001
67.00 C#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-27.70 C#H2#O	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
31.94 C#H3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-17.89 C#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
-26.42 C#O	1.0716	.9898	.9069	.8240	.7859	.7430	.6657	.5953	.5376	.5006	.4750	.4424	1.0202
-94.05 C#O2	.7167	.7986	.8815	.9644	1.0026	1.0454	1.1228	1.1932	1.2509	1.2878	1.3134	1.3459	.7681
199.00 C2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
112.10 C2#H	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
54.19 C2#H2	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
12.50 C2#H4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
189.70 C3	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
242.30 C4	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
52.10 H	.1319	.1078	.0871	.0692	.0617	.0537	.0401	.0279	.0169	.0073	.0019	.0003	.1163
9.33 H#O	.3431	.2807	.2246	.1747	.1535	.1306	.0919	.0580	.0289	.0084	.0011	.0001	.3030
.00 H2	.2375	.2158	.1959	.1779	.1700	.1617	.1478	.1372	.1323	.1392	.1605	.1931	.2236
-57.80 H2#O	1.2714	1.3363	1.3947	1.4466	1.4888	1.4926	1.5326	1.5663	1.5912	1.5994	1.5844	1.5531	1.3131
59.56 O	.1084	.0813	.0591	.0412	.0341	.0269	.0158	.0077	.0025	.0003	.0000	.0000	.0907
.00 O2	.2298	.2011	.1695	.1361	.1201	.1018	.0680	.0369	.0128	.0016	.0000	.0000	.2121

SYSTEM LIQUID BIPROPELLANT										PC 300. PSIA		HEAT FORM		WT. 8/0		
COMPONENT										DENSITY		(KCAL/POUN.WT.)				
REF. FORMULA										GM/CC						
DEG K										1.14		-3.08		75.		
LOR										10.2 82		1.14		75.		
AP-1										250 CONL.953		0.80		-6.42		
										FROZEN EXPANSION						
										C STAR = 5516.4 FT/SEC						
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	DEG K	OPT DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC		
			DEG K	KCAL/1000G	GM DEG			/P	LVL	10000	50000	LVL	LVL	LVL		
1.000	1.000	100.000	3511.4	-19.59	444	117.7	95.6	.972	204.9	207.4	212.3	215.3	1.195	1.244		
2.000	1.794	107.239	3164.1	-35.52	444	211.8	19.4	1.187	233.7	239.0	249.1	251.2	1.363	1.465		
3.000	9.047	33.162	2382.8	-70.92	444	233.2	32.4	1.719	240.4	248.0	262.7	265.6	1.402	1.549		
4.000	24.153	12.400	1966.1	-89.14	431	256.0	28.4	2.290	230.9				1.400			
5.000	33.210	9.033	1850.5	-94.10	427	254.6	25.8	2.859					1.635			
6.000	43.283	6.336	1761.4	-97.88	423	261.0	24.0	3.457					1.682			
7.000	53.848	5.371	1689.5	-100.91	420	266.0	22.6	4.049					1.683			
8.000	64.631	4.632	1627.7	-103.41	417	270.0	21.4	4.618					1.700			
9.000	75.378	3.880	1578.7	-105.53	415	273.4	20.5	5.134					1.714			
10.000	87.405	3.432	1534.2	-107.37	412	276.3	19.7	5.747					1.727			
11.000	100.170	2.995	1494.9	-108.99	410	278.9	19.0	6.358					1.738			
12.000	113.232	2.649	1459.9	-110.42	408	281.1	18.4	6.964					1.747			
13.000	126.515	2.371	1428.4	-111.70	406	283.1	17.9	7.558					1.754			
14.000	139.841	2.145	1399.7	-112.87	405	284.9	17.5	8.136					1.763			
15.000	153.132	1.959	1373.5	-113.93	403	286.5	17.0	8.694					1.770			
16.000	166.321	1.804	1349.4	-114.90	402	287.9	16.6	9.231					1.776			
17.000	179.510	1.673	1327.1	-115.79	400	289.3	16.3	9.744					1.782			
18.000	193.547	1.550	1306.3	-116.62	399	290.5	16.0	10.307					1.788			
19.000	208.403	1.436	1286.9	-117.40	398	291.7	15.7	10.916					1.793			
20.000	224.553	1.336	1268.7	-118.12	397	292.8	15.4	11.524					1.797			
21.000	240.553	1.248	1251.5	-118.80	395	293.8	15.1	12.132					1.802			
22.000	256.518	1.169	1235.4	-119.43	394	294.7	14.9	12.738					1.806			
23.000	272.625	1.100	1220.2	-120.03	393	295.6	14.7	13.336					1.810			
24.000	289.212	1.037	1205.7	-120.60	392	296.4	14.4	13.930					1.813			
25.000	305.883	.981	1192.0	-121.14	391	297.2	14.2	14.517					1.817			
26.000	322.822	.931	1178.9	-121.65	390	297.8	14.1	15.094					1.820			
27.000	339.739	.886	1166.4	-122.14	390	298.7	13.9	15.666					1.823			
28.000	355.268	.844	1154.5	-122.60	389	299.4	13.7	16.227					1.826			
29.000	371.766	.807	1143.1	-123.04	388	300.0	13.5	16.777					1.829			
30.000	388.216	.773	1132.2	-123.44	387	300.6	13.4	17.314					1.831			
31.000	404.605	.741	1121.7	-123.81	386	301.2	13.2	17.848					1.834			
32.000	420.926	.711	1111.7	-124.24	386	301.8	13.1	18.367					1.836			
33.000	437.174	.686	1102.0	-124.63	385	302.3	13.0	18.877					1.839			
34.000	453.220	.659	1092.6	-124.99	384	302.8	12.8	19.386					1.841			
35.000	470.064	.633	1083.6	-125.34	383	303.3	12.7	19.893					1.843			
36.000	486.159	.608	1074.9	-125.67	383	303.8	12.6	20.400					1.844			
37.000	512.629	.585	1066.5	-125.99	382	304.2	12.5	21.275					1.847			
38.000	531.880	.564	1058.3	-126.30	381	304.7	12.3	21.882					1.849			
39.000	551.457	.544	1050.5	-126.60	381	305.1	12.2	22.488					1.851			
40.000	571.266	.525	1042.9	-126.89	380	305.5	12.1	23.093					1.853			
41.000	591.172	.507	1035.4	-127.17	380	305.9	12.0	23.697					1.854			
42.000	611.202	.491	1028.2	-127.45	379	306.3	11.9	24.299					1.856			
43.000	631.343	.475	1021.3	-127.71	378	306.7	11.8	24.899					1.858			
44.000	651.580	.460	1014.5	-127.97	378	307.1	11.7	25.498					1.859			
45.000	671.900	.446	1007.9	-128.22	377	307.4	11.6	26.090					1.861			
46.000	692.293	.433	1001.5	-128.46	377	307.7	11.6	26.681					1.862			
47.000	712.744	.421	995.2	-128.69	376	308.1	11.5	27.269					1.864			
48.000	733.244	.408	989.1	-128.92	376	308.4	11.4	27.853					1.865			
49.000	753.781	.398	983.2	-129.14	375	308.7	11.3	28.432					1.867			
50.000	774.346	.387	977.4	-129.36	375	309.0	11.2	29.008					1.868			
5.562	20.414	14.496	2029.6	-86.40	.433	241.1	29.9	2.036	241.1	250.1	267.5	271.0	1.406	1.581		

SHIFTING EXPANSION															
C STAR = 5682.7 FT/SEC															
EPSILON	PC/P	P PSIA	TEMP	ENTHALPY	CP CAL/	DEG K	OPT DELVAC	DELVAC	I SEA	I AT	I AT	I VAC	CF SEA	CF VAC	
				DEG K	DEG K	DEG K	DEG K	DEG K	LVL	10000	50000	LVL	LVL	LVL	
	1.000	300.000	3511.4	-34.87	2.014	115.3	101.9	.589	208.5	211.1	216.2	217.2	1.230	1.181	
1.000	1.733	173.102	3357.1	-34.87	2.014	115.3	101.9	.589	208.5	211.1	216.2	217.2	1.230	1.181	
2.000	7.759	38.471	2996.0	-71.54	1.975	213.0	46.8	1.211	242.0	247.4	257.8	259.8	1.370	1.471	
3.000	15.276	22.597	2879.6	-84.28	1.922	237.3	40.1	1.776	251.3	259.1	274.4	277.4	1.423	1.570	
4.000	19.413	15.453	2773.7	-92.55	1.871	251.9	36.4	2.358	251.7	264.2	286.4	288.4	1.437	1.633	
5.000	26.022	11.537	2735.0	-98.41	1.825	262.2	34.0	2.950							
6.000	32.785	9.151	2688.8	-103.36	1.782	269.9	32.3	3.533							
7.000	40.116	7.478	2650.7	-107.25	1.742	278.2	31.0	4.147							
8.000	47.480	6.192	2618.4	-110.53	1.705	281.3	30.0	4.741							
9.000	55.337	5.421	2590.4	-113.36	1.670	285.6	29.1	5.344							
10.000	62.975	4.744	2565.7	-115.85	1.637	289.4	28.4	5.954							
11.000	70.515	4.254	2543.5	-118.06	1.605	292.7	27.7	6.519							
12.000	77.983	3.847	2523.6	-120.04	1.574	295.6	27.2	7.067							
13.000	86.470	3.486	2505.0	-121.65	1.545	298.0	26.7	7.590							
14.000	95.121	3.154	2488.1	-123.51	1.516	300.7	26.2	8.122							
15.000	103.849	2.880	2472.5	-125.03	1.489	302.9	25.8	8.649							
16.000	112.675	2.643	2457.8	-126.45	1.462	304.4	25.5	9.171							
17.000	121.552	2.429	2444.1	-127.78	1.437	306.0	25.1	9.678							
18.000	130.311	2.230	2431.1	-129.04	1.412	307.0	24.8	10.180							
19.000	139.080	2.157	2418.8	-130.14	1.389	310.1	24.6	11.384							
20.000	147.778	2.030	2407.2	-131.22	1.366	311.6	24.4	11.964							
21.000	156.396	1.918	2396.1	-132.25	1.344	314.1	24.0	12.534							
22.000	164.902	1.813	2385.5	-133.22	1.324	316.8	23.8	13.088							
23.000	173.308	1.731	2375.4	-134.14	1.301	315.7	23.6	13.630							
24.000	181.607	1.652	2365.4	-135.02	1.281	316.4	23.4	14.157							
25.000	190.440	1.573	2356.4	-135.86	1.260	318.0	23.2	14.738							
26.000	200.340	1.497	2347.4	-136.66	1.240	319.1	23.0	15.261							
27.000	210.101	1.426	2338.8	-137.42	1.220	320.0	22.8	15.806							
28.000	219.952	1.364	2330.5	-138.16	1.200	321.2	22.7	16.410							
29.000	229.882	1.305	2322.5	-138.86	1.182	322.1	22.5	17.235							
30.000	239.827	1.251	2314.5	-139.54	1.163	323.5	22.3	17.858							
31.000	249.820	1.200	2307.0	-140.19	1.146	324.7	22.2	18.462							
32.000	259.883	1.154	2299.4	-140.82	1.128	324.8	22.0	19.098							
33.000	269.933	1.111	2292.4	-141.43	1.111	325.0	21.9	19.715							
34.000	280.040	1.071	2285.4	-142.02	1.095	326.1	21.8	20.328							
35.000	290.115	1.034	2278.6	-142.59	1.079	327.1	21.6	20.937							
36.000	300.230	0.999	2272.4	-143.14	1.064	328.0	21.5	21.542							
37.000	310.319	0.967	2266.4	-143.67	1.049	328.6	21.4	22.143							
38.000	320.354	0.936	2259.0	-144.19	1.034	329.2	21.3	22.739							
39.000	330.430	0.908	2252.7	-144.69	1.020	329.9	21.2	23.330							
40.000	340.484	0.884	2246.4	-145.18	1.006	330.5	21.1	23.914							
41.000	350.484	0.856	2240.5	-145.66	0.992	331.0	21.0	24.495							
42.000	360.453	0.832	2234.4	-146.12	0.979	331.8	20.9	25.069							
43.000	370.385	0.810	2228.8	-146.57	0.967	332.4	20.8	25.638							
44.000	380.279	0.789	2223.2	-147.00	0.954	332.9	20.7	26.200							
45.000	390.132	0.769	2217.6	-147.41	0.943	333.4	20.6	26.757							
46.000	399.942	0.750	2212.0	-147.85	0.930	334.0	20.5	27.308							
47.000	409.709	0.732	2206.6	-148.25	0.918	334.4	20.4	27.853							
48.000	419.432	0.715	2201.3	-148.65	0.907	335.1	20.3	28.393							
49.000	429.106	0.699	2196.1	-149.03	0.896	335.6	20.2	28.928							
50.000	438.750	0.684	2190.9	-149.42	0.885	336.1	20.1	29.454							
4.180	20.149	1.690	2783.2	-133.44	1.844	253.8	36.0	2.444	253.8	264.6	285.6	289.8	1.437	1.441	

BULK DENSITY = 1.041 GM/CC
MIXTURE RATIO = 3.444 LB OXIDIZER / LB OF FUEL

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