

**THE SPECIFIC IMPULSE OF HYDROGEN BURNED
IN NITROGEN-OXYGEN MIXTURES**

JAMES H. L. LAWLER

MATERIALS CENTRAL

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FOREWORD

This Technical Note was prepared by James H. L. Lawler as part of Project 3048, "Aviation Fuels", Task 30193, "High Energy Fuels," of the Fuels Section, Fuels and Lubrication Branch, Materials Central, Directorate of Advanced Systems Technology, Wright Air Development Division.

This report covers work conducted from August 1959 to August 1960.

Mr. Herbert A. Bartick provided invaluable assistance in use of the computer program and in preparing inputs for the program. The points for these curves were run on the WADD Remington Rand Univac 1103A computer.

ABSTRACT

Specific Impulse curves are presented for oxygen-nitrogen mixtures of 90, 85, 80, 75, 70, and 60% by weight oxygen being burned with hydrogen. The chamber pressures were 1000 psia and 500 psia and various exhaust pressures from 7.35 psia to 0.005 psia were used. Expansion ratio vs. impulses for the several conditions is plotted.

PUBLICATION REVIEW

This report has been reviewed and is approved.

FOR THE COMMANDER:

L. C. Dickey

L. C. DICKEY
Asst. Chief, Fuels & Lubrication Branch
Applications Laboratory
Materials Central

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1	1000	2.00	S	4
2	1000	2.00	F	5
3	1000	0.2	S	6
4	1000	0.2	F	7
5	1000	0.02	S	8
6	1000	0.02	F	9
7	500	0.5	S	10
8	500	0.5	F	11
9	500	0.05	S	12
10	500	0.05	F	13
11	500	0.005	S	14
12	500	0.005	F	15
13	500	7.35	S	16
14	500	7.35	F	17
15	500	0.735	S	18
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17	500	0.0735	S	20
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INTRODUCTION

The purpose of this work is to obtain the specific impulse of hydrogen being burned in nitrogen-oxygen mixtures.

This technical note was prepared by use of the same computer program as used in WADC TR 59-757 and hence explanation in detail of the methods of calculation is not repeated. For a detailed treatment WADC TR 59-757, "Thermodynamics of Rocket Propulsion and Theoretical Evaluation of Some Prototype Propellant Combinations" by T.O. Dobbins, should be consulted.

A BRIEF THEORY

Adiabatic combustion is assumed in the combustion chamber of an ideal rocket. The resultant gases and/or condensed phases are then expanded through either of two methods to some set exhaust pressures. The first method assumes chemical and phase equilibrium at every temperature and pressure in the exhausting gases. This represents the theoretical upper limit of performance. The second method of expansion assumes that the chemical and phase equilibrium are frozen at the combustion equilibrium and expanded. This method represents the lower limit of performance.

In all cases the nozzle is assumed to recover 100% of the possible impulse. Since this is not possible physically, the combustion efficiency and the nozzle coefficient should be multiplied, times the calculated Isp to obtain a real system's value.

CONCLUSIONS

The specific impulse is a function of expansion ratio and is independent of the chamber pressure in the range of 500 to 1000 psia chamber pressure.

It is desirable to burn a hydrogen rich mixture as the specific impulse (Isp) is highest which slightly more hydrogen than stoichiometric. This is theorized to be due to the average molecular weight being lowered faster than the temperature drop.

Manuscript released by the author September 1960 for publication as a WADD Technical Note.

Contrails

APPENDIX I

SPECIFIC IMPULSE OF

H₂ O₂ N₂ MIXTURES

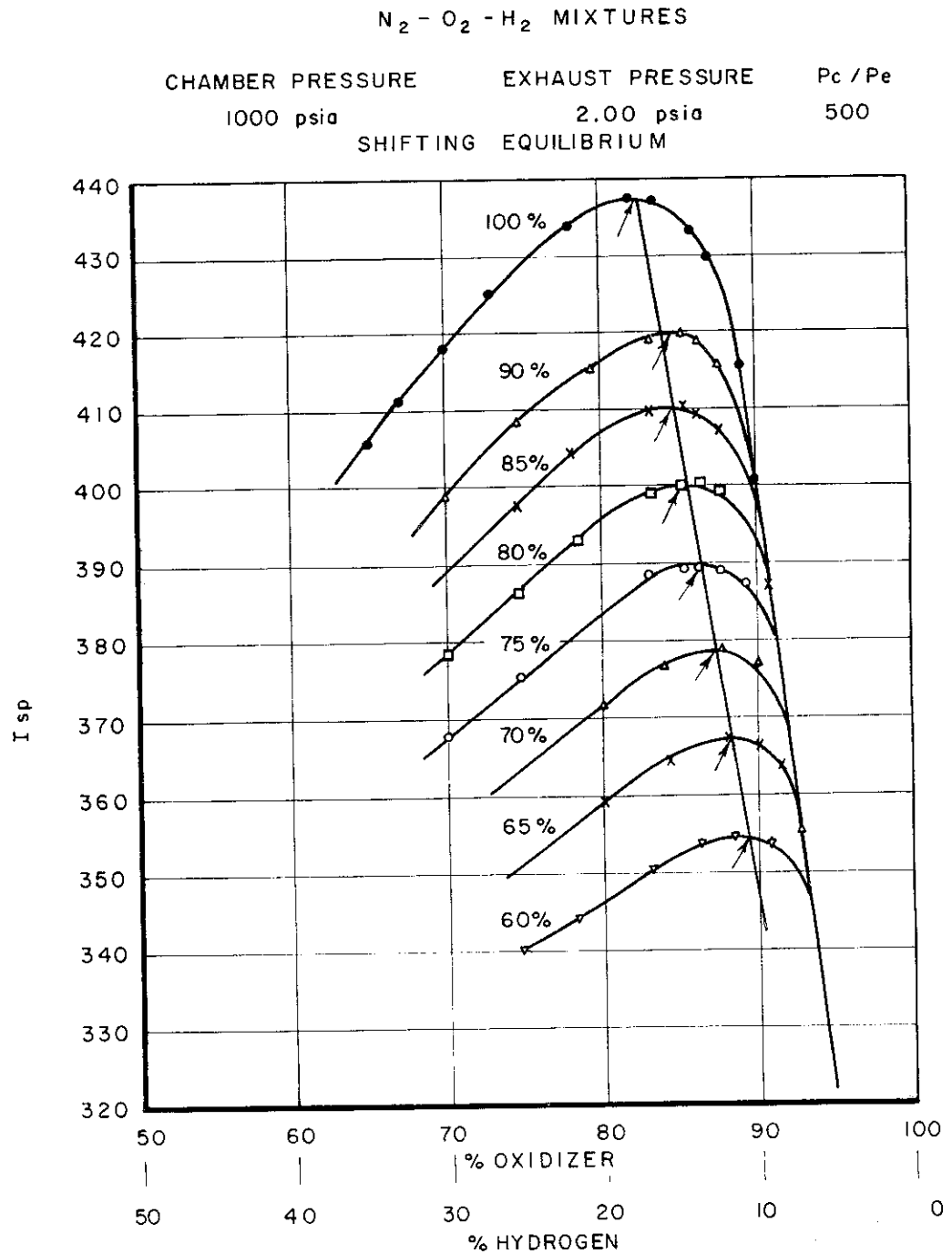


FIGURE I. $P_c = 1000$, $P_e = 2.0$, SHIFTING EQUILIBRIUM

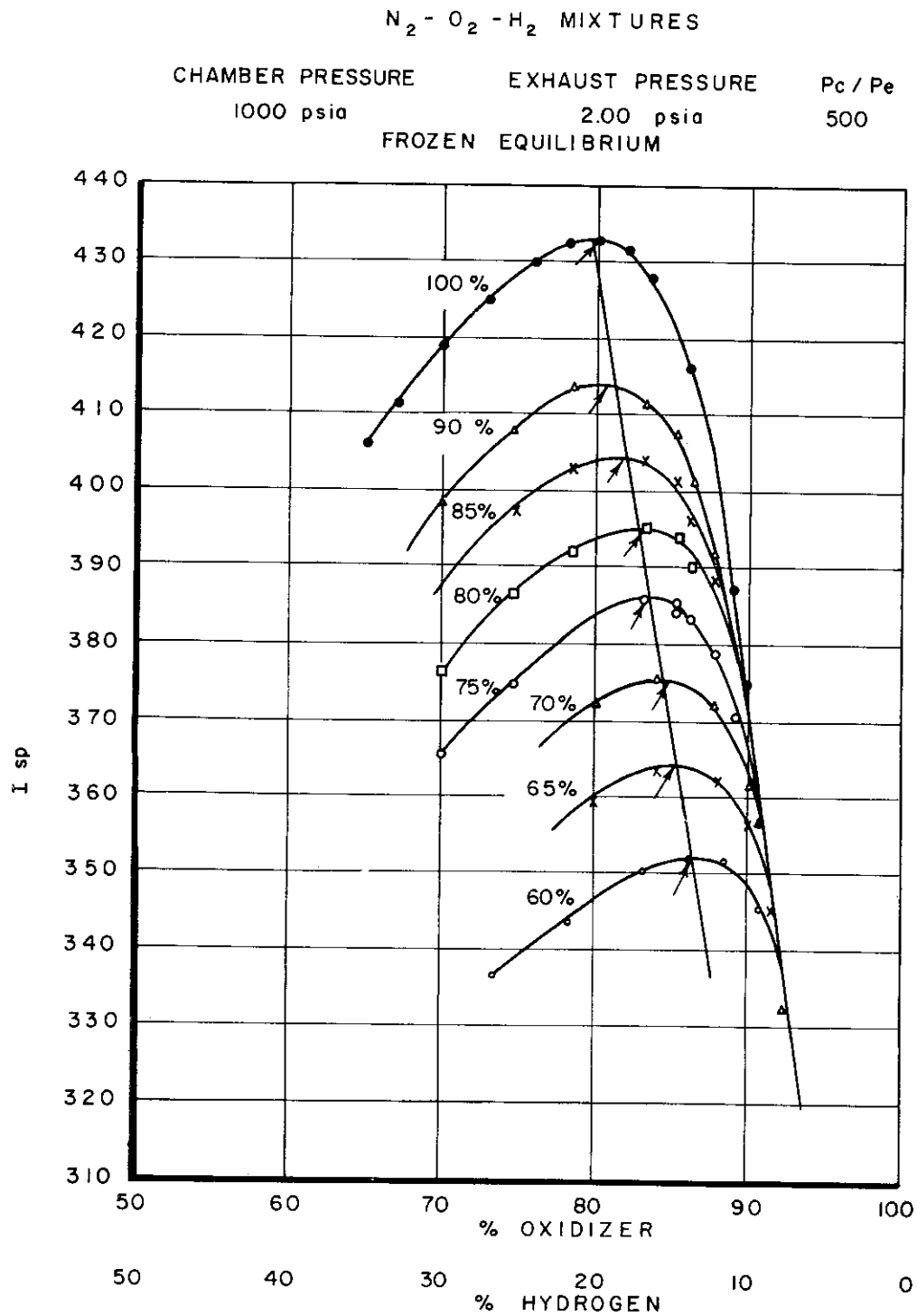


FIGURE 2. $P_c = 1000$, $P_e = 2.0$, FROZEN EQUILIBRIUM

$N_2 - O_2 - H_2$ MIXTURES

CHAMBER PRESSURE 1000 psia
 EXHAUST PRESSURE 0.2 psia
 P_c / P_e 5,000
 SHIFTING EQUILIBRIUM

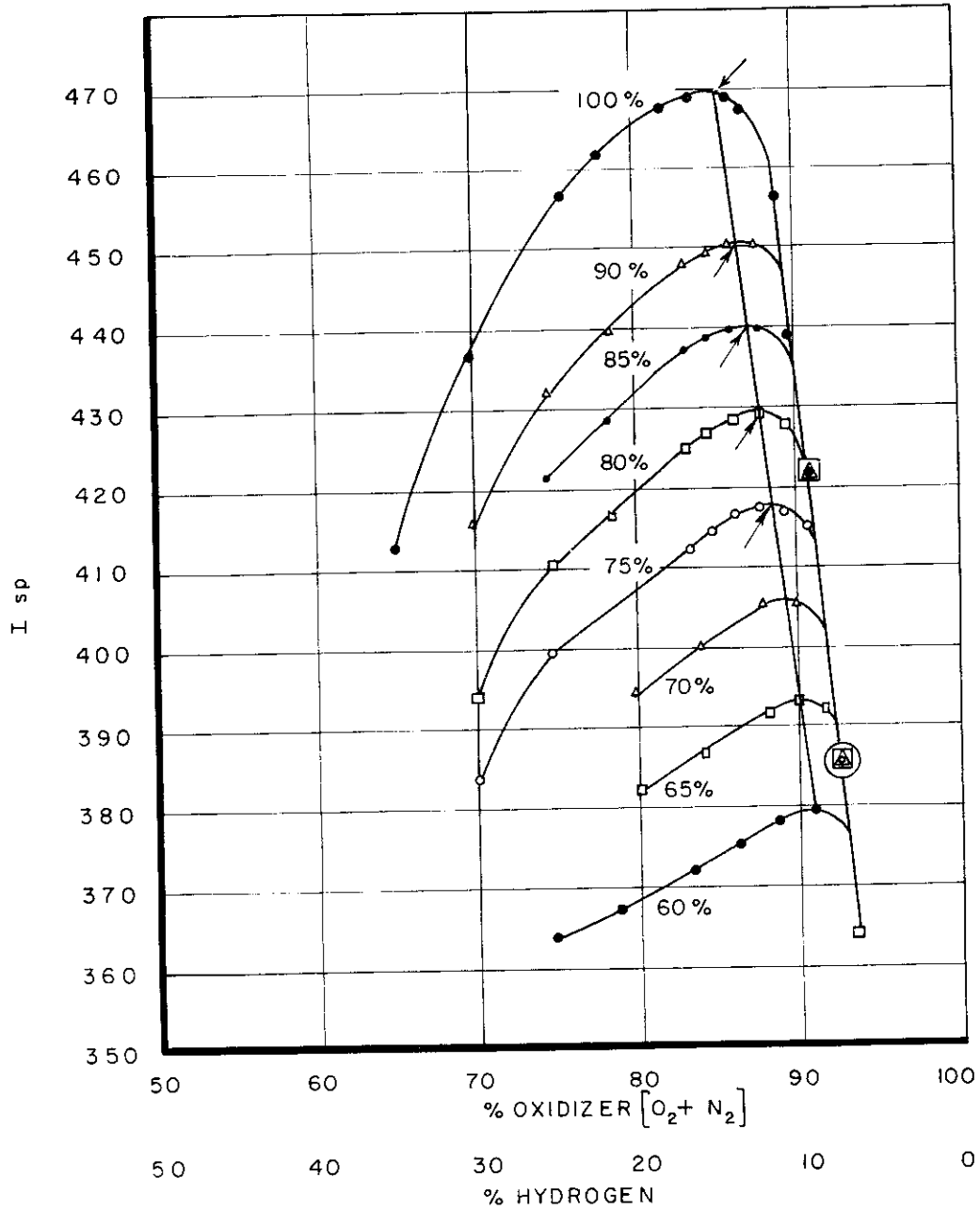


FIGURE 3. $P_c = 1000$, $P_e = 0.2$, SHIFTING EQUILIBRIUM

$N_2 - O_2 - H_2$ MIXTURES

CHAMBER PRESSURE
1000 psia

EXHAUST PRESSURE
0.20 psia

P_c / P_e
5,000

FROZEN EQUILIBRIUM

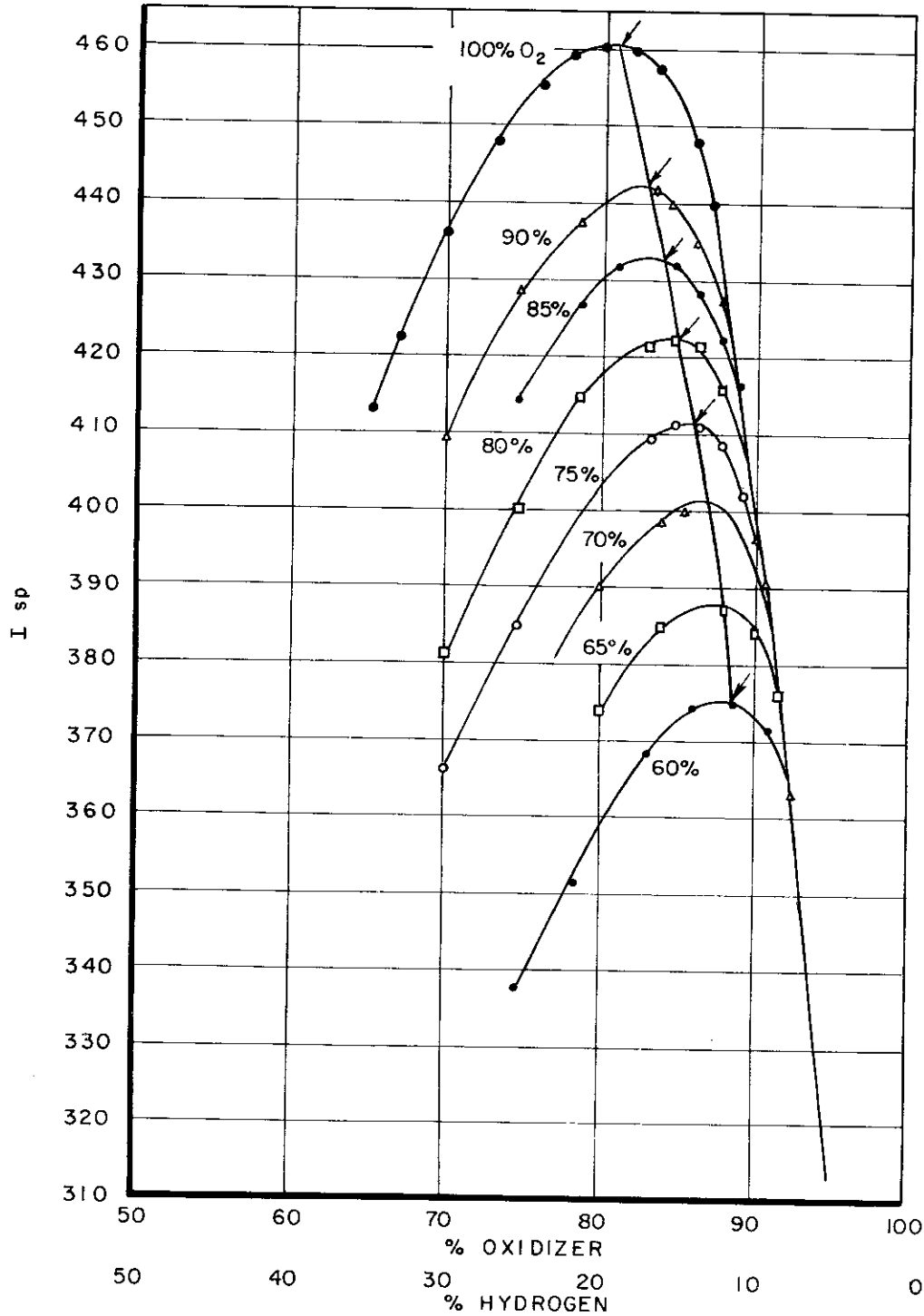


FIGURE 4. $P_c = 1000$, $P_e = 0.2$, FROZEN EQUILIBRIUM

$N_2 - O_2 - H_2$ MIXTURES

CHAMBER PRESSURE 1000 psia
 EXHAUST PRESSURE 0.02 psia
 P_c / P_e 50,000
 SHIFTING EQUILIBRIUM

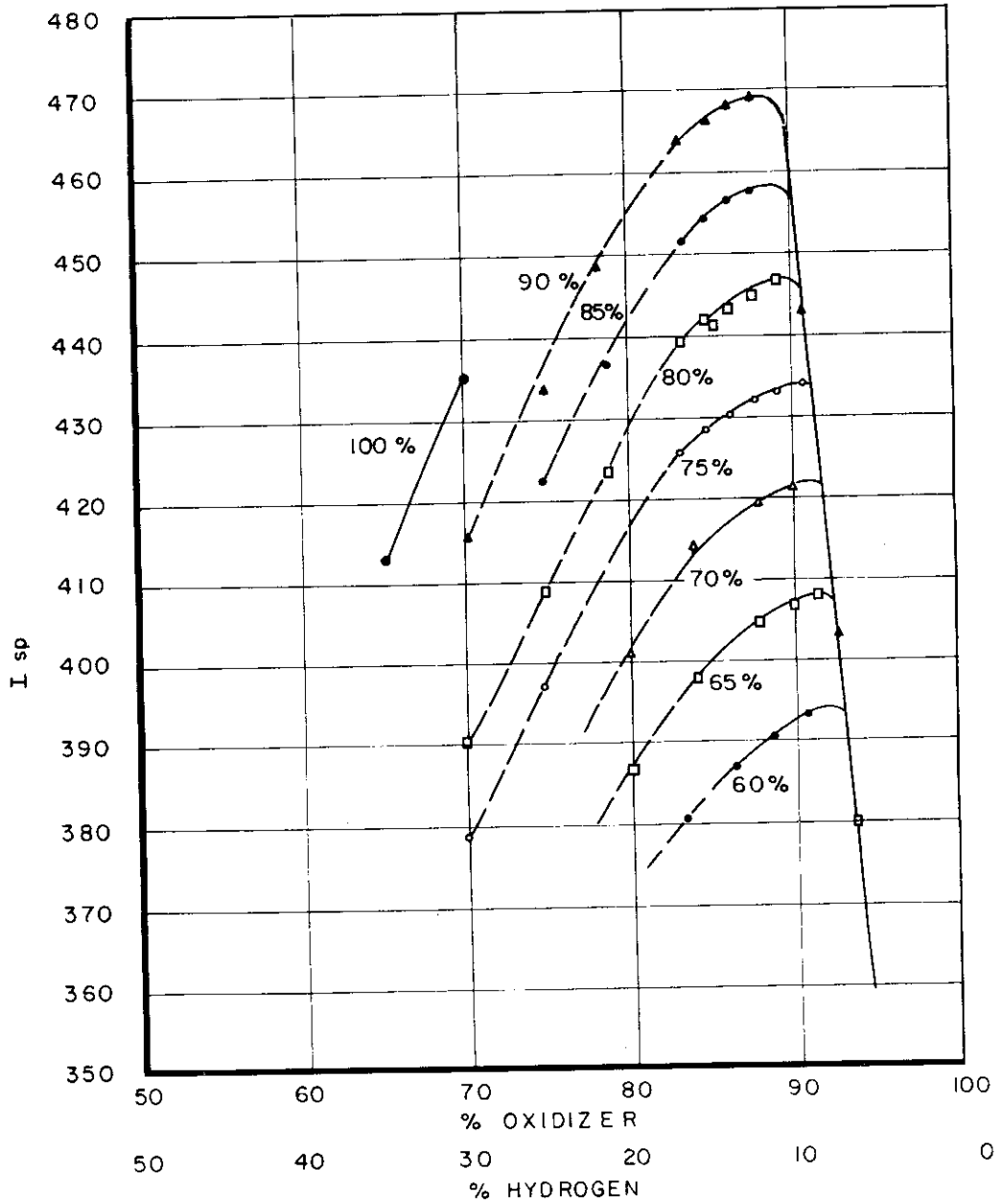


FIGURE 5. $P_c = 1000$, $P_e = 0.02$, SHIFTING EQUILIBRIUM

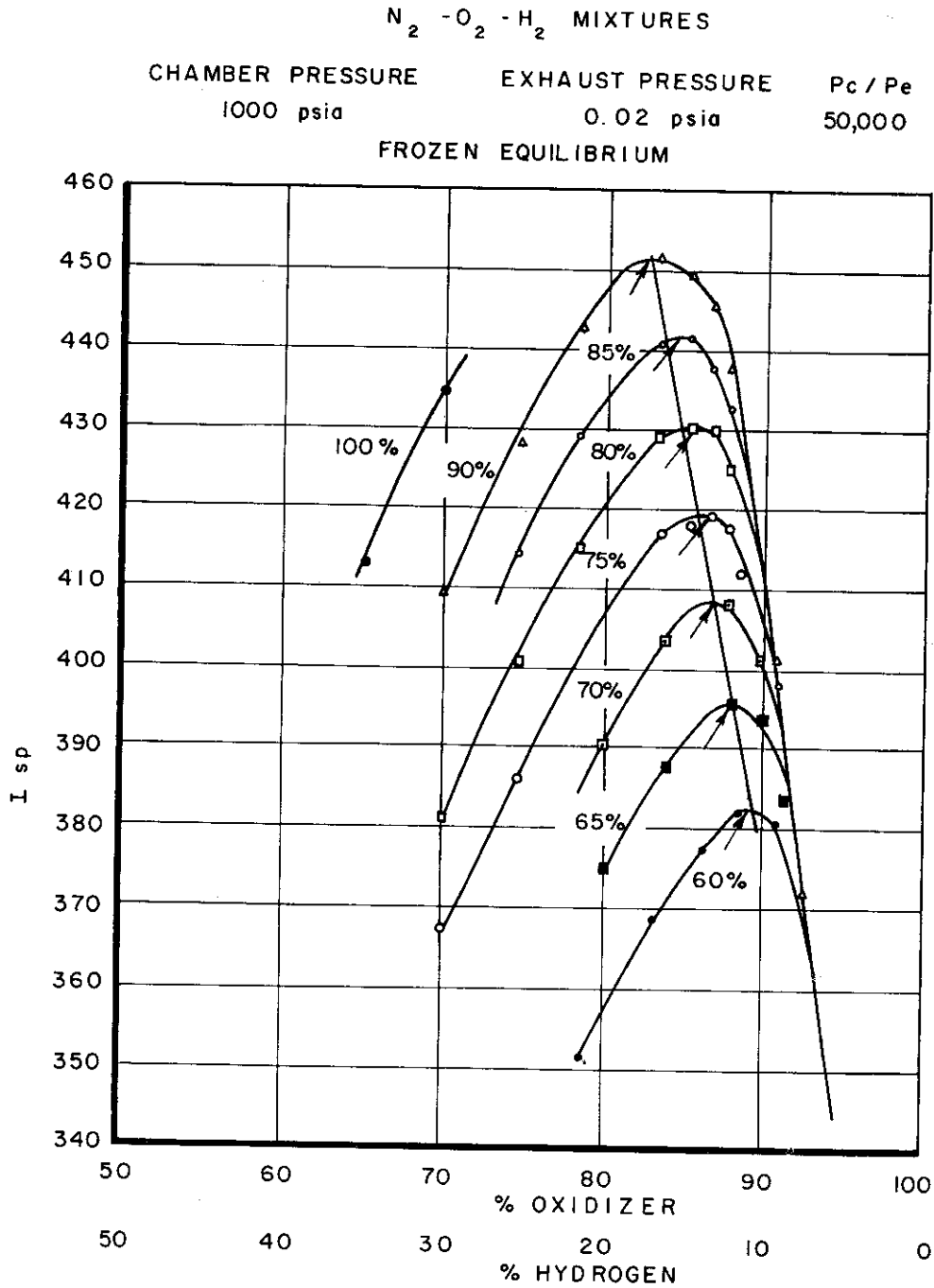


FIGURE 6. $P_c = 1000$, $P_e = 0.02$, FROZEN EQUILIBRIUM

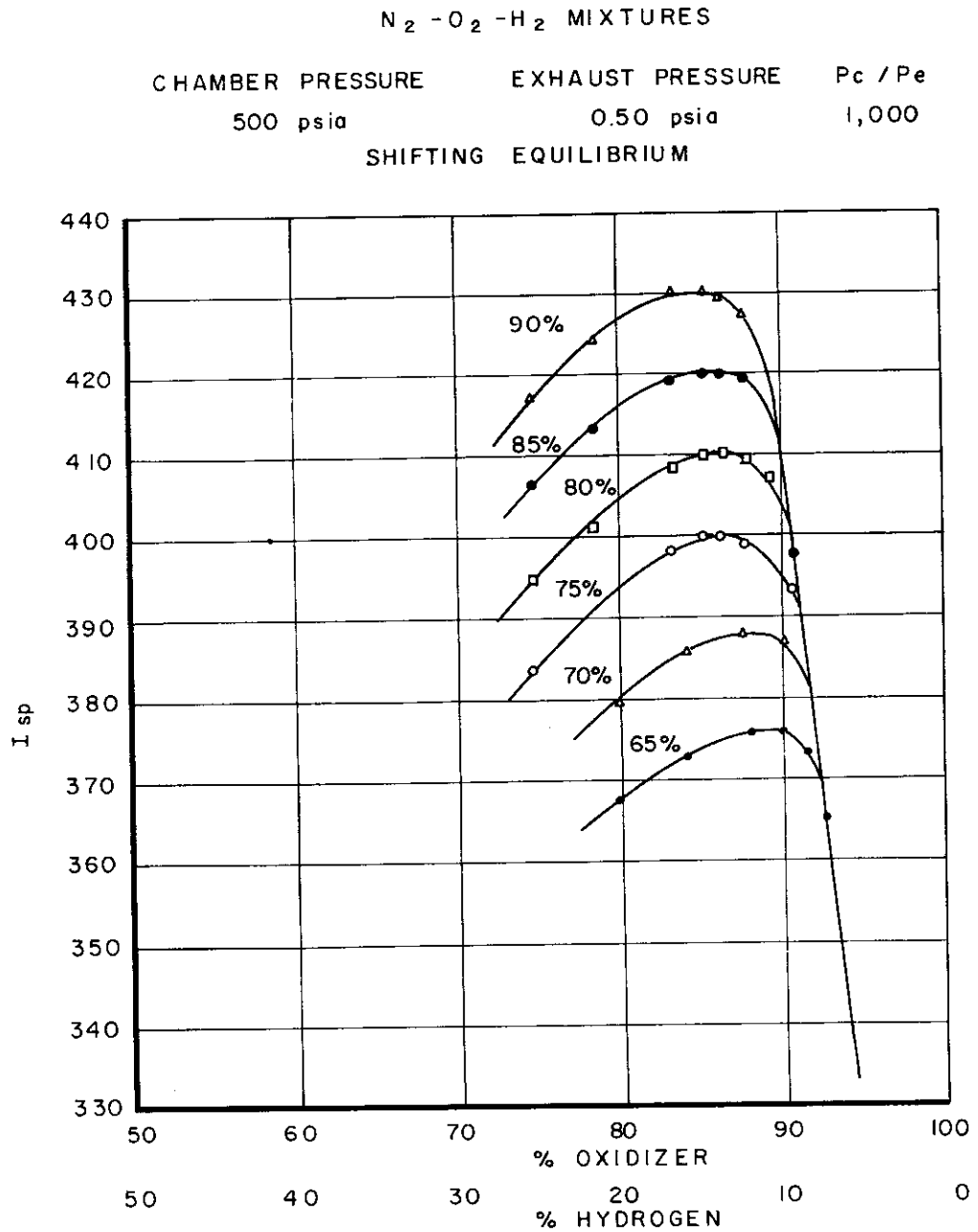


FIGURE 7. P_c = 500, P_e = 0.5, SHIFTING EQUILIBRIUM

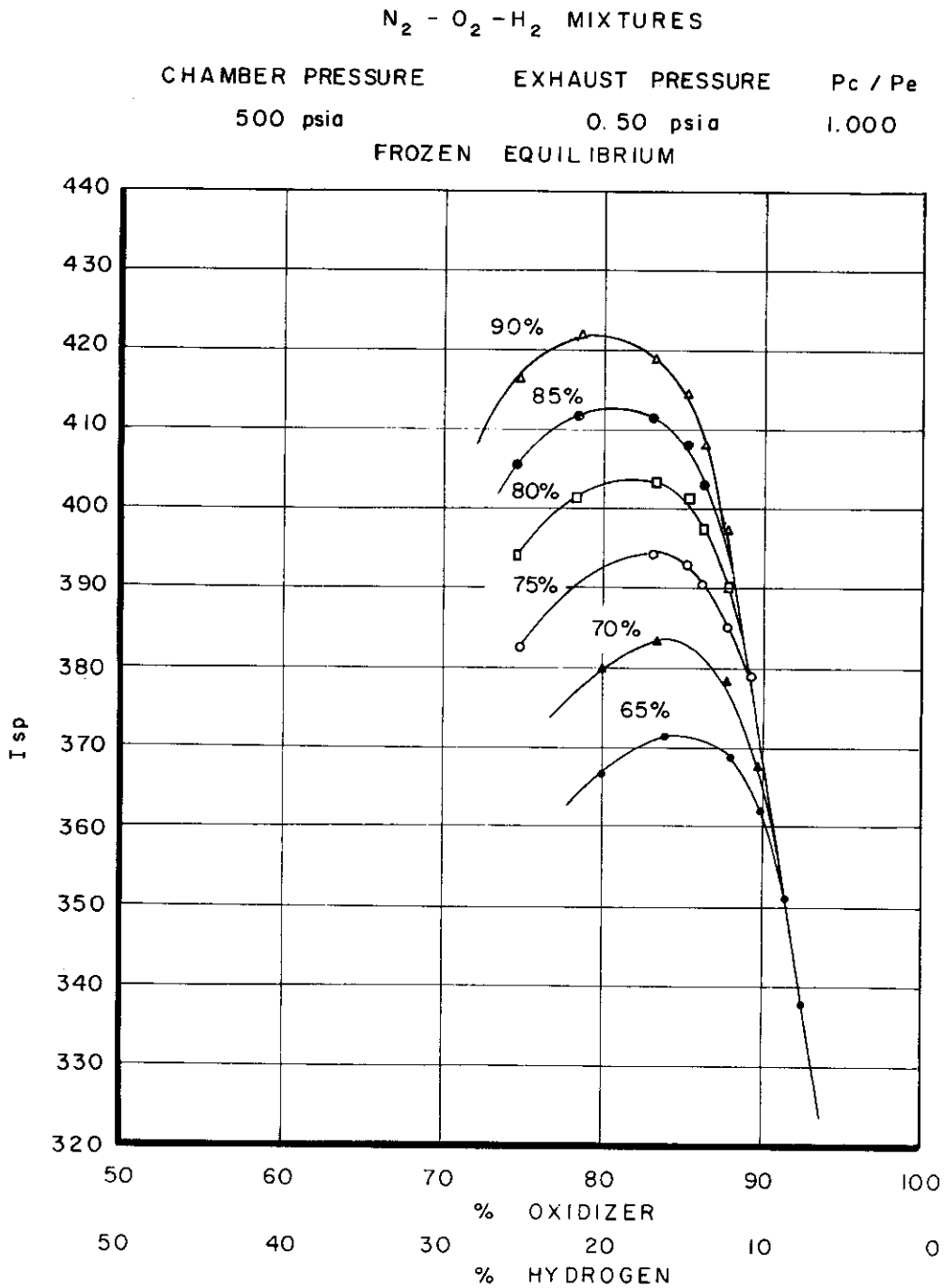


FIGURE 8. $P_c = 500$, $P_e = 0.5$, FROZEN EQUILIBRIUM

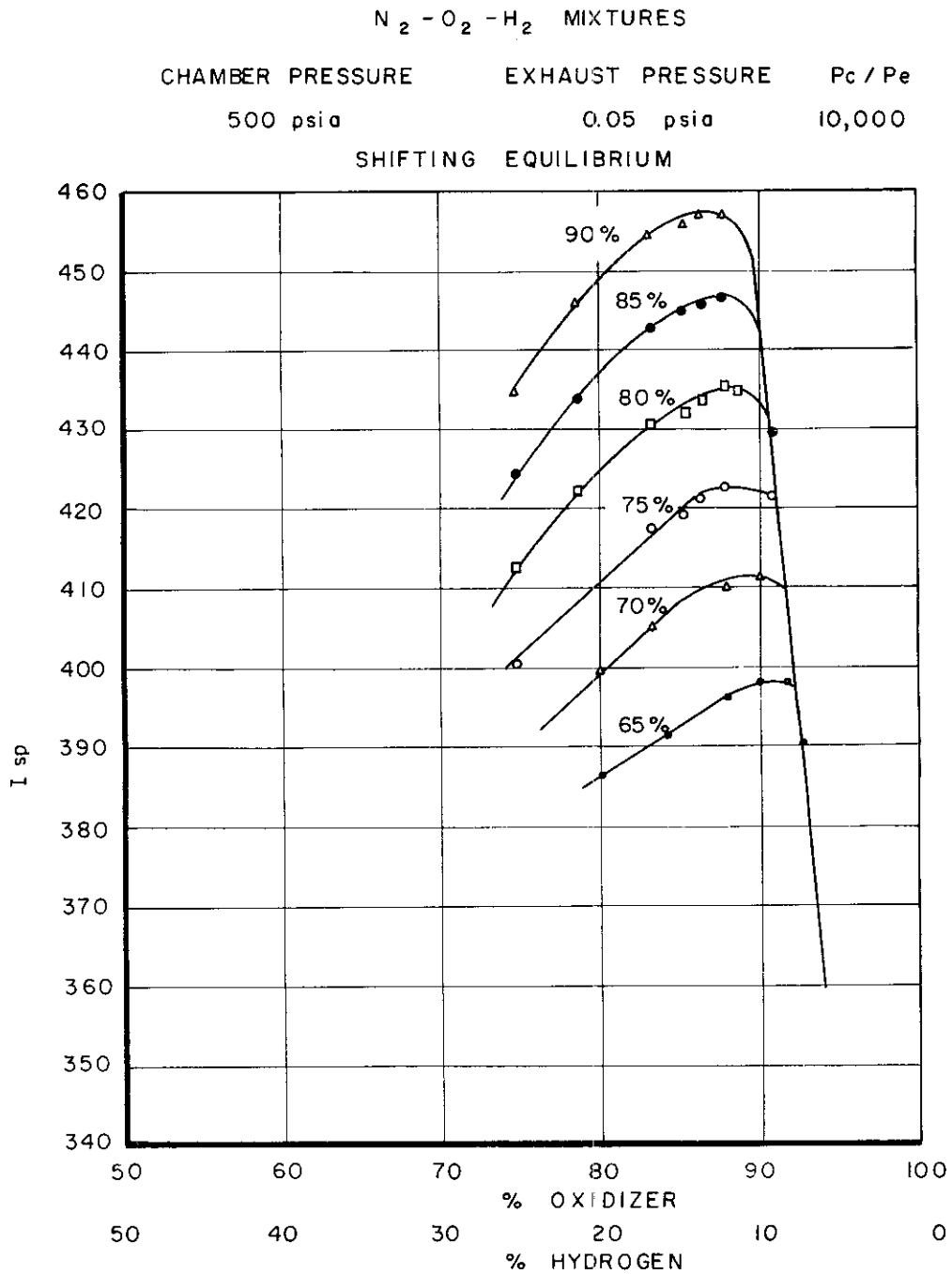


FIGURE 9. $P_c = 500$, $P_e = 0.05$, SHIFTING EQUILIBRIUM

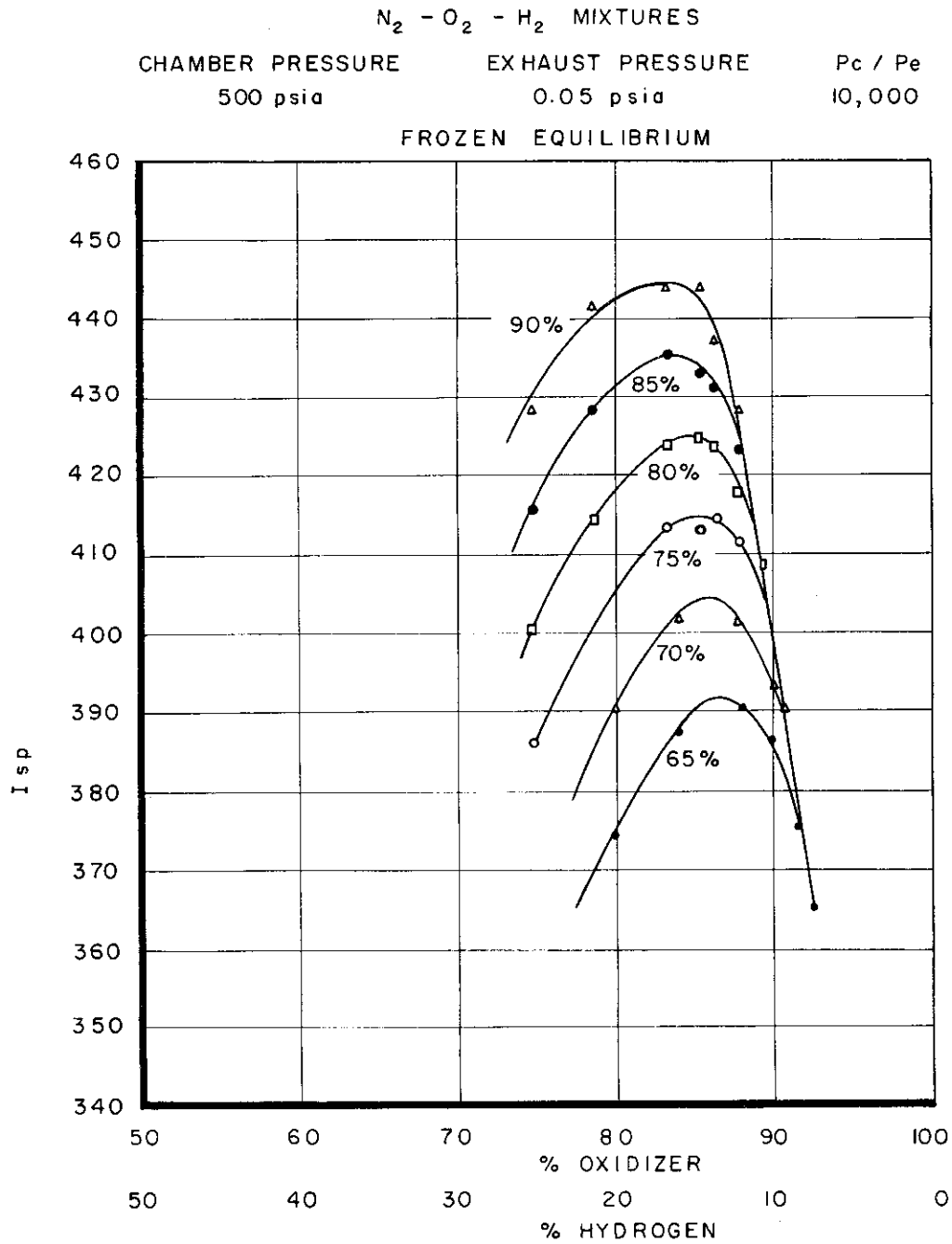


FIGURE 10. $P_c = 500$, $P_e = 0.05$, FROZEN EQUILIBRIUM

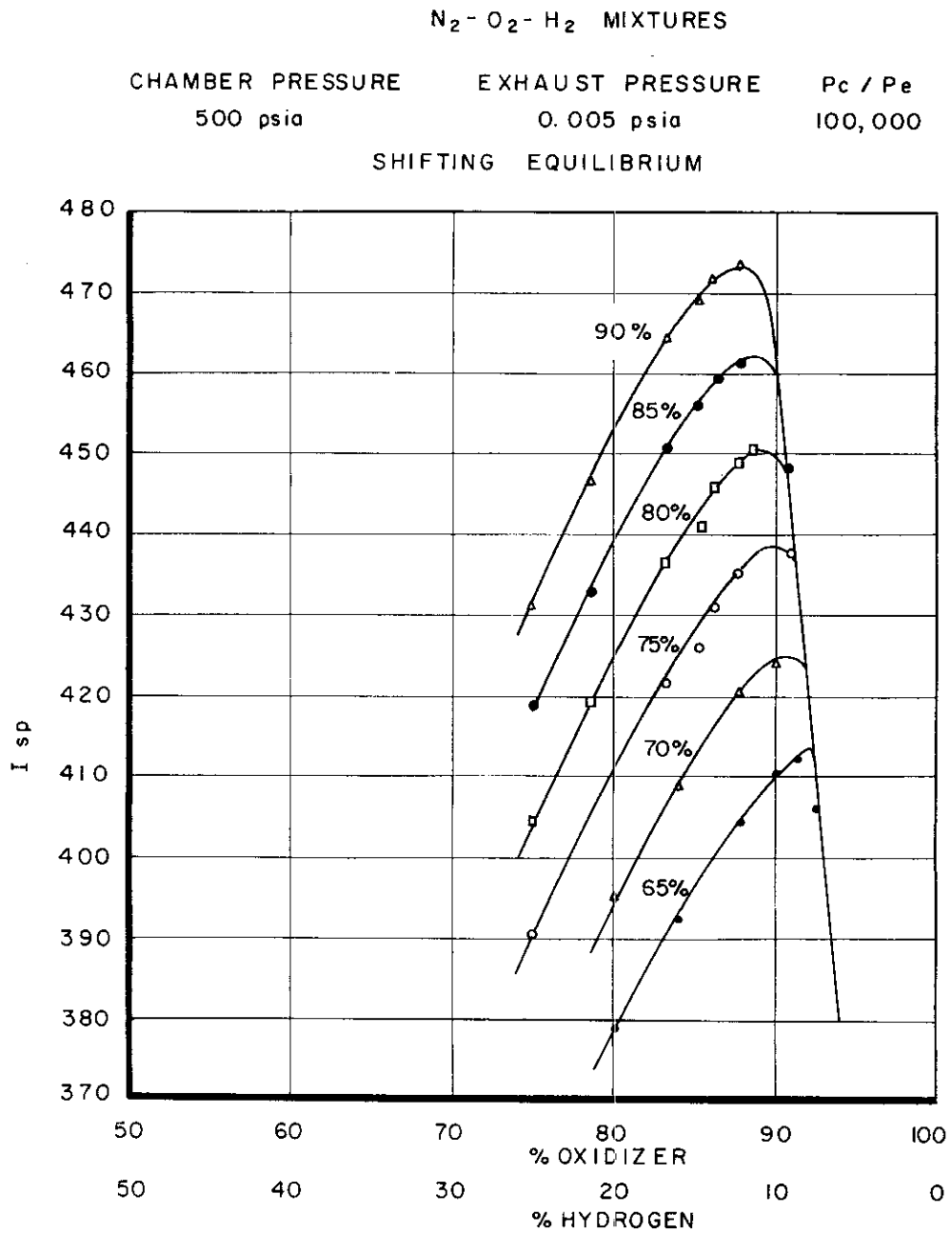


FIGURE II. P_c = 500, P_e = 0.005, SHIFTING EQUILIBRIUM

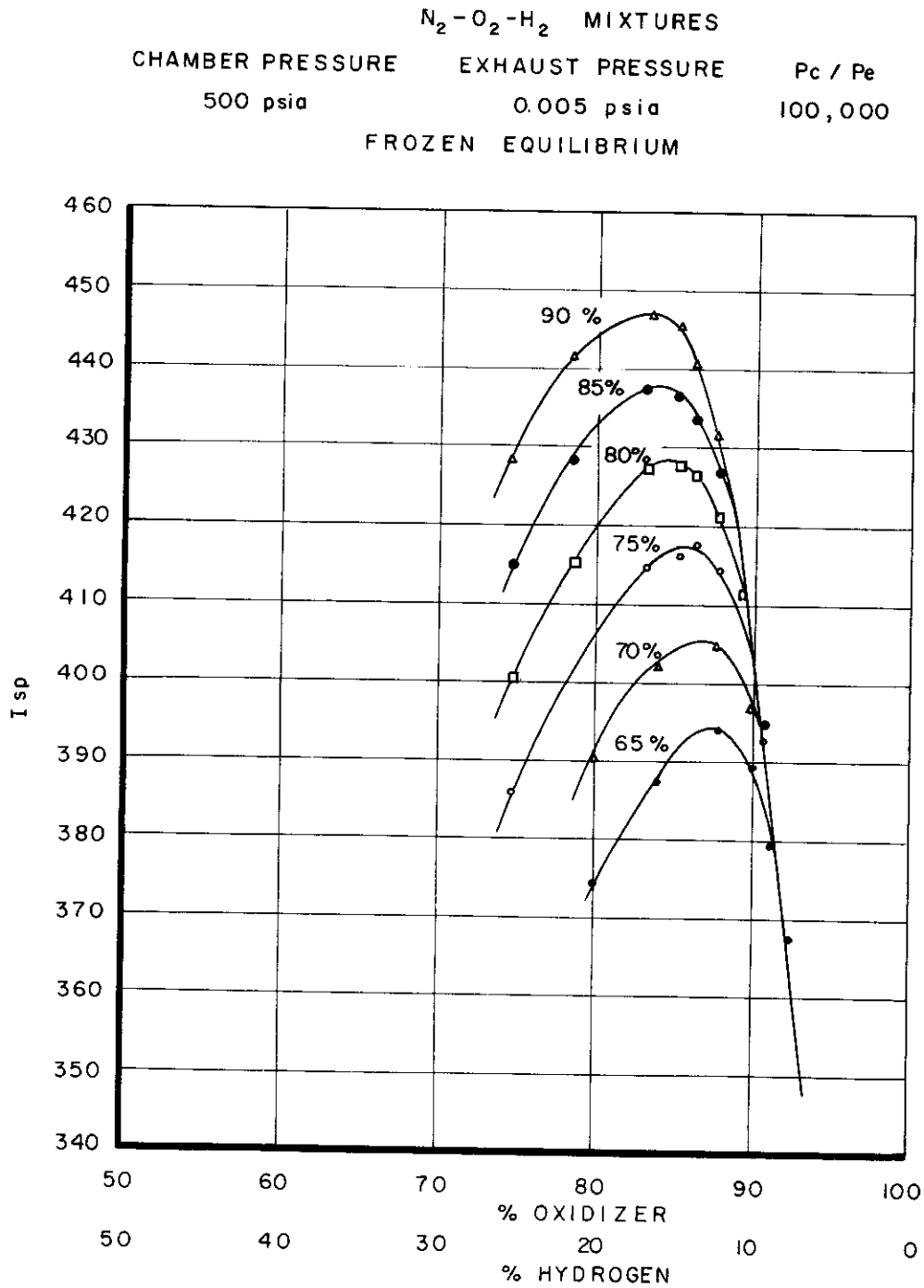


FIGURE 12. $P_c = 500$, $P_e = 0.005$, FROZEN EQUILIBRIUM

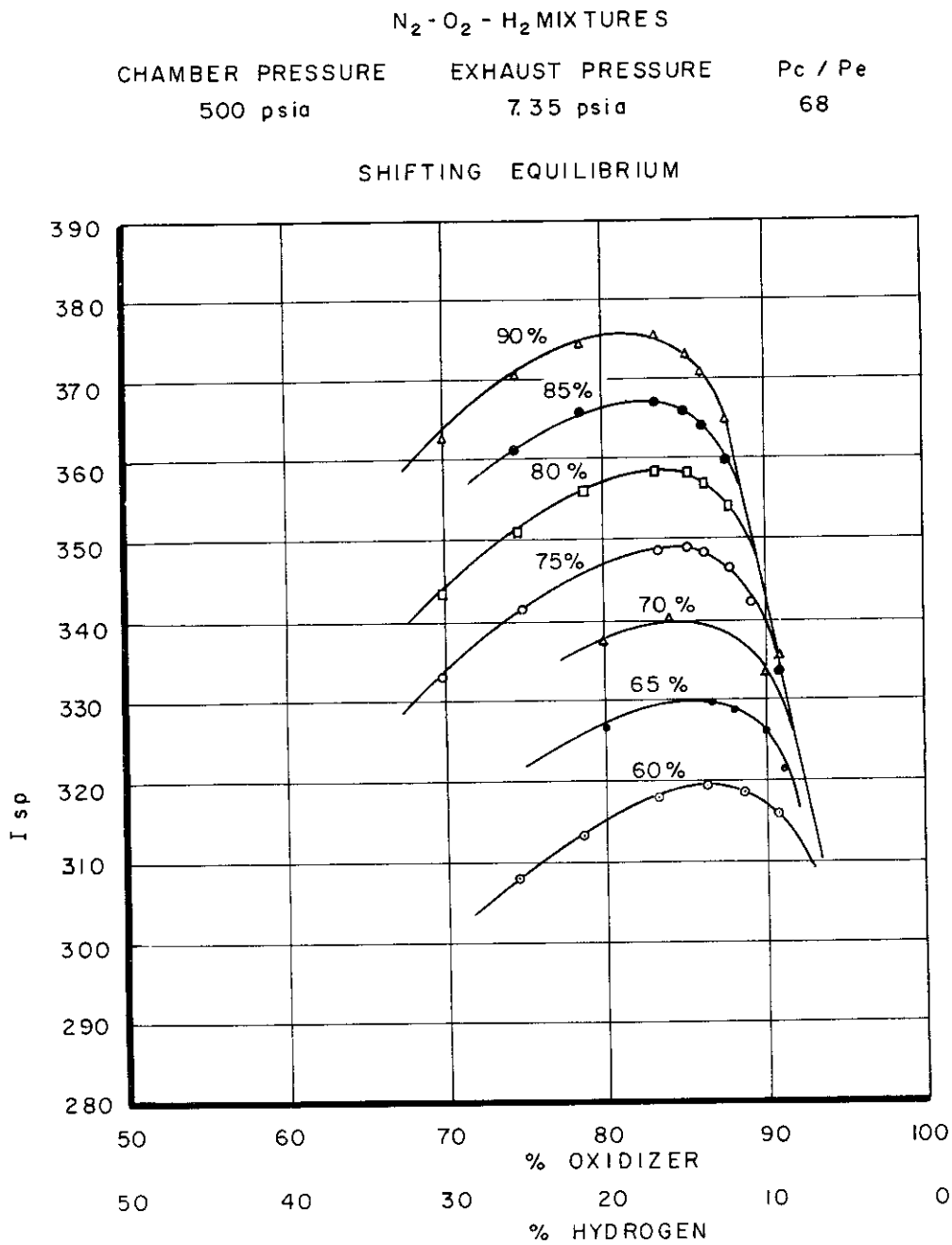


FIGURE 13. $P_c = 500$, $P_e = 7.35$, SHIFTING EQUILIBRIUM

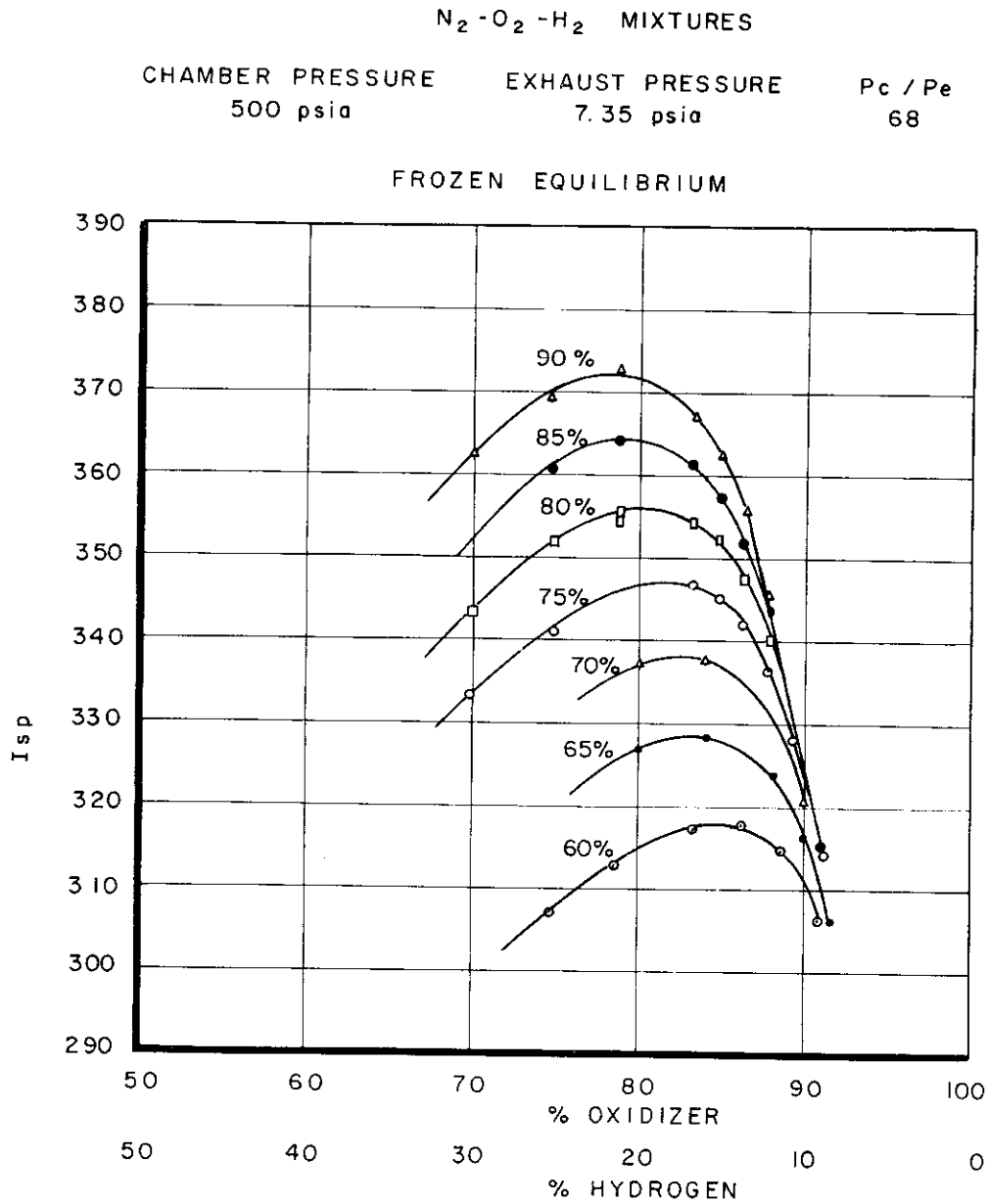


FIGURE 14. $P_c = 500$, $P_e = 7.35$, FROZEN EQUILIBRIUM

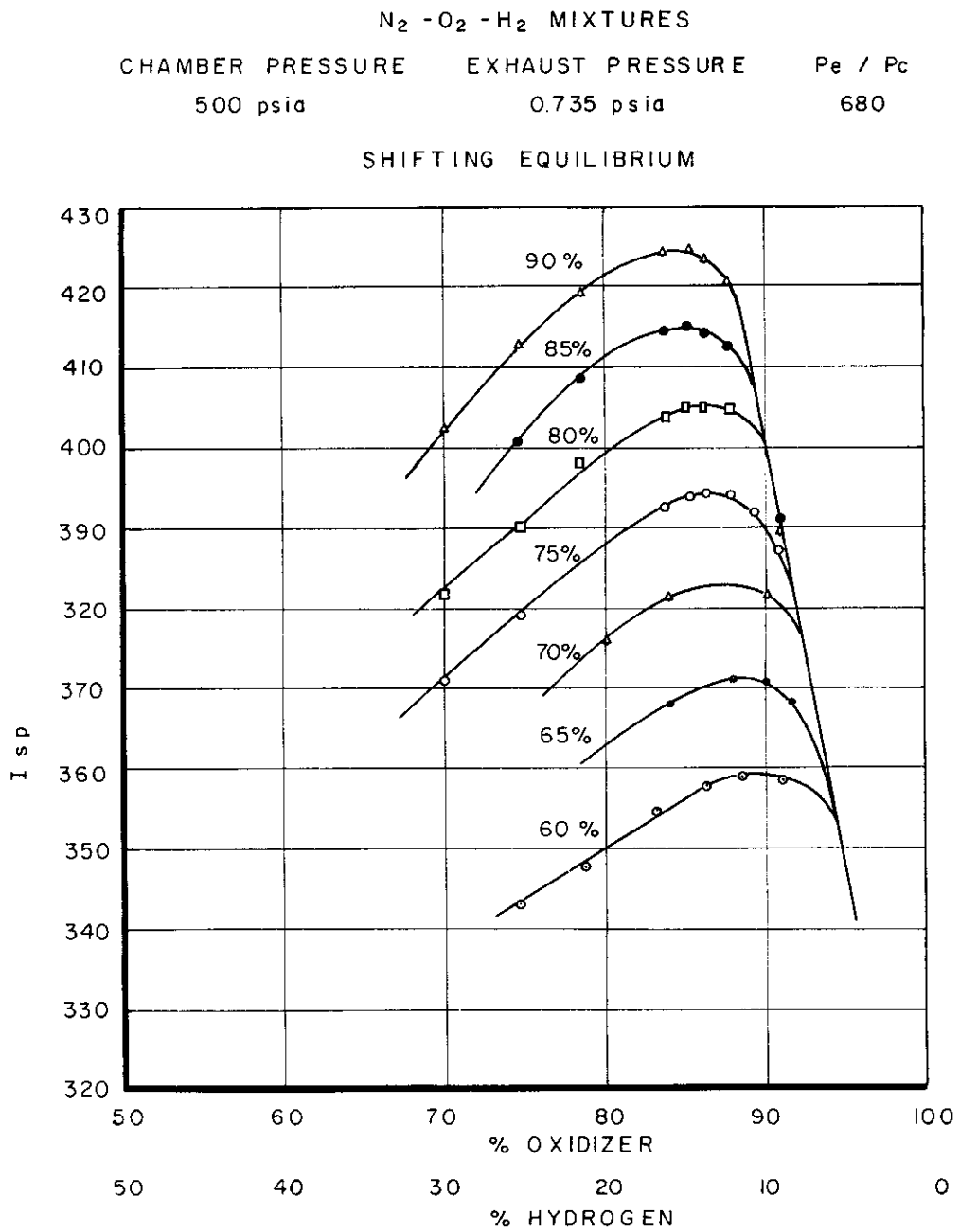


FIGURE 15. P_c = 500, P_e = 0.735, SHIFTING EQUILIBRIUM

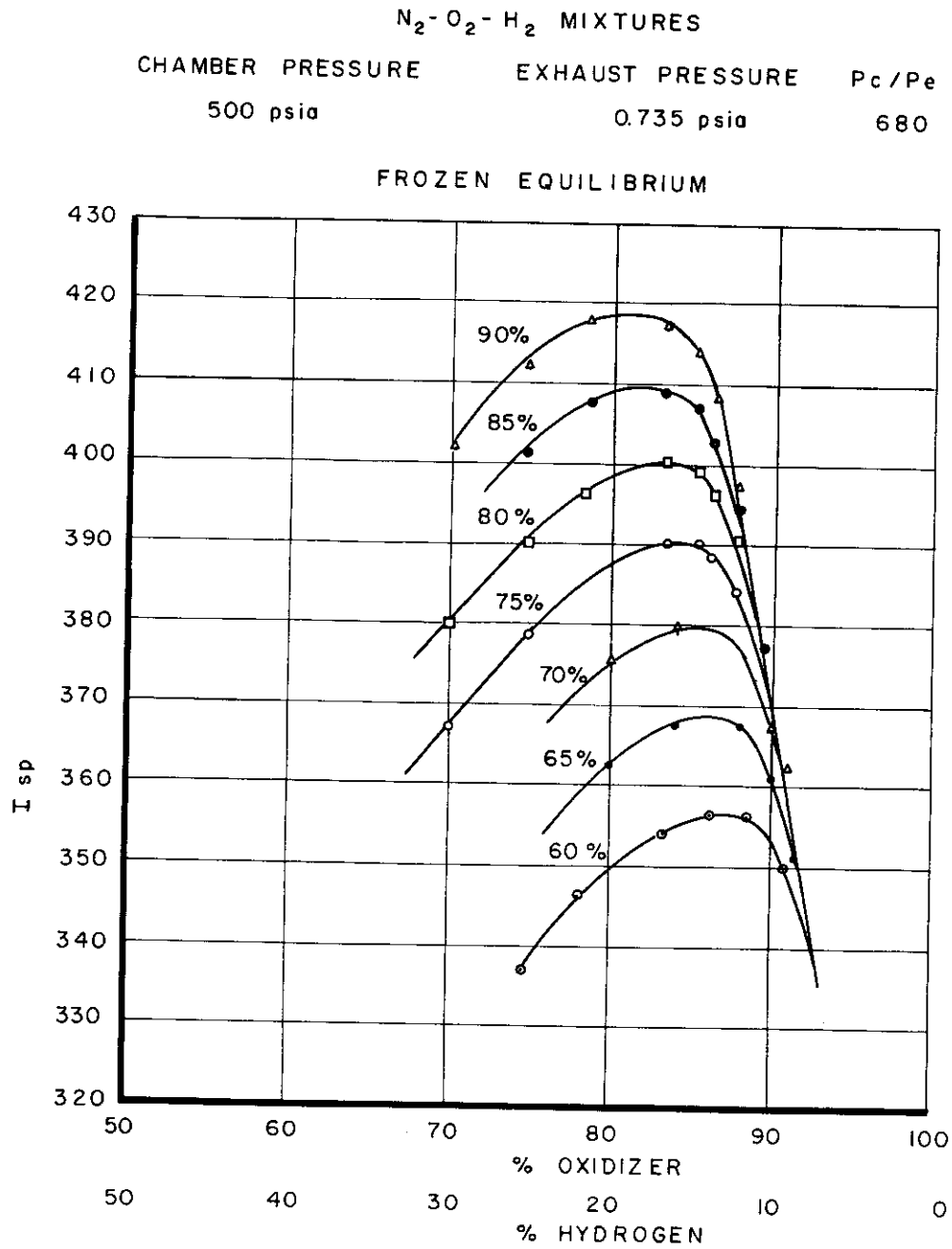


FIGURE 16. $P_c = 500$, $P_e = 0.735$, FROZEN EQUILIBRIUM

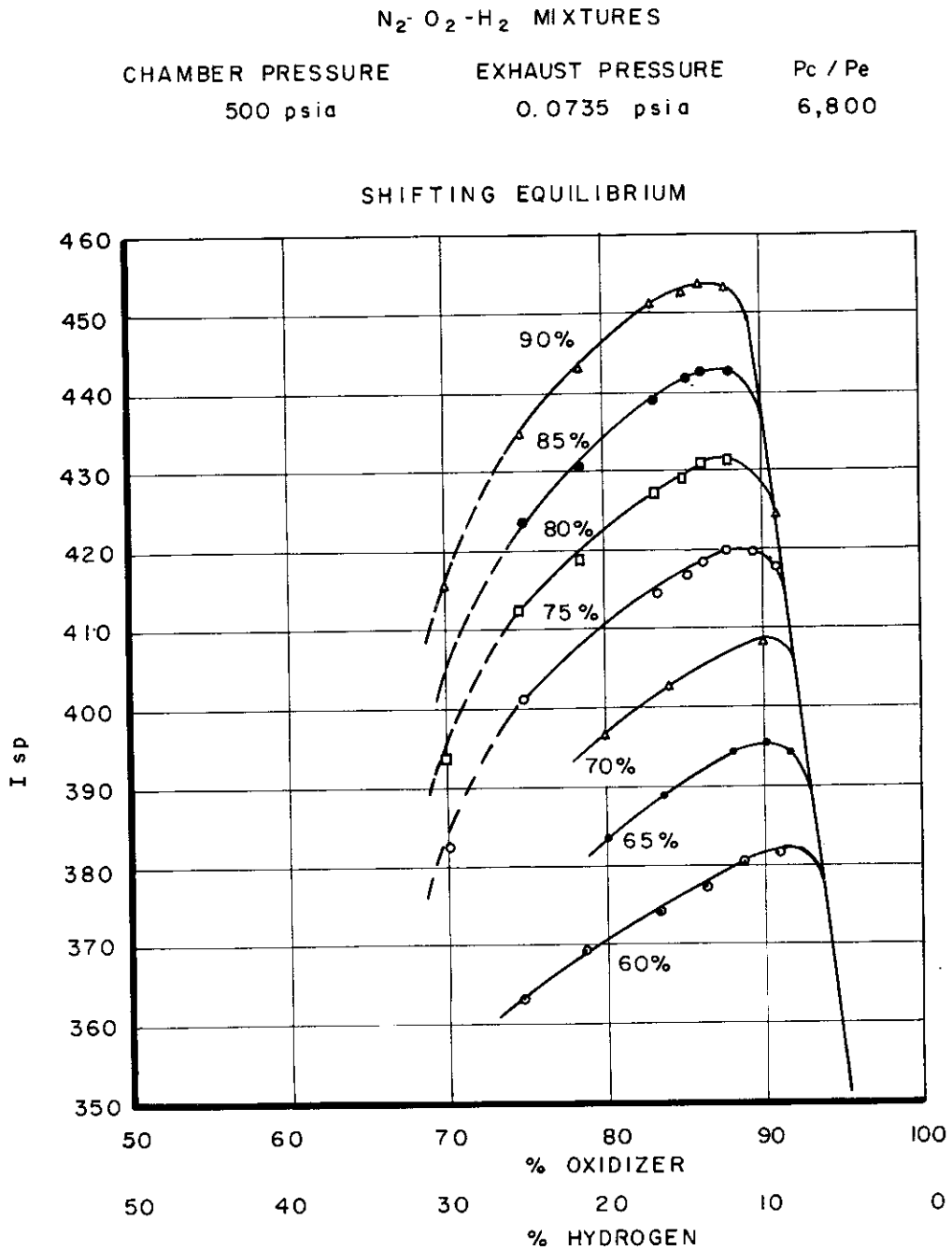


FIGURE 17. P_c = 500, P_e = 0.0735, SHIFTING EQUILIBRIUM

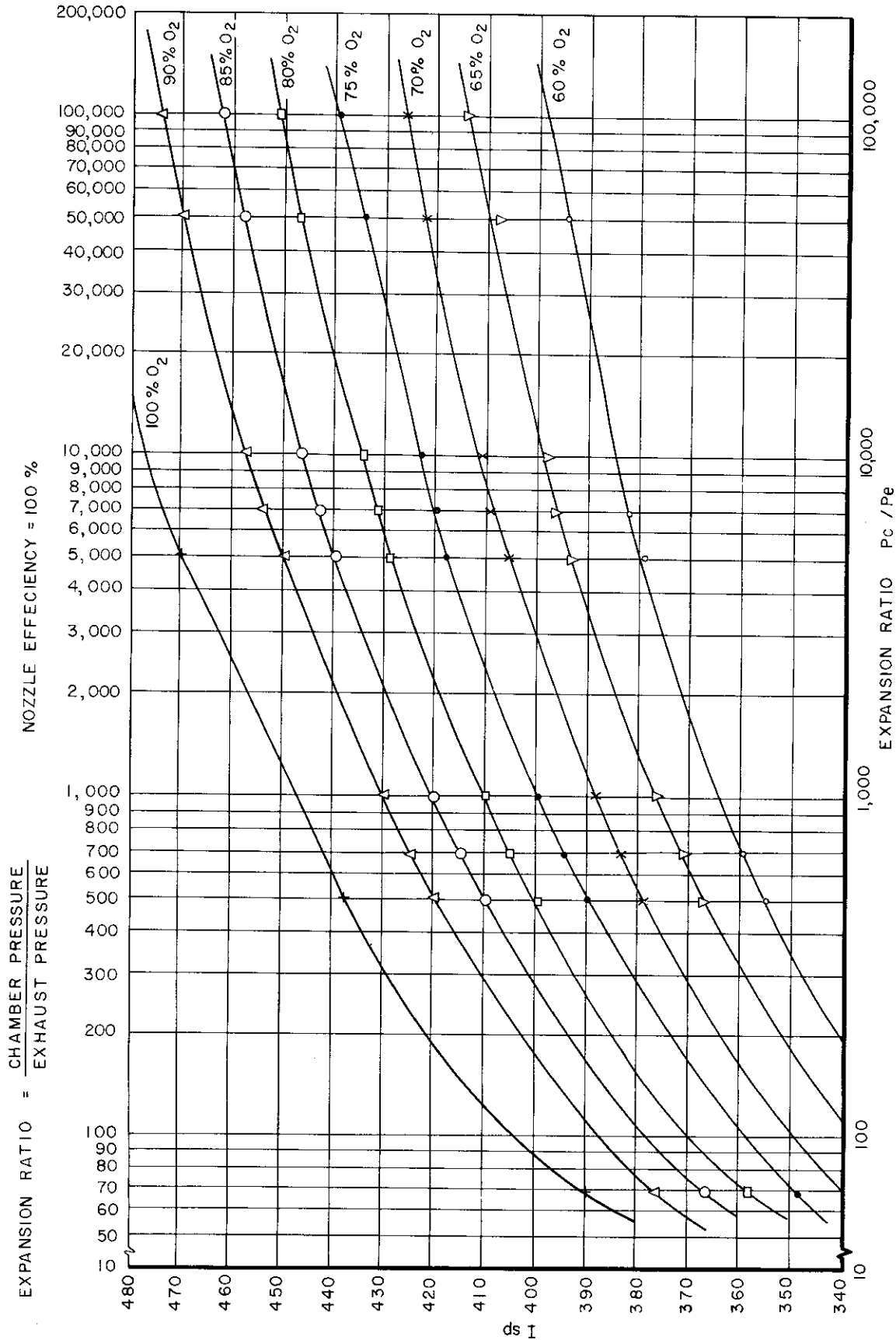


FIGURE 18. SHIFTING EQUILIBRIUM SPECIFIC IMPULSE OF HYDROGEN WITH OXYGEN - NITROGEN AS OXIDIZER

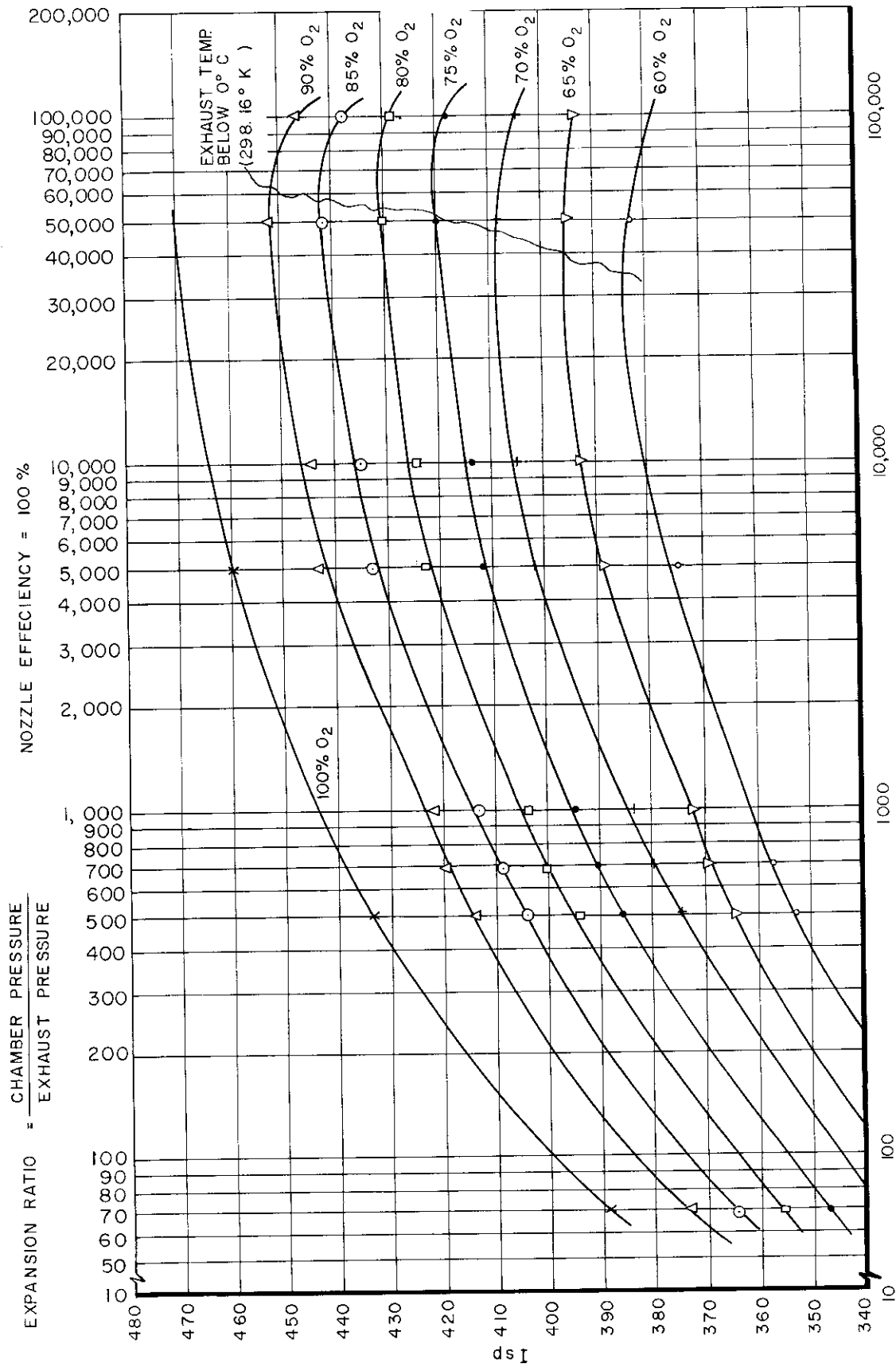


FIGURE 19. FROZEN EQUILIBRIUM SPECIFIC IMPULSE OF HYDROGEN WITH NITROGEN-OXYGEN AS OXIDIZER

APPENDIX II

COMPUTER DATA OUTPUT

The computer data output is arranged in three parts:

Data A, page 25

Data B, page 146

Data C, page 225

It is realized that the quality of reproduction in Appendix II is sometimes poor. If there are any questions, the master copy of these computer outputs is kept at Materials Central, Fuels and Lubrication Branch, Fuel Section, (WWRCEF-1), Wright-Patterson Air Force Base, Ohio. Answers may be obtained by writing to this Section or by calling Dayton, Ohio, Clearwater 3-7111, Extension 24160.

Contrails

DATA A

CHAMBER PRESSURE 1000 psia

EXHAUST PRESSURES 2, 0.2, and 0.02 psia

<p>CASE</p> <p>PROPELLANT COMPOSITION</p> <p> H2</p> <p> O2</p> <p>INGREDIENT DATA:</p> <p> H2</p> <p> O2</p> <p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p> H</p> <p> O</p> <p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p> <p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p> ISP (SEC)</p> <p> IVSP(LB-SEC/CU IN)</p> <p> TEMPERATURE (K)</p> <p> CP (CAL/GM-DEG.K)</p> <p> MOL. WT.-EFFECTIVE</p> <p> CP/CV -EFFECTIVE</p> <p> CF -APPROX.</p> <p> PEAE/M (SEC)</p> <p> AE/AT -APPROX.</p> <p>FROZEN EQUILIBRIA</p> <p> ISP (SEC)</p> <p> TEMPERATURE (K)</p> <p> C* (FT/SEC)</p> <p> CF</p> <p> PEAE/M (SEC)</p> <p> AE/AT</p>	<p>WEIGHT%</p> <p>30.000</p> <p>70.000</p> <p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0800</p> <p>KCAL/100 GM</p> <p>EXHAUST</p> <p>2.000</p> <p>1000.0</p> <p>KCAL/100 GM</p> <p>EXHAUST</p> <p>2.000</p> <p>2066.3</p> <p>1.5960</p> <p>6.7191</p> <p>1.2686</p> <p>418.62</p> <p>3.1261</p> <p>451.20</p> <p>1.0999</p> <p>6.7200</p> <p>1.5677</p> <p>1.0984</p> <p>17.867</p> <p>28.125</p> <p>418.47</p> <p>450.00</p> <p>2066.3</p> <p>7950.5</p>	<p>MOLAR</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>EXHAUST</p> <p>0.2000</p> <p>EXHAUST</p> <p>0.2000</p> <p>435.58</p> <p>3.2527</p> <p>298.10</p> <p>1.0715</p> <p>6.7200</p> <p>1.5812</p> <p>1.7671</p> <p>8.8067</p> <p>1785.4</p> <p>435.37</p> <p>298.10</p> <p>1.7663</p> <p>8.8121</p> <p>1787.5</p>	<p>REF. TEMP.</p> <p>20.000</p> <p>90.000</p> <p>LB/CU IN</p> <p>EXHAUST</p> <p>200.0E-4</p> <p>435.58</p> <p>3.2527</p> <p>298.10</p> <p>1.0715</p> <p>6.7200</p> <p>1.5812</p> <p>1.7671</p> <p>8.8067</p> <p>1785.4</p> <p>435.37</p> <p>298.10</p> <p>1.7663</p> <p>8.8121</p> <p>1787.5</p>
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WADD TN 60-254

C-SE
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2056.3	451.20	290.16	290.16
ENTHALPY (KILOCALORIES)	-34.818	-230.22	-252.87	-252.87
ENTROPY (CALORIES/DEG.K)	607.15	617.15	670.22	730.32
HEAT CAPACITY (CAL/K)	139.60	109.99	107.15	107.15
MOLES OF GAS	14.883	14.881	14.881	14.881
MOLECULAR COMPOSITION				
H	0.0038	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	10.5041	10.5000	10.5060	10.5060
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0002	0.0000	0.0000	0.0000
H2O	4.3748	4.3750	4.3750	4.3750

CASE			
PROPELLANT COMPOSITION	WEIGHT%	MOLAR	
H2	35.000		
O2	65.000		
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY
H2	H2	-1.0870	710.0E-4
O2	O2	-3.0900	1.142
ATOMIC COMPOSITION(GM AT/100GM)			REF. TEMP.
H	34.7222		20.000
C	4.0625		20.000
PROPELLANT ENTHALPY	-30.017	KCAL/100 GM	
PROPELLANT DENSITY	0.1912	KCAL/CC	
	CHARGE	EXHAUST	EXHAUST
	1000.0	2.000	200.0E-4
PRESSURE (PSI)			
SHIFTING EQUILIBRIA			
ISP (SEC)		406.01	412.75
IVSP(LB-SEC/CU IN)		2.0677	2.7120
TEMPERATURE (K)	1724.7	347.00	290.16
CP (CAL/GM-DEG.K)	1.2762	1.2522	1.2381
MOI. WT.-EFFECTIVE	5.7590	5.7500	5.7600
CP/CV -EFFECTIVE	1.2021	1.2803	1.2863
CF -APPROX.		1.0802	1.7080
PEAE/M (SEC)		12.903	10.843
AE/AT -APPROX.		20.701	224.35
FROZEN EQUILIBRIA			
ISP (SEC)		400.00	412.73
TEMPERATURE (K)	1724.7	347.03	290.16
C* (FT/SEC)	7774.0		
CF		1.0801	1.7080
PEAE/M (SEC)		12.904	10.843
AE/AT		20.700	224.36

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CASE BASIS: 1.0 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	1724.7	347.00	290.16	298.16
ENTHALPY (KI-CALORIES)	-30.017	-220.47	-234.81	-234.01
ENTROPY (CALORIES/DEGREE K)	703.52	703.52	763.33	844.77
HEAT CAPACITY (CAL/K)	152.62	123.22	123.81	123.81
MOLES OF GAS	17.361	17.361	17.361	17.361
MOLECULAR COMPOSITION:				
H	0.0003	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	13.2984	13.2980	13.2936	13.2986
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	4.0625	4.0625	4.0625	4.0625

CASE No.							
PROPELLANT COMPOSITION	WEIGHT%	MOLAR					
H2	30.000						
O2	63.000						
N2	7.000						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.			
H2	H2	-1.0970	710.0E-4	20.400			
O2	O2	-3.0800	1.142	90.200			
N2	N2	-2.9000	0.0030	77.400			
ATOMIC COMPOSITION(GH AT/100GM)							
H		29.7619					
O		0.4997					
C		3.9375					
PROPELLANT ENTHALPY		-34.860	KCAL/100 GM				
PROPELLANT DENSITY		0.2056	GM/CC				
PRESSURE (PSI)	CHAMBER		EXHAUST				
SHIFTING EQUILIBRIA		1000.0	2.000	0.007	LB/CU IN	200.0E-4	
ISP (SEC)				415.30		414.62	
IVSP(LB-SEC/CU IN)				3.0851		3.0200	
TEMPERATURE (K)		1874.7		290.16		298.16	
CP (CAL/GM-DEG.K)		1.3728		1.0576		1.0607	
MOL. WT.-EFFECTIVE		6.0096		6.0344		6.0069	
CP/CV -EFFECTIVE		1.2804		1.3792		1.3798	
CF -APPROX.				1.7602		1.7573	
PELE/M (SEC)				9.0821		9.1328	
AE/AT -APPROX.				192.46		1935.6	
FROZEN EQUILIBRIA							
ISP (SEC)				407.46		409.46	
TEMPERATURE (K)		1874.7		290.16		298.16	
G* (FT/SEC)		7591.3					
CF				1.7354		1.7354	
PELE/M (SEC)				9.0250		9.0250	
AE/AT				201.85		201.85	

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CASE N2
BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	208.0E-4
TEMPERATURE (KELVIN)	1874.7	420.99	298.16	298.16
ENTHALPY (KILOCALORIES)	-34.869	-217.67	-235.09	-232.114
ENTROPY (CALORIES/DEG.K)	640.33	640.33	664.68	733.89
HEAT CAPACITY (CAL/K)	137.28	109.50	109.76	106.07
MOLES OF GAS	15.129	14.824	14.632	14.691
MOLECULAR COMPOSITION:				
H	0.0010	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	10.9401	10.4840	10.1950	10.2837
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	3.9375	3.9375	3.7375	3.9375
N2	0.2489	0.0967	0.0004	0.0209
NH3	0.0019	0.5065	0.4999	0.4398
NO	0.0000	0.0000	0.0000	0.0000

WADD TN 60-254

LAKE N4
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	EXHAUST
TEMPERATURE (KELVIN)	2234.1	515.17	322.52	200.0E-4
ENTHALPY (KILOCALORIES)	-30.984	-222.63	-246.04	298.16
ENTROPY (CALORIES/DEG.K)	592.47	582.47	593.47	-247.44
HEAT CAPACITY (CAL/K)	124.29	96.113	96.946	635.60
MOLES OF GAS	12.854	12.819	12.842	90.754
MOLECULAR COMPOSITION:				12.416
H	0.0086	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	8.2810	8.3385	7.6930	7.7345
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0006	0.0000	0.0000	0.0000
H2O	4.1975	4.1981	4.1931	4.1981
N2	0.4659	0.2504	0.0119	0.0490
NH3	0.0009	0.0318	0.0035	0.4344
NO	0.0000	0.0000	0.0000	0.0000

CASE N2							
PROPELLANT COMPOSITION	WEIGHT%	MOLAR					
H2	21.570						
O2	70.590						
N2	7.8400						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.			DENSITY	REF. TEMP.	
H2	H2	-1.00870			710.0E-4	20.400	
O2	O2	-3.0800			1.142	90.200	
N2	N2	-2.07000			0.8E-80	77.400	
ATOMIC COMPOSITION(GM AT/100GM)							
J		21.5988					
V		0.5597					
A		4.4119					
PROPELLANT ENTHALPY		-27.796	KCAL/100 GM				
PROPELLANT DENSITY		0.2664	GM/CC				
	CHAMBER		EXHAUST		0.010 LB/CU IN		
	1000.0		2.000		EXHAUST	200.0E-4	
PRESSURE (PSI)							
SUPPLETING EQUILIBRIA							
ICP (SEC)		414.96			440.13	448.98	
IVS(13-SEC/CU IN)		3.9946			4.2E-73	4.3220	
TEMPERATURE (K)		451.81			374.78	298.16	
CP (CAL/GM-DEG.K)		0.85132			0.81E-13	0.78319	
MOL. WT. EFFECTIVE		9.1097			9.2E-22	9.4562	
CP/CV EFFECTIVE		1.2414			1.2418	1.3667	
CF APPROX.		1.7350			1.8404	1.8772	
PEAFM (SEC)		14.908			7.9736	6.0717	
AE/AF APPROX.		31.165			160.50	1269.0	
FROZEN EQUILIBRIA							
ICP (SEC)		412.29			437.98	442.31	
TEMPERATURE (K)		642.14			352.26	298.16	
CP (BT/SEC)		251.8					
CF		7695.1					
PEAFM (SEC)		1.7280			1.8E-12	1.8493	
AE/AF		14.777			7.6E-26	6.4112	
		30.892			159.32	1340.3	

CASE V2
 BASIS: 100 G4 PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4	
TEMPERATURE (KELVIN)	2571.8	651.61	374.79	298.16	
ENTHALPY (KJ/CALORIES)	-27.796	-220.69	-250.47	-259.46	
ENTROPY (CALORIES/DEG*K)	532.17	632.17	532.17	555.23	
HEAT CAPACITY (CAL/K)	114.43	85.132	81.013	78.319	
MOLES OF GAS	11.001	10.977	1.0032	10.575	
MOLECULAR COMPOSITION:					
H	0.0373	0.0000	0.0000	0.0000	
N	0.0000	0.0000	0.0000	0.0000	
O	0.0000	0.0000	0.0000	0.0000	
H2	6.2715	6.2845	6.0062	5.6512	
O2	0.0000	0.0000	0.0000	0.0000	
OH	0.0062	0.0000	0.0000	0.0000	
H2O	4.4056	4.4119	4.4119	4.4119	
N2	0.2796	0.2786	0.2051	0.0777	
NO2	0.0004	0.0020	0.1075	0.4042	
NO	0.0001	0.0000	0.0000	0.0000	

DATE				
PROPELLANT COMPOSITION	WEIGHTS	MOLAR	DENSITY	REF. TEMP.
H2	16.679		710.0E-4	20.400
OP	75.000		1.142	90.200
N2	8.330		0.8030	77.400
INGREDIENT DATA	FORMULA	HEAT OF FORM.		
H2	H2	-1.5870		
O2	O2	-3.0300		
N2	N2	-2.5000		
ATOMIC COMPOSITION(CAL AT/100GM)				
H	16.677			
O	0.2947			
N	4.0675			
PROPELLANT ENTHALPY	-23.684	KCAL/100 GM		
PROPELLANT DENSITY	0.2218	GM/CC		
CHAMBER	EXHAUST			
1000.0	2.070			
PRESSURE (PSI)				
SHOOTING FACILITY				
ISP (SEC)				
IVARIABLE-SEC/CU IN)				
TEMPERATURE (K)				
CS (CAL/AM-DEG.K)				
MOL. WT.-EFFECTIVE				
CP/CV -EFFECTIVE				
CS -APPROX.				
PEAF/M (SEC)				
AE/AF -APPROX.				
PROPER FACILITY				
ISP (SEC)				
TEMPERATURE (K)				
CS (BT/SEC)				
CF				
PEAF/M (SEC)				
AE/AF				

			0.016	LB/CI IN
			EXHAUST	EXHAUST
			0.200	200.0E-4
			449.49	463.91
			5.214	5.2934
			542.70	318.27
			0.67303	0.63850
			11.675	11.846
			1.3785	1.3563
			1.8135	1.9794
			8.9411	5.0071
			124.17	1008.2
			442.33	451.27
			438.19	298.16
			1.673	1.9254
			7.4452	4.9590
			156.62	1057.9

WADD TN 60-254

CASE NZ
GRAINS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
TEMPERATURE (PSI)	1000.0	2.000	0.2000	EXHAUST
TEMPERATURE (KELVIN)	3115.8	950.06	542.70	200.0E-4
ENTHALPY (KILOCALORIES)	-23.684	-220.21	-254.85	316.27
ENTROPY (CALORIES/DEGREE K)	462.08	402.08	462.08	-271.02
HEAT CAPACITY (CAL/K)	95.499	73.636	67.303	463.08
MOLES OF GAS	3.0812	3.0601	3.0454	63.856
MOLECULAR COMPOSITION:				8.4416
H	0.1491	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0013	0.0000	0.0000	0.0000
H2	3.0494	3.0813	3.0402	3.0402
O2	0.0010	0.0000	0.0000	0.0000
OH	0.0733	0.0000	0.0000	0.0000
H2O	4.0081	4.0875	4.0675	4.0675
NO	0.2961	0.2973	0.2969	0.2350
NH3	0.0001	0.0000	0.0000	0.1246
NO2	0.0023	0.0000	0.0000	0.0000

CASE 14					
PROPELLANT COMPOSITION	WEIGHT%	MOLAR			
H2	15.250				
O2	76.271				
N2	8.480				
INCREASING DATA:	FORMULA	HEAT OF FORM.		QUANTITY	REF. TEMP.
H2	H2	-1.5870		710.07-4	20.400
O2	O2	-3.0509		1.142	90.200
N2	N2	-2.7000		0.0090	77.400
ATOMIC COMPOSITION(GM AT/100GM)					
H	15.250				
O	0.0054				
N	4.7669				
PROPELLANT ENTHALPY	-22.493 KCAL/100 GM				
PROPELLANT DENSITY	0.5424 GM/CC				
CHAMBER	EXHAUST			0.0124 LB/CC IN	EXHAUST
PRESSURE (PSI)	1000.0			0.2000	200.0E-4
SHIFTING EQUILIBRIA					
ISP (SEC)	417.80			449.95	460.29
IVSP (SEC/CCU IN)	5.1931			5.2060	5.7682
TEMPERATURE (K)	1077.2			580.75	354.12
CP (CAL/GM-DEG.K)	0.90204			0.62666	0.60140
MOL. WT.-EFFECTIVE	12.438			12.711	12.741
CP/CCU -EFFECTIVE	1.2152			1.2055	1.3502
CF -APPROX.	1.0159			1.9063	2.0170
PERFORM (SEC)	17.452			9.2045	5.1536
AF/AT -APPROX.	37.746			202.56	1114.6
FROZEN EQUILIBRIA					
ISP (SEC)	407.65			440.12	449.58
TEMPERATURE (K)	947.59			464.19	306.40
CF* (FT/SEC)	3203.2			1.2038	1.9447
CF	7428.0			7.3310	4.7373
PERFORM (SEC)				150.56	1024.6
AF/AT					

BASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.007-4
TEMPERATURE (KELVIN)	3203.2	1077.2	579.75	354.12
ENTHALPY (KILOCALORIES)	-22.493	-22.003	-25.16	-272.37
ENTROPY (CALORIES/DEG.K)	441.56	441.56	441.56	441.56
HEAT CAPACITY (CAL/K)	90.204	70.870	67.066	60.140
MOLES OF GAS	8.0398	7.0672	7.0670	7.8489
MOLECULAR COMPOSITION:				
H	0.1909	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0053	0.0000	0.0000	0.0000
H2	2.7864	3.7976	2.7074	2.7702
O2	0.0036	0.0000	0.0000	0.0000
OH	0.1323	0.0000	0.0000	0.0000
H2O	4.0167	4.7609	4.7669	4.7669
N2	0.0000	0.0027	0.0026	0.02935
NH3	0.0001	0.0000	0.0001	0.0163
NO	0.0052	0.0000	0.0000	0.0000

WADD TN 60-254

CASE H2
BASIS: 100 GR PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	EXHAUST
TEMPERATURE (KELVIN)	3398.5	1258.9	743.36	290.0E-4
ENTHALPY (KILOCALORIES)	-21.263	-222.75	-254.69	425.44
ENTROPY (CALORIES/DEGREEK)	416.82	416.82	416.82	-273.35
HEAT CAPACITY (CAL/K)	84.575	68.792	61.774	416.82
MOLES OF GAS	7.4024	7.1480	7.1179	56.150
MOLECULAR COMPOSITION:				7.1471
H	0.2189	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.6140	0.0000	0.0000	0.0000
H2	2.0447	1.9903	1.9809	0.0000
O2	0.0128	0.0000	0.0000	1.9896
OH	0.2252	0.0000	0.0000	0.0000
H2O	4.2734	4.8474	4.8494	0.0000
N2	0.5021	0.5077	0.5077	4.8494
NH3	0.0000	0.0000	0.0000	0.5072
NO	0.0111	0.0000	0.0000	0.0000

<p>CASE N2 PROPELLANT COMPOSITION</p>	<p>WEIGHTS</p>	<p>MOLAR</p>	<p>REF. TEMP.</p>
<p>H2 12.280</p> <p>O2 78.950</p> <p>N2 8.7700</p>	<p>-1.5870</p> <p>-3.0800</p> <p>-2.9090</p>	<p>710.00E-4</p> <p>1.142</p> <p>0.8089</p>	<p>20.400</p> <p>90.200</p> <p>77.400</p>
<p>INGREDIENT DATA:</p>	<p>FORMULA</p>	<p>HEAT OF FORM.</p>	<p>URNILITY</p>
<p>H2</p> <p>O2</p> <p>N2</p>	<p>H2</p> <p>O2</p> <p>N2</p>	<p>-1.5870</p> <p>-3.0800</p> <p>-2.9090</p>	<p>0.043 LB/CI IN</p> <p>EXHAUST</p> <p>EXHAUST</p>
<p>ATOMIC COMPOSITION(GM AT/100GM)</p>	<p>CHAMBER</p>	<p>EXHAUST</p>	<p>200.0E-4</p>
<p>H 12.1825</p> <p>N 0.6261</p> <p>O 4.9344</p>	<p>-20.001</p> <p>0.2953</p> <p>1000.0</p>	<p>KCAL/100 GM</p> <p>EXHAUST</p> <p>2.000</p>	<p>450.05</p> <p>6.4084</p> <p>904.15</p> <p>0.57049</p> <p>15.614</p> <p>1.2014</p> <p>2.0015</p> <p>11.124</p> <p>252.30</p>
<p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p>	<p>CHAMBER</p>	<p>EXHAUST</p>	<p>469.56</p> <p>6.7070</p> <p>529.74</p> <p>0.52375</p> <p>15.614</p> <p>1.3210</p> <p>2.01300</p> <p>6.2466</p> <p>1416.8</p>
<p>3503.8</p> <p>0.76586</p> <p>14.761</p> <p>1.4067</p>	<p>1000.0</p>	<p>415.81</p> <p>5.9393</p> <p>1451.9</p> <p>0.66032</p> <p>15.614</p> <p>1.2395</p> <p>1.6862</p> <p>19.334</p> <p>45.852</p>	<p>427.28</p> <p>469.62</p> <p>1.9082</p> <p>6.7118</p> <p>905.67</p>
<p>PRESSURE (PSI)</p> <p>SHOOTING FACILITY</p> <p>ISP (SEC)</p> <p>IVSR/LB-REC/CI IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CI -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAF/M (SEC)</p> <p>AE/AT -APPROX.</p>	<p>CHAMBER</p>	<p>EXHAUST</p>	<p>457.35</p> <p>298.16</p> <p>1.9839</p> <p>3.9931</p> <p>905.67</p>
<p>3503.8</p> <p>7092.8</p>	<p>3503.8</p> <p>7092.8</p>	<p>39.852</p> <p>1077.5</p> <p>1.7760</p> <p>16.120</p> <p>36.562</p>	<p>427.28</p> <p>469.62</p> <p>1.9082</p> <p>6.7118</p> <p>905.67</p>
<p>FROZEN EQUIVALENT</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF (FT/SEC)</p> <p>CF</p> <p>PEAF/M (SEC)</p> <p>AE/AT</p>	<p>CHAMBER</p>	<p>EXHAUST</p>	<p>427.28</p> <p>469.62</p> <p>1.9082</p> <p>6.7118</p> <p>905.67</p>
<p>3503.8</p> <p>7092.8</p>	<p>3503.8</p> <p>7092.8</p>	<p>39.852</p> <p>1077.5</p> <p>1.7760</p> <p>16.120</p> <p>36.562</p>	<p>427.28</p> <p>469.62</p> <p>1.9082</p> <p>6.7118</p> <p>905.67</p>

CASE NZ
 BASTS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3503.8	1451.9	904.15	529.74
ENTHALPY (KILOCALORIES)	-20.001	-218.71	-252.79	-273.39
ENTROPY (CALORIES/DEG.K)	394.53	394.53	304.53	394.58
HEAT CAPACITY (CAL/K)	78.586	66.032	57.049	52.375
MOLES OF GAS	6.7747	6.4043	6.4043	6.4043
MOLECULAR COMPOSITION:				
H	0.4185	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0323	0.0000	0.0000	0.0000
H2	1.2628	1.1569	1.169	1.1568
O2	0.0429	0.0000	0.0000	0.0000
OH	0.2495	0.0000	0.0000	0.0000
H2O	4.4444	4.5344	4.5344	4.9344
N2	0.2018	0.2130	0.2130	0.2130
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0224	0.0000	0.0000	0.0000

WADD TN 60-254

CASE M4
GRAIN: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	0.0000
TEMPERATURE (KELVIN)	3519.6	1729.3	1130.9	693.17
ENTHALPY (KILOCALORIES)	-17.324	-189.33	-222.63	-243.76
ENTROPY (CALORIES/DEG.K)	340.77	340.77	340.77	340.77
HEAT CAPACITY (CAL/K)	65.605	57.730	51.037	45.190
MOLES OF GAS	5.2917	5.1386	5.1458	5.1358
MOLECULAR COMPOSITION:				
H	0.113	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0841	0.0002	0.0000	0.0000
H2	0.0989	0.0014	0.0000	0.0000
O2	0.0259	0.0006	0.0024	0.0000
OH	0.0237	0.0002	0.0000	0.0000
H2O	3.7925	4.0035	4.0000	4.0000
N2	0.4936	0.0000	0.0000	0.0000
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0616	0.0025	0.0000	0.0000

WADD TN 60-254

CASE NZ
BASIS: 100 GM PROPELLANT

	CHAIRER	EXHAUST	EXHAUST	"XHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.00E-4
TEMPERATURE (KELVIN)	3300.8	1409.9	927.23	549.80
ENTHALPY (KILOCALORIES)	-15.915	-161.10	-186.96	-202.81
ENTROPY (CALORIES/DEGREE K)	310.86	110.86	310.86	310.86
HEAT CAPACITY (CAL/K)	58.732	80.289	48.814	39.648
MOLES OF GAS	5.0470	1.7727	4.7024	4.7724
MOLECULAR COMPOSITION:				
H	0.0501	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0818	0.0000	0.0000	0.0000
H2	0.0633	0.0000	0.0000	0.0000
O2	0.0659	0.7653	0.7652	0.7653
OH	0.4576	0.0012	0.0000	0.0000
H2O	3.2583	0.0749	0.0756	0.0756
N2	0.2914	0.2298	0.2505	0.2305
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0782	0.0014	0.0000	0.0000

CASE NO
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3254.1	1323.2	317.54	475.75
ENTHALPY (KILOCALORIES)	-15.135	-145.63	-167.73	-181.08
ENTROPY (CALORIE/DEGREE-K)	294.90	294.90	294.90	294.90
HEAT CAPACITY (CAL/K)	55.160	46.481	40.922	36.066
MOLES OF GAS	4.7816	4.5843	4.5842	4.5842
MOLECULAR COMPOSITION:				
H	0.0782	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0684	0.0000	0.0000	0.0000
CL	0.0026	0.0000	0.0000	0.0000
CH	0.0880	1.0060	1.0064	1.0064
H2O	0.5528	0.0000	0.0000	0.0000
N2	2.7450	3.2439	3.2440	3.2440
NH3	0.0025	0.0334	0.0337	0.0337
NO	0.0000	0.0000	0.0000	0.0000
	0.0915	0.0000	0.0000	0.0000

CASE	%								
PROPELLANT COMPOSITION									
H ₂		WEIGHTS		MOLAR					
O ₂		4.7500							
N ₂		85.710							
		9.5300							
INGREDIENT DATA:									
H ₂		FORMULA		HEAT OF FORM.		DENSITY		REF. TEMP.	
O ₂				-1.6870		710.0E-4		20.000	
N ₂				-1.0800		1.142		90.000	
				-1.9000		0.8080		77.400	
ATOMIC COMPOSITION (GM AT/100GM)									
H			4.7222						
O			0.6805						
N			5.2569						
PROPELLANT ENTHALPY									
			-13.691	KCAL/100 GM					
PROPELLANT DENSITY									
			0.0498	GM/CC					
CHAMBER									
			1000.0	EXHAUST					
PRESSURE (PSI)									
				2.000					
SHIFTING EQUILEBRIA									
ISP (SEC)				292.64		314.01		325.64	
IVSP (M-SEC/100 IN)				6.0707		7.3724		7.0455	
TEMPERATURE (K)			2049.6	994.14		584.96		326.59	
CP (CAL/GM-DEG.K)			0.4720	0.30332		0.24734		0.2011	
MOL. WT.-EFFECTIVE			23.407	25.814		26.013		25.914	
CP/00 -EFFECTIVE			1.2164	1.2783		1.2711		1.2526	
CF -APPROX.				1.0272		1.0606		2.0332	
PEAFM (SEC)				12.335		6.7431		3.6411	
AE/AT -APPROX.				38.501		21.4.13		1156.7	
FROZEN EQUILEBRIA									
ISP (SEC)				284.37		302.75		310.80	
TEMPERATURE (K)			2949.6	658.71		418.10		298.16	
CP (BT/SEC)			5123.1						
CF				1.7630		1.8190		1.9405	
PEAFM (SEC)				11.233		4.9506		3.5474	
AE/AT				75.066		152.92		1106.2	

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2949.6	994.14	584.96	326.59
ENTHALPY (KILOCALORIES)	-13.691	-112.12	-127.01	-135.56
ENTROPY (CALORIES/DEGREE K)	260.93	260.93	260.93	260.93
HEAT CAPACITY (CAL/DEGREE K)	47.720	38.332	34.836	32.011
MOLES OF GAS	4.2722	4.1992	4.1992	4.1992
MOLECULAR COMPOSITION:				
H	0.0046	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0281	0.0600	0.0600	0.0000
H2	0.0164	0.0000	0.0000	0.0000
O2	1.4115	1.4978	1.4979	1.4979
OH	0.1856	0.0000	0.0000	0.0000
H2O	2.2477	2.2611	2.2611	2.2611
N2	0.0039	0.0401	0.0402	0.0402
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0725	0.0000	0.0000	0.0000

CASE	N4								
PROPELLANT COMPOSITION		WEIGHT%	MOLAR						
H2		25.370							
O2		63.430							
N2		11.200							
INGREDIENT DATA:	FORMULA	HEAT OF FORM.		DENSITY	REF. TEMP.				
H2	H2	-1.0870		710.0E-4	20.400				
O2	O2	-3.0500		1.142	90.200				
N2	N2	-2.9000		0.0080	77.400				
ATOMIC COMPOSITION(GM AT/100GM)									
H		25.1680							
N		0.7995							
O		3.0644							
PROPELLANT ENTHALPY		-31.011	KCAL/100 GM						
PROPELLANT DENSITY		0.2343	GM/CC						
CHAMBER	EXHAUST	2.000							
CHAMBER	EXHAUST	1000.0							
EXHAUST	EXHAUST	0.009	LB/CU IN						
EXHAUST	EXHAUST	0.2000							
PRESSURE (PSI)									
SHIFTING EQUILIBRIA									
ISP (SEC)		397.68		421.65	422.17				
IVSP(LB-SEC/CU IN)		3.0671		3.0700	3.0744				
TEMPERATURE (K)		400.62		38.50	298.16				
CP (CAL/GM-DEG.K)		0.90176		0.9022	0.90509				
MOL. WT.-EFFECTIVE		7.7019		6.752	8.0796				
CF/AV -EFFECTIVE		1.2647		1.2632	1.3732				
CF -APPROX.		1.7033		1.0759	1.6081				
PEAF/M (SEC)		13.477		8.0439	7.5575				
AE/AT -APPROX.		28.861		17.68	1013.4				
FROZEN EQUILIBRIA									
ISP (SEC)		397.39		414.95	414.95				
TEMPERATURE (K)		470.32		296.16	296.16				
CP (BT/SEC)		1.7020		1.7772	1.7772				
CF		13.257		8.0668	8.0668				
PEAF/M (SEC)		28.454		17.75	1727.5				
AE/AT									

WADD TN 60-254

CASE N4
BASIS: 100 GR PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.0 0	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2140.4	450.62	321.50	298.16
ENTHALPY (KILOCALORIES)	-31.011	-212.77	-235.33	-235.84
ENTROPY (CALORIES/DEG.K)	580.23	580.23	580.23	634.89
HEAT CAPACITY (CAL/K)	12.228	90.176	90.222	90.505
MOLES OF GAS	12.985	12.868	12.832	14.377
MOLECULAR COMPOSITION:				
H	0.0045	0.0070	0.0000	0.0000
N	0.0000	0.0070	0.0000	0.0000
O	0.0000	0.0070	0.0000	0.0000
H2	8.0159	8.4911	7.4021	7.7071
O2	0.0000	0.0070	0.0000	0.0000
OH	0.0003	0.0070	0.0000	0.0000
H2O	3.7641	3.7644	3.7644	3.9644
N2	0.0991	0.0568	0.0238	0.0962
NH3	0.0012	0.0859	0.7519	0.6072
NO	0.0000	0.0070	0.0000	0.0000

CASE	N4						
PROPELLANT COMPOSITION							
H2		21.570	WEIGHT%				
O2		66.670					
N2		11.760					
INGREDIENT DATA:							
H2	H4		HEAT OF FORM.			DENSITY	REF. TEMP.
O2	O2					710.0E-4	20.400
N2	N4					1.142	90.200
						0.8080	77.400
ATOMIC COMPOSITION(GM AT/100GM)							
H		21.5988					
N		0.0395					
O		4.1669					
PROPELLANT ENTHALPY							
		-27.824	KCAL/100 GM				
PROPELLANT DENSITY							
		0.2654	GM/CC				
PRESSURE (PSI)							
		1000.0	CHAMBER				
SHIFTING EQUILIBRIA							
ISP (SEC)							
IVSP(LB-SEC/CU IN)		404.40				428.70	436.64
TEMPERATURE (K)		3.8703				4.1113	4.1875
CP (CAL/GM-DEG.K)		597.86				361.59	298.16
MOL. WT.-EFFECTIVE		0.82039				0.80746	0.78230
CP/CM -EFFECTIVE		8.7942				9.2077	9.4539
CF -APPROX.		1.2508				1.2630	1.3669
PEAF/M (SEC)		1.7259				1.8995	1.8434
AE/AT -APPROX.		14.254				7.8916	6.2381
PROZEN EQUILIBRIA		30.417				160.39	1331.1
ISP (SEC)							
TEMPERATURE (K)		402.40				427.07	429.15
CP (BT/SEC)		594.06				323.27	298.16
CF							
PEAF/M (SEC)		1.7216				1.8226	1.8315
AE/AT		14.172				7.4846	6.6862
		30.241				152.44	1426.7

WADD TN 60-254

CASE N4
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	200.00	200.00	200.00
TEMPERATURE (KELVIN)	2406.3	599.96	361.59	298.16
ENTHALPY (KILOCALORIES)	-27.824	-212.78	-239.04	-246.94
ENTROPY (CALORIES/DEGREE K)	530.85	530.85	530.85	530.85
HEAT CAPACITY (CAL/K)	11.71	85.076	8.0746	78.270
MOLES OF GAS	11.131	11.113	10.822	10.566
MOLECULAR COMPOSITION:				
H	0.0223	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.2220	6.2236	6.0263	5.7034
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0029	0.0000	0.0000	0.0000
H2O	4.1639	4.1659	4.1669	4.1669
N2	0.4194	0.4159	0.4210	0.4434
NH3	0.0006	0.0058	0.0275	0.0527
NO	0.0000	0.0000	0.0000	0.0000

WADD TN 60-254

CASE: N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2974.1	867.05	489.28	307.33
ENTHALPY (KILOCALORIES)	-23.715	-219.84	-243.26	-258.29
ENTROPY (CALORIES/DEGREE-K)	461.94	1261.94	461.94	461.94
HEAT CAPACITY (CAL/N)	95.182	72.608	67.226	63.658
MOLES OF GAS	8.7924	8.7149	8.7116	8.4409
MOLECULAR COMPOSITION:				
H	0.1085	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0007	0.0000	0.0000	0.0000
H2	3.8118	3.0418	3.8368	3.4338
O2	0.0003	0.0000	0.0000	0.0000
OH	0.0429	0.0000	0.0000	0.0000
H2O	4.3810	4.4269	4.4469	4.4269
N2	0.4454	0.4461	0.4444	0.5101
NH3	0.0002	0.0001	0.0034	0.2721
NO	0.0014	0.0000	0.0000	0.0000

WADD TN 60-254

CASE NZ
BASIS 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3151.9	980.76	563.41	326.41
ENTHALPY (KILOCALORIES)	-22.524	-210.08	-243.83	-259.54
ENTROPY (CALORIES/DEGREE-K)	440.76	440.76	440.76	440.76
HEAT CAPACITY (CAL/K)	90.008	69.824	65.450	60.162
MOLES OF GAS	8.2394	8.0181	8.0176	7.9280
MOLECULAR COMPOSITION:				
H	0.4479	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0024	0.0000	0.0000	0.0000
H2	3.0385	3.0619	3.0612	2.9267
O2	0.0014	0.0000	0.0000	0.0000
OH	0.0835	0.0000	0.0000	0.0000
H2O	4.4101	4.0025	4.0025	4.0025
N2	0.4518	0.4536	0.4534	0.4086
NH3	0.0001	0.0000	0.0005	0.0002
NO	0.0036	0.0000	0.0000	0.0000

CASE	Nz	WEIGHTS	MOLAR	REF. TEMP.
PROPELLANT COMPOSITION				
H2		13.790		20.400
O2		73.280		90.200
N2		12.930		77.400
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	
H2	H2	-1.0870	710.0F-4	
O2	O2	-3.0800	1.142	
N2	N2	-2.7000	0.8080	
ATOMIC COMPOSITION(GH/AT/100GM)				
H		13.6806		
N		0.7230		
O		4.5800		
PROPELLANT ENTHALPY		-21.299	MCAL/100 GM	
PROPELLANT DENSITY		0.7644	GM/CC	
CHAMBER			EXHAUST	
1000.0			2.000	
PRESSURE (PSI)				
SHIFTING EQUILIBRIA				
ISP (SEC)		409.96		456.33
IVSP(LB-SEC/CU IN)		5.7980		6.0086
TEMPERATURE (K)		1144.2		373.07
CP (CAL/GM-DEG.K)		0.84496		0.56272
MOL. WT. EFFECTIVE		13.355		15.710
CP/CV EFFECTIVE		1.2137		1.3470
CF -APPROX.				2.0320
PEAF/M (SEC)				5.1553
AE/AT -APPROX.				1.147.6
FROZEN EQUILIBRIA				
ISP (SEC)		390.59		437.80
TEMPERATURE (K)		970.94		317.05
G* (FT/SEC)				
CF				
PEAF/M (SEC)		1.7660		1.9494
AE/AT		15.849		4.6882
		35.286		1043.6

WADD TN 60-254

CASE MZ
 GASIST 100 Gm PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
TEMPERATURE (KELVIN)	1000.0	200.0	0.0	200.0
ENTHALPY (KILOCALORIES)	3303.6	1124.2	0.0	0.0
ENTROPY (CALORIES/DEGREE K)	-21.299	-214.45	-243.75	313.07
HEAT CAPACITY (CAL/K)	410.35	410.35	410.35	410.35
MOLES OF GAS	84.496	60.968	59.868	56.272
MOLECULAR COMPOSITION:	7.4877	7.5013	7.5017	7.2939
H	0.1836	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0073	0.0000	0.0000	0.0000
H2	2.4724	2.4602	2.4602	2.2484
O2	0.0056	0.0000	0.0000	0.0000
OH	0.1538	0.0000	0.0000	0.0000
H2O	4.2990	4.2890	4.2890	4.5800
N2	0.4573	0.4613	0.4615	0.4576
NH3	0.0001	0.0000	0.0001	0.0079
NO	0.0084	0.0000	0.0000	0.0000

<p>BASE No</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H</p> <p>N</p> <p>O</p> <p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p> <p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB*SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAF/M (SEC)</p> <p>AE/AT -APPROX.</p> <p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF* (FT/SEC)</p> <p>CF</p> <p>PEAF/M (SEC)</p> <p>AE/AT</p>	<p>WEIGHT%</p> <p>12.280</p> <p>74.560</p> <p>13.160</p> <p>FORMULA</p> <p>H4</p> <p>O4</p> <p>N2</p> <p>HEAT OF FORM*</p> <p>-1.6870</p> <p>-3.0800</p> <p>-2.9000</p> <p>12.1825</p> <p>0.9395</p> <p>4.0600</p> <p>-20.033</p> <p>0.929</p> <p>CHAMBER</p> <p>1000.0</p> <p>3453.4</p> <p>0.78598</p> <p>14.616</p> <p>1.4092</p> <p>CF -APPROX.</p> <p>PEAF/M (SEC)</p> <p>AE/AT -APPROX.</p> <p>3453.4</p> <p>7050.8</p> <p>CF</p> <p>PEAF/M (SEC)</p> <p>AE/AT</p>	<p>MOLAR</p> <p>REF. TEMP.</p> <p>710.0E-4</p> <p>90.200</p> <p>77.400</p> <p>DENSITY</p> <p>0.0142</p> <p>EXHAUST</p> <p>0.2000</p> <p>EXHAUST</p> <p>2.0 0</p> <p>408.08</p> <p>5.7926</p> <p>1511.1</p> <p>0.64830</p> <p>15.242</p> <p>1.4517</p> <p>1.8622</p> <p>18.225</p> <p>41.582</p> <p>380.09</p> <p>1040.8</p> <p>1.7727</p> <p>15.848</p> <p>36.158</p> <p>LB/CU IN</p> <p>EXHAUST</p> <p>200.0E-4</p> <p>457.99</p> <p>6.5010</p> <p>458.86</p> <p>0.52218</p> <p>15.242</p> <p>1.3328</p> <p>2.0899</p> <p>5.6830</p> <p>1296.6</p> <p>452.62</p> <p>298.16</p> <p>1.9741</p> <p>4.0768</p> <p>930.15</p>
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WADD TN 60-254

CASE N4
BASIS: 100 GA PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PPFSSURE (PSI)	1000.0	200.0	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3423.4	1511.1	790.29	458.80
ENTHALPY (KILOCALORIES)	-20.033	-211.42	-242.62	-261.10
ENTROPY (CALORIES/DEG.K)	394.46	394.46	394.46	394.46
HEAT CAPACITY (CAL/K)	75.598	64.870	56.039	52.218
MOLES OF GAS	6.0418	6.0610	6.0610	6.0600
MOLECULAR COMPOSITION:				
H	0.1988	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0195	0.0000	0.0000	0.0000
H2	1.0448	1.43.3	1.4312	1.4309
O2	0.0222	0.0000	0.0000	0.0000
OH	0.4610	0.0000	0.0000	0.0000
H2O	4.0165	4.0600	4.0600	4.0600
N2	0.4604	0.4697	0.4697	0.4696
NH3	0.0000	0.0000	0.0000	0.0002
NC	0.0187	0.0000	0.0000	0.0000

<p>NAME</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>WEIGHT%</p> <p>9.0900</p> <p>77.270</p> <p>13.640</p>	<p>MULAN</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>
<p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0800</p> <p>-2.7000</p>		
<p>FORMULA</p> <p>H2</p> <p>O4</p> <p>N2</p>			
<p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H</p> <p>N</p> <p>O</p>	<p>9.0178</p> <p>0.9737</p> <p>4.0294</p> <p>-17.357</p> <p>0.4704</p> <p>1000.0</p>		
<p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p>	<p>KCAL/100 GM</p> <p>CHAMBER</p> <p>EXHAUST</p> <p>2.0 0</p>		
<p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT -APPROX.</p>	<p>0.0170</p> <p>0.2000</p> <p>422.80</p> <p>7.1263</p> <p>1126.1</p> <p>0.51268</p> <p>19.395</p> <p>1.2198</p> <p>2.1043</p> <p>11.873</p> <p>293.45</p> <p>390.33</p> <p>510.31</p>	<p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>290.0E-4</p>	<p>443.99</p> <p>7.5463</p> <p>689.04</p> <p>0.45204</p> <p>19.395</p> <p>1.2931</p> <p>2.2097</p> <p>6.9192</p> <p>1721.6</p> <p>400.53</p> <p>298.16</p>
<p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>C* (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>357.02</p> <p>6.2730</p> <p>1724.0</p> <p>0.57843</p> <p>19.325</p> <p>1.2154</p> <p>1.7262</p> <p>19.818</p> <p>49.442</p> <p>357.02</p> <p>1095.0</p> <p>3504.6</p> <p>6404.6</p>		<p>1.9427</p> <p>6.3526</p> <p>150.08</p> <p>1.9934</p> <p>3.6172</p> <p>900.12</p>

WADD TN 60-254

CASE N4
BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.6000	200.0E-4
TEMPERATURE (KELVIN)	3504.0	1724.0	1165.1	689.04
ENTHALPY (KILOCALORIES)	-17.357	-154.50	-224.30	-243.90
ENTROPY (CALORIES/DEGREE K)	34.026	341.76	341.26	341.26
HEAT CAPACITY (CAL/K)	65.683	57.847	51.553	42.204
MOLES OF GAS	5.0202	5.1587	5.1566	5.1540
MOLECULAR COMPOSITION:				
H	0.1150	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0686	0.0001	0.0000	0.0000
H2	0.4530	0.0018	0.0000	0.0000
O2	0.4320	0.1532	0.1502	0.1602
OH	0.4687	0.0067	0.0000	0.0000
H2O	3.7641	4.0038	4.0038	4.5089
N2	0.4549	0.4857	0.4868	0.4869
NH3	0.0008	0.0000	0.0000	0.0000
NO	0.0639	0.0000	0.0001	0.0000

CASE N ₂							
PROPELLANT COMPOSITION	WEIGHT%	MOULAR	DENSITY	REF. TEMP.			
H ₂	7.4100		710.00E-4	20.400			
O ₂	78.700		1.142	90.200			
N ₂	13.890		0.8090	77.400			
INGREDIENT DATA:	FORMULA	HEAT OF FORM.					
H ₂	H ₂	-1.6870					
O ₂	O ₂	-3.0800					
N ₂	N ₂	-2.0000					
ATOMIC COMPOSITION(GM AT/100GM)							
H		7.3512					
N		0.7916					
O		4.9187					
PROPELLANT ENTHALPY		-15.948	KCAL/100 GM				
PROPELLANT DENSITY		0.2250	CM/CC				
CHAMBER		1000.0	EXHAUST				
EXHAUST		2.000	EXHAUST				
PRESSURE (PSI)							
SHOOTING EQUILIBRIA							
ISP (SEC)		355.70					
IVP(LB-SEC/CU IN)		6.7472					
TEMPERATURE (K)		1462.1					
CP (CAL/GM-DEG.K)		0.50410					
MOL. WT. EFFECTIVE		20.863					
CP/CV EFFECTIVE		1.2330					
CF -APPROX.		1.8976					
PEAF/M (SEC)		17.034					
AE/AT -APPROX.		45.438					
FROZEN EQUILIBRIA							
ISP (SEC)		350.08					
TEMPERATURE (K)		1047.4					
CP (BT/SEC)		3307.0					
CF		6031.0					
PEAF/M (SEC)							
AE/AT							

CASE NZ
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.600	0.0000	0.0000	0.0000
TEMPERATURE (KELVIN)	3367.0	1402.1	0.0000	0.0000	0.0000
ENTHALPY (KILOCALORIES)	-15.948	-161.36	0.0000	0.0000	0.0000
ENTROPY (CALORIES/DEGREEK)	311.58	311.58	0.0000	0.0000	0.0000
HEAT CAPACITY (CAL/K)	58.807	50.410	0.0000	0.0000	0.0000
MOLES OF GAS	5.0665	4.7932	0.0000	0.0000	0.0000
MOLECULAR COMPOSITION:					
H	0.0523	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000	0.0000
O	0.0729	0.0000	0.0000	0.0000	0.0000
H2	0.1801	0.0000	0.0000	0.0000	0.0000
O2	0.2368	0.0206	0.0000	0.0000	0.0000
OH	0.4315	0.0011	0.0000	0.0000	0.0000
H2O	3.2537	3.6750	3.6750	3.6756	3.6756
N2	0.4522	0.4950	0.4950	0.4958	0.4958
NH3	0.0000	0.0000	0.0000	0.0000	0.0000
NO	0.0872	0.0015	0.0000	0.0000	0.0000

<p>CASE N2</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H</p> <p>N</p> <p>O</p> <p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p> <p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOLE WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAF/M (SEC)</p> <p>AE/AT -APPROX.</p> <p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF (FT/SEC)</p> <p>CF</p> <p>PEAF/M (SEC)</p> <p>AE/AT</p>	<p>WEIGHT%</p> <p>4.7600</p> <p>80.950</p> <p>14.290</p> <p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0890</p> <p>-2.7000</p> <p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>4.7222</p> <p>1.0201</p> <p>5.0594</p> <p>-13.726 KCAL/100 GM</p> <p>0.0426 K/M/CC</p> <p>CHAMBER</p> <p>1000.0</p> <p>2943.9</p> <p>0.47795</p> <p>23.305</p> <p>1.2172</p> <p>2943.9</p> <p>5128.2</p>	<p>MOLAR</p> <p>DENSITY</p> <p>710.0F-4</p> <p>1.142</p> <p>0.8080</p> <p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p> <p>0.0232 LB/CU IN</p> <p>EXHAUST</p> <p>0.2000</p> <p>314.14</p> <p>7.2936</p> <p>530.41</p> <p>0.34373</p> <p>23.695</p> <p>1.2227</p> <p>1.9894</p> <p>6.7416</p> <p>210.25</p> <p>305.92</p> <p>405.82</p> <p>1.9-81</p> <p>4.9-13</p> <p>15.0-48</p> <p>292.91</p> <p>6.7925</p> <p>988.60</p> <p>0.30379</p> <p>23.695</p> <p>1.2796</p> <p>1.0264</p> <p>12.319</p> <p>38.419</p> <p>284.59</p> <p>852.14</p> <p>1.07676</p> <p>11.226</p> <p>35.011</p> <p>EXHAUST</p> <p>200.0E-4</p> <p>325.72</p> <p>7.5625</p> <p>323.55</p> <p>0.32125</p> <p>23.695</p> <p>1.3533</p> <p>2.0316</p> <p>3.6244</p> <p>1130.3</p> <p>310.08</p> <p>298.16</p> <p>1.9391</p> <p>3.5580</p> <p>1109.6</p>
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WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.00E-4
TEMPERATURE (KELVIN)	2043.9	980.50	580.41	323.55
ENTHALPY (KILOCALORIES)	-13.726	-114.26	-127.14	-155.65
ENTROPY (CALORIES/DEGREE K)	261.86	261.86	261.86	261.86
HEAT CAPACITY (CAL/K)	47.795	18.379	34.373	32.125
MOLES OF GAS	4.2909	4.2203	4.2003	4.2203
MOLECULAR COMPOSITION:				
H	0.0046	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0260	0.0000	0.0000	0.0000
H2	0.0191	0.0000	0.0000	0.0000
O2	1.4600	1.3491	1.3491	1.3491
OH	0.1734	0.0000	0.0000	0.0000
H2O	2.4505	2.2611	2.3511	2.3611
N2	0.4678	0.2100	0.2101	0.2101
NHS	0.0000	0.0000	0.0000	0.0000
NO	0.0344	0.0001	0.0000	0.0000

CASE NO					
PROPELLANT COMPOSITION	WEIGHT%	MOLAR			
H2	30.000				
O2	56.000				
N2	14.000				
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.	
H2	H2	-1.0870	710.0E-4	20.400	
O2	O2	-3.0800	1.142	90.200	
N2	N2	-2.7000	0.8080	77.400	
ATOMIC COMPOSITION(GM AT/100GM)					
H		29.7619			
N		0.9994			
O		3.2000			
PROPELLANT ENTHALPY		-34.920	KCAL/100 GM		
PROPELLANT DENSITY		0.2045	GM/CC		
PRESSURE (PSI)	CHAMBER	EXHAUST	EXHAUST	EXHAUST	
SHIFTING EQUILIBRIA	1000.0	2.000	0.2000	200.0E-4	
ISP (SEC)					
IVSP(LB-SEC/CU IN)		378.26		393.96	391.55
TEMPERATURE (K)		2.7954		2.9114	2.8936
CP (CAL/GM-DEG.K)		400.51		298.16	298.16
MOL. WT.-EFFECTIVE		1.0824		1.0438	1.0542
CP/CV -EFFECTIVE		6.8242		6.7519	6.8579
CF -APPROX.		1.5601		1.5772	1.5791
PEAE/M (SEC)		1.0860		1.7566	1.7458
AE/AT -APPROX.		13.414		9.4122	9.6000
FROZEN EQUILIBRIA		29.900		207.84	2147.2
ISP (SEC)		370.62		381.67	381.67
TEMPERATURE (K)		338.11		298.16	298.16
C* (FT/SEC)		1679.4		1.7018	1.7018
CF		7215.8		10.385	10.385
PEAE/M (SEC)				231.53	231.53
AE/AT					

CASE NZ
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.02-4
TEMPERATURE (KELVIN)	1670.4	400.21	290.16	290.16
ENTHALPY (KI-CALORIES)	-34.020	-107.50	-217.29	-211.11
ENTROPY (CALORIES/MOLE-K)	631.21	631.21	657.72	731.08
HEAT CAPACITY (CAL/K)	134.38	130.24	104.35	105.42
MOLES OF GAS	15.376	14.034	14.394	14.582
MOLECULAR COMPOSITION:				
H	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
CO2	11.2740	10.2900	9.8868	10.1026
O2	0.0000	0.0000	0.0000	0.0000
CO	0.0000	0.0000	0.0000	0.0000
H2O	3.3000	3.3000	3.3000	3.5000
N2	0.4975	0.4362	0.4010	0.4002
NO	0.0044	0.7270	0.7961	0.7389
NO2	0.0000	0.0000	0.0000	0.0000

<p>BASE N₂ PROPELLANT M2 O2 N2 INGREDIENT M2 O2 N2 ATOMIC CO POSITION (M AT/100GM) H N O PROPELLANT ENTHALPY PROPELLANT DENSITY PRESSURE PSI SHIFTING QUANTITIES ISP (SEC) I_{sp} (LB-SEC/CU IN) TEMPERATURE (K) CP CAL/GM-DEG K MOL WT EFFECTIVE CV EFFECTIVE CF APPROX PEA /M (SEC) AE/ T APPROX FROZEN QUANTITIES ISP (SEC) TEMPERATURE (K) CF PEA /M (SEC) AE/ T</p>	<p>COMPOSITION H2 O2 N2 DATA: H2 O2 N2 FORMULA HEAT OF FORM -1.0070 -3.0480 -2.7000 KCAL/100 GM GM/CC EXHAUST CHAMBER 1000.0 25.1686 1.0658 3.7312 -31.030 0.2336 2005.3 1.2215 7.0240 1.2715 2005.3 7348.8 2005.3 7348.8</p>	<p>MOLAN -1.0070 -3.0480 -2.7000 EXHAUST 2.010 386.70 3.2638 422.16 0.93994 7.7370 1.0453 1.0479 1.0123 20.871 380.33 422.87 1.0461 12.733 27.954</p>	<p>DENSITY REF. TEMP (10.0) -4 20.400 1.142 90.200 0.8980 77.400 EXHAUST 20.0VE-4 0.2000 410.55 409.85 2.4650 2.4591 3.1734 2.7019 0.87669 0.70343 1.0650 0.0942 1.0273 1.2732 1.0323 1.7992 0.8566 7.7702 1.7904 1.7039 400.70 400.70 290.16 290.16 1.7591 1.7591 0.4583 0.4583 1.0222 1.0222</p>
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WADD TN 60-254

CASE No
 BASIS: 10 GR PROPELLANT

PRESSURE PSI
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEGREE)
 HEAT CAPACITY (CAL/IN)
 MOLES OF AS
 MOLECULAR COMPOSITION

H
 N
 O
 H2
 O2
 OH
 H2O
 H2
 NH3
 NO

CHAMBER	EXHAUST	EXHAUST	EXHAUST
1000.0	200.0	0.6500	200.00-4
2005.3	455.16	317.54	290.16
-31.056	-202.90	-224.74	-224.08
570.52	370.52	370.52	1634.62
124.15	93.994	99.669	90.342
13.116	12.922	12.121	14.224
0.0022	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000
8.0473	8.3644	7.2891	7.7084
0.0000	0.0000	0.0000	0.0000
0.0001	0.0000	0.0000	0.0000
2.7312	3.7312	3.7312	3.7312
0.2320	0.4367	0.0349	0.1512
0.0018	0.4924	0.0960	0.7631
0.0000	0.0000	0.0000	0.0000

<p>BASE N2 PROPELLANT H2 O2 N2 INGREDIENTS H2 O2 N2 ATOMIC CU POSITION(GM AT/100GM) H N O PROPELLANT ENTHALPY PROPELLANT DENSITY PRESSURE PSI SHIFTING OUTLETKIA ISP (SEC) Isp (LB-SEC/CU IN) TEMPERATURE (K) CP CAL/GM-DEG(K) MOM Wt-EFFECTIVE CP V-EFFECTIVE CF APPROX. PEA /M (SEC) AE/ T APPROX. FROZEN EN ILLERIN ISP (SEC) TEMPERATURE (K) CF FT/SEC CF PEA /M (SEC) AE/ T</p>	<p>COMPOSITION H2 O2 N2 DATA: H2 O2 N2 FORMULA H2 O2 N2 ENTHALPY KCAL/100 GM GM/CC EXHAUST CHAMBER 1000.0 PSI OUTLETKIA SEC LB-SEC/CU IN K GM-DEG(K) Wt-EFFECTIVE V-EFFECTIVE APPROX. M (SEC) APPROX. ILLERIN SEC K FT/SEC M (SEC) T</p>	<p>WEIGHT* 21.570 62.750 15.680 HEAT OF FORM. -1.8870 -3.0800 -2.7000 FORMULA H2 O2 N2 ENTHALPY KCAL/100 GM GM/CC EXHAUST CHAMBER 1000.0 PSI OUTLETKIA SEC LB-SEC/CU IN K GM-DEG(K) Wt-EFFECTIVE V-EFFECTIVE APPROX. M (SEC) APPROX. ILLERIN SEC K FT/SEC M (SEC) T</p>	<p>MOLAR HEAT OF FORM. -1.8870 -3.0800 -2.7000 FORMULA H2 O2 N2 ENTHALPY KCAL/100 GM GM/CC EXHAUST CHAMBER 1000.0 PSI OUTLETKIA SEC LB-SEC/CU IN K GM-DEG(K) Wt-EFFECTIVE V-EFFECTIVE APPROX. M (SEC) APPROX. ILLERIN SEC K FT/SEC M (SEC) T</p>	<p>DENSITY 710.0E-4 1.142 0.0080 0.010 EXHAUST 0.0000 416.95 3.7037 326.56 0.00356 7.02787 1.02634 1.0203 7.02787 17.098 412.16 290.16 1.0126 0.7942 154.68</p>	<p>REF. TEMP. 20.400 90.200 77.400 0.010 EXHAUST 200.0E-4 423.74 400490 290.10 0.70210 9.4582 1.02672 1.00506 6.4510 1405.0 412.16 290.16 1.0126 0.7942 154.68</p>
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BASE NO-
 BASIS: 10 GR PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	290.0	0.0000	0.0000
TEMPERATURE (KELVIN)	4326.7	550.54	226.56	290.19
ENTHALPY (KILOGALORIES)	-27.852	-203.69	-227.65	-234.20
ENTROPY (CALORIES/DEGREE)	520.06	328.00	329.03	330.59
HEAT CAPACITY (CAL/K)	110.59	55.048	40.356	70.219
MOLES OF AS	11.265	11.242	10.777	10.572
MOLECULAR COMPOSITION:				
H	0.0125	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
FE	6.7707	6.7518	9.0850	9.7477
VE	0.0000	0.0000	0.0000	0.0000
VM	0.0012	0.0000	0.0000	0.0000
WZU	3.7200	3.7217	3.7219	3.7217
WE	0.0572	0.0511	0.0486	0.0464
WPS	0.0008	0.0071	0.0017	0.0069
WU	0.0000	0.0000	0.0000	0.0000

BASE	N2								
PROPELLANT COMPOSITION		WEIGHT%		MOLAR		DENSITY		REF. TEMP.	
H2		16.660		-1.8670		710.0E-4		20.400	
O2		66.670		-3.0000		18142		90.200	
N2		16.670		-2.0000		0.0080		77.400	
INGREDIENT DATA:		FORMULA		HEAT OF FORM.					
H2	H2								
O2	O2								
N2	N2								
ATOMIC COMPOSITION (Wt AT/100GM)									
H			16.5276						
O			4.1900						
			4.1669						
PROPELLANT ENTHALPY			-23.736	KCAL/100 GM					
PROPELLANT DENSITY			0.2188	GM/CC					
CHAMBER				EXHAUST					
			1000.0		2.0000				
PRESSURE (PSI)									
SHIFTING EQUILIBRIA									
ISP (SEC)									
IVSR (LB-SEC/CU IN)									
TEMPERATURE (K)									
CP (CAL/GM-DEG K)			2801.4						
NO. REFLECTIVE			0.94734						
CP/CV REFLECTIVE			11.226						
CP APPROX.			1.4296						
PLAE/M (SEC)									
AE/AT APPROX.									
FROZEN EQUILIBRIA									
ISP (SEC)									
TEMPERATURE (K)			2801.4						
CP (FT/SEC)			7300.1						
CP									
PLAE/M (SEC)									
AE/AT									

BASE N2
 BASIS: 100 GA PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	200.0	0.0000	200.0E-4
TEMPERATURE (KELVIN)	2801.4	769.15	442.18	300.73
ENTHALPY (KILOGCALORIES)	-23.736	-207.12	-251.43	-245.59
ENTROPY (CALORIES/DEGREE K)	460.20	400.20	460.26	400.26
HEAT CAPACITY (CAL/K)	94.734	71.900	67.593	65.349
MOLES OF GAS	0.07077	8.8589	0.0452	8.04140
MOLECULAR COMPOSITION				
H	0.0730	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0002	0.0000	0.0000	0.0000
H2	4.0720	4.0965	4.0735	3.4290
O2	0.0001	0.0000	0.0000	0.0000
OH	0.0230	0.0000	0.0000	0.0000
H2O	4.1420	4.1669	4.1669	4.1669
N2	0.0945	0.0940	0.0872	0.03720
NH3	0.0003	0.0003	0.0157	0.04450
NO	0.0006	0.0000	0.0000	0.0000

CASE No.							
PROPELLANT COMPOSITION	WEIGHT%	MOLAR	DENSITY	REF. TEMP.			
H ₂	15.250		710.0E-4	20.400			
O ₂	67.800		1.142	90.200			
N ₂	16.950		0.8080	77.400			
INGREDIENT DATA:							
H ₂	FORMULA	HEAT OF FORM.					
O ₂		-1.6870					
N ₂		-3.0800					
		-2.9900					
ATOMIC COMPOSITION(GM AT/100GM)							
H		15.1290					
N		1.2100					
O		4.2375					
PROPELLANT ENTHALPY							
		-22.554	KCAL/100 GM				
PROPELLANT DENSITY							
	CHAMBER	0.7386	GM/CC				
	EXHAUST	2.000					
PRESSURE (PSI)							
SHIFTING EQUILIBRIA							
ISM (SEC)		400.27					
IVSP(LB-SEC/CU IN)		4.9000					
TEMPERATURE (K)		809.64					
CP (CAL/GM-DEG.K)		0.60822					
MOLE AT. EFFECTIVE		12.241					
CP/CV EFFECTIVE		1.7087					
CF APPROX.		1.7790					
PEAK/M (SEC)		15.690					
AE/AT APPROX.		34.890					
FROZEN EQUILIBRIA							
ISM (SEC)		394.12					
TEMPERATURE (K)		822.50					
CP (PT/SEC)		3025.1					
CF		7226.5					
PEAK/M (SEC)		1.7522					
AE/AT		15.121					
		33.014					
		1.0790					
		7.1891					
		159.82					
		426.62					
		422.99					
		441.53					
		5.4051					
		511.84					
		0.00004					
		12.590					
		1.2570					
		1.9631					
		4.0500					
		1.078.4					
		420.72					
		296.10					
		1.9150					
		4.9373					
		1057.0					

WADD TN 60-254

VASE N4
 BASIS 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3025.1	887.64	303.92	311.89
ENTHALPY (KI-CALORIES)	-22.554	-200.68	-232.14	-246.60
ENTROPY (CALORIES/DEG K)	437.58	437.58	437.53	439.58
HEAT CAPACITY (CAL/K)	89.724	68.824	63.414	60.004
MOLES OF GAS	8.2490	8.2694	8.2671	7.99428
MOLECULAR COMPOSITION				
H	0.1074	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0009	0.0000	0.0000	0.0000
H2	3.2011	3.2268	3.2234	2.9870
O2	0.0005	0.0000	0.0000	0.0000
OH	0.0481	0.0000	0.0000	0.0000
H2O	4.1854	4.2375	4.2375	4.2375
N2	0.0059	0.0050	0.0038	0.4917
NH3	0.0002	0.0001	0.0024	0.2260
NO	0.0021	0.0000	0.0000	0.0000

<p>CASE No PROPELLANT COMPOSITION H2 O2 N2</p>	<p>WEIGHT% 13.790 68.970 17.240</p>	<p>MOLAR</p>	<p>REF. TEMP. 20.400 90.200 77.400</p>	<p>DENSITY 710.0E-4 1.142 0.8080</p>
<p>INGREDIENT DATA: H4 O4 N2</p>	<p>FORMULA H4 O4 N2</p>	<p>HEAT OF FORM. -1.8870 -3.0800 -2.9700</p>		
<p>ATOMIC COMPOSITION (GM AT/100GM) H N O</p>	<p>13.6800 1.2307 4.2100 -21.330 0.7624 CHAMBER 1000.0</p>	<p>KCAL/100 GM EXHAUST 2.000</p>	<p>LB/CU IN EXHAUST 200.0E-4</p>	<p>EXHAUST 428.54 5.6107 587.99 0.27527 13.415 1.2314 1.9314 8.8441 19.30 420.94 422.94</p>
<p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p>	<p>5170.7 0.84342 13.185 1.2176</p>			
<p>PRESSURE (PSI) SHIFTING EQUILIBRIA ISP (SEC) IVP(LB-SEC/CU IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOLE #1-EFFECTIVE CP/CV-EFFECTIVE CF-APPROX. PEAK/M (SEC) AE/AT-APPROX.</p>	<p>3170.7 0.84342 13.185 1.2176</p>			
<p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) CF PEAK/M (SEC) AE/AT</p>	<p>3170.7 7128.6</p>			

WADD TN 60-254

CASE No
 BASIS: 100 GM PROPELLANT
 PRESSURE (PSI)
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEGREEK)
 HEAT CAPACITY (CAL/K)
 MOLES OF GAS
 MOLECULAR COMPOSITION
 H
 N
 O
 H2
 O2
 OH
 H2O
 H2
 NH3
 NO

CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
1000.0	2.000	0.2000	0.0000	0.0000
3170.7	10.606	367.99	0.0000	0.0000
-21.330	-203.55	-254.35	0.0000	0.0000
417.54	417.54	417.54	2.2292	2.4484
34.342	65.913	59.527	0.0000	0.0000
7.5845	7.4559	7.4555	0.0000	0.0000
0.446	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0055	0.0000	0.0000	0.0000	0.0000
2.5186	2.2296	2.2292	2.2292	2.4484
0.0022	0.0000	0.0000	0.0000	0.0000
0.0965	0.0000	0.0000	0.0000	0.0000
4.2009	4.2106	4.2106	4.2106	4.2106
0.0126	0.0152	0.0152	0.0152	0.0582
0.0001	0.0000	0.0003	0.0003	0.0542
0.0054	0.0000	0.0000	0.0000	0.0000

<p>BASE N₂ PROPELLANT COMPOSITION H₂ O₂ N₂</p>	<p>WEIGHT% 12.280 70.180 17.540</p>	<p>MOLAR</p>	<p>HEAT OF FORM. -1.0870 -3.0800 -2.7000</p>	<p>DENSITY (10.0E-4 1.142 0.8080</p>	<p>REF. TEMPO 20.400 90.200 77.400</p>
<p>INGREDIENT DATA: H₂ O₂ N₂</p>	<p>FORMULA H₂ O₂ N₂</p>				
<p>ATOMIC COMPOSITION(GM AT/100GM) H N O</p>	<p>12.1825 1.2521 4.2862</p>				
<p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p>	<p>-20.065 0.2904 1000.0</p>	<p>KCAL/100 GM GM/CC EXHAUST CHAMBER</p>	<p>2.600</p>	<p>0.0141 0.2000</p>	<p>LB/CC IN EXHAUST EXHAUST 200.0E-4</p>
<p>PRESSURE (PSI) SHIFTING EQUILIBRIA ISP (SEC) IVSP(LB-SEC/CC IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOL. WT. EFFECTIVE CF/CV EFFECTIVE CF APPROX. PCAE/M (SEC) AE/AT APPROX.</p>	<p>3344.0 0.70563 14.450 1.1122</p>	<p>399.35 5.0335 1101.0 0.62909 14.887 1.2694 1.0370 17.184 39.550</p>	<p>427.26 6.0555 703.51 0.20029 14.887 1.3128 1.9752 2.0509 5.1869 1.95.4</p>	<p>445.70 6.2874 398.22 0.22273 14.892 1.2428 2.0509 5.1869 1.95.4</p>	<p>424.72 328.61</p>
<p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) CF (PT/SEC) CF PCAE/M (SEC) AE/AT</p>	<p>5344.0 6972.0</p>	<p>364.37 992.58</p>	<p>1.7687 12.495 35.850</p>	<p>1.0161 0.0055 150.83</p>	<p>197549 406291 1005.0</p>

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CASE N2
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3344.0	1101.0	702.51	346.22
ENTHALPY (KILOCALORIES)	-20.065	-203.35	-231.83	-248.37
ENTROPY (CALORIES/DEG K)	394.02	394.02	394.02	394.02
HEAT CAPACITY (CAL/K)	78.563	62.909	50.029	54.473
MOLES OF GAS	6.9206	6.7172	6.7173	6.7149
MOLECULAR COMPOSITION				
H	0.4716	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0103	0.0000	0.0000	0.0000
H2	1.7533	1.7050	1.7050	1.7013
O2	0.0100	0.0000	0.0000	0.0000
OH	0.1809	0.0000	0.0000	0.0000
H2O	4.1616	4.2862	4.2862	4.2862
N2	0.6193	0.6261	0.6260	0.6248
NH3	0.0001	0.0000	0.0000	0.0000
NO	0.0134	0.0000	0.0000	0.0000

CASE N2							
PROPELLANT COMPOSITION	WEIGHT%	MULAR					
H2	10.710						
O2	71.430						
N2	17.860						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.			
H2	H2	-1.8870	710.00-4	20.400			
O2	O2	-3.0800	1.1142	90.200			
N2	N2	-2.9000	0.8080	77.400			
ATOMIC COMPOSITION (GM AT/100GM)							
H	10.6250						
N	1.4750						
O	4.4644						
PROPELLANT ENTHALPY	-18.748	KCAL/100 GM					
PROPELLANT DENSITY	0.4246	GM/CC					
PRESSURE (PSI)	CHAMBER	EXHAUST	0.053	LB/CU IN			
SHIFTING EQUILIBRIA	1000.0	2.000	0.2000	EXHAUST	200.0E-4		
ISP (SEC)			428.52		446.80		
IVSPLAT-REV/CU IN)			6.3743		6.8549		
TEMPERATURE (K)			870.60		507.37		
CP (CAL/GM-DEG.K)	3426.6		0.53836		0.48244		
MOL. WT. EFFECTIVE	0.72343		16.807		16.807		
CF/CM EFFECTIVE	15.952		1.2412		1.3240		
CF -APPROX.	1.2080		1.8821		2.1221		
PEAFAM (SEC)			10.240		10.451		
AE/AT -APPROX.			43.317		248.19		
FROZEN EQUILIBRIA							
ISP (SEC)			370.71		407.76		
TEMPERATURE (K)	3426.6		1028.9		472.79		
CP (FT/SEC)	6774.2						
CF			1.7750		1.9806		
PEAFAM (SEC)			15.357		3.6751		
AE/AT			36.469		151.44		

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CASE 12
 BASIS: 100 GR PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	0.0000E-4
TEMPERATURE (KELVIN)	3456.6	1405.1	870.60	507.27
ENTHALPY (KILOCALORIES)	-13.748	-19.21	-29.79	-248.18
ENTROPY (CALORIES/DEGREE K)	360.69	300.69	300.69	760.69
HEAT CAPACITY (CAL/K)	72.343	60.816	57.136	48.044
MOLES OF GAS	6.2688	5.2500	3.2000	3.9500
MOLECULAR COMPOSITION:				
H	0.1663	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0274	0.0000	0.0000	0.0000
H2	1.0583	0.0431	0.0081	0.0431
O2	0.0424	0.0070	0.0000	0.0000
OH	0.0012	0.0000	0.0000	0.0000
H2O	4.0204	4.0064	4.0044	4.0044
N2	0.0221	0.0375	0.0075	0.0375
NO2	0.0000	0.0000	0.0000	0.0000
NO	0.0306	0.0000	0.0000	0.0000

CASE	N4								
PROPELLANT COMPOSITION		WEIGHT%		MOLE%					
H2		9.0900		-1.0870					
O2		72.750		-3.00800					
N2		18.180		-2.7000					
INGREDIENT DATA		FORMULA		HEAT OF FORM		DENSITY		REF. TEMP.	
H2		H2				710.0E-4		20.400	
O2		O2				1.142		90.200	
N2		N2				0.8090		77.400	
ATOMIC COMPOSITION(GM AT/100GM)									
H				9.09176					
N				1.4978					
O				4.3453					
PROPELLANT ENTHALPY				-17.390	KCAL/100 GM				
PROPELLANT DENSITY				0.4666	GM/CC				
				CHAMBER					
				1000.0	EXHAUST				
					2.000				
PRESSURE (PSI)									
SHIFTING EQUILIBRIA									
ISP (SEC)				380.80		426.73		443.97	
IVSP(LB/SEC/OU IN)				6.2238		7.1399		7.4882	
TEMPERATURE (K)				1722.0		1165.4		687.78	
CP (CAL/GM-DEG K)				0.57990		0.51354		0.49258	
NO. OF DEFECTIVE				19.306		19.319		19.319	
CP/GV DEFECTIVE				1.4158		1.4505		1.4941	
CF APPROX.				1.9261		2.0050		2.02100	
PEAK/M (SEC)				19.940		11.914		6.9327	
AE/AT APPROX.				49.661		290.65		176.6	
FROZEN EQUILIBRIA									
ISP (SEC)				357.00		387.58		399.54	
TEMPERATURE (K)				1481.7		200.95		290.10	
CP (FT/SEC)									
CF				5402.2					
PEAK/M (SEC)				6401.2					
AE/AT									
				1.0780		1.07400		1.07895	
				14.019		6.2240		3.0462	
				36.881		157.45		90.832	

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VASE N2
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3482.3	1742.8	1125.4	687.78
ENTHALPY (KILOCALORIES)	-17.390	-189.34	-222.76	-245.92
ENTROPY (CALORIES/DEGREE K)	341.52	341.52	341.52	341.52
HEAT CAPACITY (CAL/K)	65.708	57.990	51.354	45.258
MOLES OF GAS	5.0544	5.0798	5.0762	5.0762
MOLECULAR COMPOSITION				
H	0.1179	0.0001	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0527	0.0000	0.0000	0.0000
H2	0.2240	0.0050	0.0000	0.0000
O2	0.1525	0.0194	0.0183	0.0182
OH	0.4055	0.0040	0.0000	0.0000
H2O	3.7252	4.5019	4.2089	4.5089
N2	0.0192	0.0484	0.0489	0.0489
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0593	0.0000	0.0000	0.0000

<p>CASE NAME PROPELLANT COMPOSITION H2 O4 N2</p>	<p>WEIGHT% 7.4100 74.070 18.520</p>	<p>MOLAN</p>	<p>REF. TEMP. 20.400 90.200 77.400</p>	<p>DENSITY (10.0E-4) 1.142 0.0080</p>
<p>INGREDIENT DATA: H2 O2 N2</p>	<p>FORMULA H4 O2 N2</p>	<p>HEAT OF FORM. -1.0870 -3.0800 -2.9000</p>		
<p>ATOMIC COMPOSITION (GM AT/100GM) H N O</p>	<p>7.2512 1.2221 4.0294</p>			
<p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p>	<p>-15.982 KCAL/100 GM 0.2204 GM/CC CHAMBER 1000.00</p>	<p>KCAL/100 GM EXHAUST 2.070</p>	<p>0.0188 LB/CC IN EXHAUST 0.2000</p>	<p>200.0E-4</p>
<p>PRESSURE (PSI) SHIFTING EQUILIBRIA ISP (SEC) IVSP (LJ-SEC/100 IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOL. WT. EFFECTIVE CP/CV EFFECTIVE CF APPROX. PEAK/M (SEC) AE/AT APPROX.</p>	<p>3302.0 0.50887 19.654 1.2075</p>	<p>322.99 6.0930 1424.2 0.50231 20.774 1.0232 1.0960 17.004 42.295</p>	<p>386.21 7.6620 714.68 0.44335 20.775 1.6751 2.1506 7.0562 20.658</p>	<p>403.53 7.2880 540.03 0.29710 20.775 1.2173 2.1506 5.5692 1.4837</p>
<p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) CF (PI/SEC) CF PEAK/M (SEC) AE/AT</p>	<p>3382.5 6028.4</p>	<p>322.39 1043.7 1.7764 13.771 30.089</p>	<p>304.10 474.05</p>	<p>372.20 270.10 1.9830 3.5230 9.2859</p>

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CASE N ₂	CHAMBER	EXHAUST	EXHAUST	EXHAUST
BASIS 100 GM PROPELLANT	1000.0	2.000	0.2000	200.0E-4
PRESSURE (PSI)	3382.5	1454.2	714.68	540.03
TEMPERATURE (KELVIN)	-15.982	-161.63	-187.40	-203.14
ENTHALPY (KILOCALORIES)	314.10	312.10	312.10	312.10
ENTROPY (CALORIES/DEG.K)	58.887	50.531	44.335	34.710
HEAT CAPACITY (CAL/K)	5.0879	4.8138	4.8135	4.8135
MOLES OF GAS				
MOLECULAR COMPOSITION				
H	0.0049	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0634	0.0000	0.0000	0.0000
H ₂	0.2022	0.0000	0.0000	0.0000
O ₂	0.4151	0.4759	0.4769	0.4769
OH	0.4012	0.0010	0.0000	0.0000
H ₂ O	3.2453	3.8751	3.8756	3.6750
N ₂	0.0164	0.0603	0.0610	0.0610
NH ₃	0.0000	0.0000	0.0000	0.0000
NO	0.0892	0.0014	0.0000	0.0000

<p>BASE N₂</p> <p>PROPELLANT COMPOSITION</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>WEIGHT%</p> <p>6.5400</p> <p>74.770</p> <p>18.690</p>	<p>MOLAR</p> <p>-1.9870</p> <p>-3.0600</p> <p>-2.9000</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>	<p>DENSITY</p> <p>(10.0E-4)</p> <p>1.142</p> <p>0.8080</p>
<p>INGREDIENT DATA:</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.9870</p> <p>-3.0600</p> <p>-2.9000</p>	<p>DENSITY</p> <p>(10.0E-4)</p> <p>1.142</p> <p>0.8080</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>
<p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H</p> <p>N</p> <p>O</p>	<p>6.4881</p> <p>1.2342</p> <p>4.0751</p>	<p>HEAT OF FORM.</p> <p>-15.253</p> <p>0.2534</p>	<p>DENSITY</p> <p>(10.0E-4)</p> <p>1.142</p> <p>0.8080</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>
<p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p>	<p>KCAL/100 GM</p> <p>CHAMBER</p> <p>EXHAUST</p>	<p>1000.0</p> <p>2.000</p>	<p>DENSITY</p> <p>(10.0E-4)</p> <p>1.142</p> <p>0.8080</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>
<p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. #1-EFFECTIVE</p> <p>CP/CV-EFFECTIVE</p> <p>CF-APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT-APPROX.</p>	<p>1000.0</p> <p>3279.3</p> <p>0.52310</p> <p>20.753</p> <p>1.2094</p>	<p>CHAMBER</p> <p>EXHAUST</p>	<p>DENSITY</p> <p>(10.0E-4)</p> <p>1.142</p> <p>0.8080</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>
<p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>5279.3</p> <p>5702.5</p>	<p>CHAMBER</p> <p>EXHAUST</p>	<p>DENSITY</p> <p>(10.0E-4)</p> <p>1.142</p> <p>0.8080</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>

CASE NO PROPELLANT COMPOSITION H2 O2 N2	WEIGHT% 4.7600 76.190 19.050	M/LAK HEAT OF FORM. -1.0870 -3.0800 -2.9000	DENSITY 710.0E-4 1.142 0.8080	REF. TEMP. 20.400 90.200 77.400	
INGREDIENT DATA: H2 O2 N2	FORMULA H2 O2 N2	HEAT OF FORM. -1.0870 -3.0800 -2.9000	DENSITY 710.0E-4 1.142 0.8080	REF. TEMP. 20.400 90.200 77.400	M/LAK HEAT OF FORM. -1.0870 -3.0800 -2.9000
ATOMIC COMPOSITION (GM AT/100GM) H N O	FORMULA H2 O2 N2	HEAT OF FORM. -1.0870 -3.0800 -2.9000	DENSITY 710.0E-4 1.142 0.8080	REF. TEMP. 20.400 90.200 77.400	M/LAK HEAT OF FORM. -1.0870 -3.0800 -2.9000
PROPELLANT ENTHALPY PROPELLANT DENSITY PRESSURE (PSI) SHIFTING EQUILIBRIA ISP (SEC) IVP(LB-SEC/CU IN) TEMPERATURE (K) CP (CAL/GM-DEG K) MOLE #1 EFFECTIVE CP/CV EFFECTIVE CP APPROX. PEAKM (SEC) WE/AT APPROX.	CHAMBER 1000.0 4.7222 1.2599 4.7619 -13.761 0.0356 0.47875 43.202 1.4175 0.47875 43.202 1.4175 0.47875 43.202 1.4175	KCAL/100 GM EXHAUST 2.000 274.99 6.7284 967.86 0.20424 2.2877 1.02810 1.0252 12.301 30.315	EXHAUST 200.0E-4 314.27 7.4158 372.75 0.22410 2.2877 1.02244 1.02578 0.7181 209.25	LB/CU IN EXHAUST 200.0E-4 362.80 7.4816 360.42 0.22240 2.2877 1.02540 2.0296 3.0068 1.123.4	20.400 90.200 77.400
FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) CP (FT/SEC) CF PEAKM (SEC) WE/AT	2929.0 5104.7	282.86 624.04	309.15 404.20	311.03 296.19	1.9072 4.0196 152.24

BASE NC
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	20000	0.6800	200.0E-4
TEMPERATURE (KELVIN)	2959.6	982.85	372.75	320.45
ENTHALPY (KI-CALORIES)	-13.761	-112.42	-127.27	-135.75
ENTHALPY (CALORIES/DEGREE K)	262.63	262.63	262.63	262.63
HEAT CAPACITY (CAL/K)	47.875	38.424	34.410	32.240
MOLES OF GAS	4.2099	4.2412	4.2412	4.2412
MOLECULAR COMPOSITION				
H	0.0040	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0241	0.0000	0.0000	0.0000
H2	0.0201	0.0000	0.0000	0.0000
O2	1.1106	1.2002	1.2004	1.2004
OH	0.1715	0.0000	0.0000	0.0000
H2O	2.2529	2.2611	2.2611	2.2611
H2	0.0341	0.0799	0.0500	0.0500
NH2	0.0000	0.0000	0.0000	0.0000
NO	0.0918	0.0001	0.0000	0.0000

CASE NAME	N2				
PROPELLANT COMPOSITION		WEIGHTS		MOLALS	
H2		30.000			
O2		52.500			
N2		17.500			
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.	
H2	H2	-1.0870		710.0E-4	20.000
O2	O2	-2.0800		1.142	90.200
N2	N2	-2.2900		0.0030	77.400
ATOMIC COMPOSITION(GM AT/100GM)					
H		29.7619			
O		1.2493			
N		3.2812			
PROPELLANT LINTHAPEY		-34.045	KCAL/100 GM		
PROPELLANT DENSITY		0.2040	CM/CC		
PRESSURE (PSI)		1000.0	EXHAUST	0.007	LB/CC IN
SHIFTING EQUILIBRIA			EXHAUST	0.0000	EXHAUST
ISP (SEC)					200.0E-4
IVSP(LB-SEC/CC IN)					379.05
TEMPERATURE (K)		1500.0			2.7108
CP (CAL/GM-DEG.K)		1.2275			296.16
MOL. WT.-EFFECTIVE		6.4520			1.0369
CP/CV -EFFECTIVE		1.5021			7.0118
CF -APPROX.					1.5751
PEAE/M (SEC)					1.7554
AE/AT -APPROX.					9.0030
PROZEN EQUILIBRIA					220.29
ISP (SEC)					360.09
TEMPERATURE (K)		1500.0			298.16
CF* (FT/SEC)		7012.8			1.0836
CF					10.887
PEAE/M (SEC)					247.74
AE/AT					25.271

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CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	1600.0	392.50	290.16	298.16
ENTHALPY (KI-CALORIES)	-34.045	-190.58	-202.38	-200.24
ENTROPY (CALORIES/DEG.K)	600.03	625.03	654.02	730.16
HEAT CAPACITY (CAL/K)	132.75	107.50	102.69	105.19
MOLES OF GAS	15.090	14.552	14.252	14.646
MOLECULAR COMPOSITION:				
H	0.0001	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	11.2098	10.1358	9.7338	10.1604
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	3.2812	3.2812	3.2812	3.2812
N2	0.0214	0.1377	0.0027	0.1449
NH3	0.0065	0.0740	1.2440	0.0996
NO	0.0000	0.0000	0.0000	0.0000

CASE N4 PROPELLANT COMPOSITION H2 O2 N2	N4 H2 O2 N2	WEIGHT% 25.370 55.970 18.660	FORMULA H2 O2 N2	MOLAR -1.5870 -3.0800 -2.7000	HEAT OF FORM. -1.5870 -3.0800 -2.7000	REF. TEMP. 29.400 90.200 77.400
ATOMIC COMPOSITION(GM AT/100GM)						
	H	25.1686				
	N	1.2321				
	O	3.4981				
PROPELLANT ENTHALPY						
PROPELLANT DENSITY						
PRESSURE (PSI)						
SHIFTING EQUILIBRIA						
ISP (SEC)						
IVP(LB-SEC/CU IN)						
TEMPERATURE (K)						
CP (CAL/GM-DEG.K)						
MOLE #/EFFEFFECTIVE						
CP/CV EFFECTIVE						
CP APPROX.						
PEAE/M (SEC)						
AE/AT APPROX.						
FROZEN EQUILIBRIA						
ISP (SEC)						
TEMPERATURE (K)						
G* (FT/SEC)						
CP						
PLAE/M (SEC)						
AE/AT						

DENSITY (10.00E-4) 1.0142 0.8080	U EXHAUST 0.008 0.2000	LB/CU IN EXHAUST 200.00E-4	397.26 3.2592 317.03 0.80966 8.3303 1.2664 1.8009 3.6412 1.02.83	397.01 3.3402 298.10 0.70242 8.1018 1.2753 1.7904 6.0144 1.007.1
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CHAMBER 1000.00	KCAL/100 GM GM/CC EXHAUST 2.000	372.42 3.1580 430.41 0.92648 7.7552 1.2659 1.8931 1.8959 29.221	1808.9 1.2088 7.2482 1.2784	374.80 398.70 1.0903 12.184 27.474
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CASE N4
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	0.0000
TEMPERATURE (KELVIN)	1858.9	450.41	317.03	298.10
ENTHALPY (KILOCALORIES)	-51.065	-192.09	-214.27	-212.20
ENTROPY (CALORIES/DEGREEK)	574.28	574.28	574.28	624.64
HEAT CAPACITY (CAL/K)	120.88	95.640	60.966	90.242
HEAT OF GAS	13.240	12.894	12.004	12.242
MOLECULAR COMPOSITION				
H	0.0010	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
Cl2	9.0018	8.2524	7.6172	7.7249
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	3.4981	3.4981	3.4981	3.4981
N2	0.0647	0.0681	0.0451	0.2123
NH3	0.0026	0.2559	1.6460	0.0073
NO	0.0000	0.0000	0.0000	0.0000

BASE N2
 BASIS: 100 G. PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.000	200.0E-4
TEMPERATURE (KELVIN)	2715.3	714.38	403.88	290.16
ENTHALPY (KILOCALORIES)	-23.775	-197.11	-217.42	-232.25
ENTROPY (CALORIES/DEGREE K)	750.46	450.76	450.45	400.82
HEAT CAPACITY (CAL/K)	94.250	71.370	67.175	62.351
MOLES OF GAS	9.0405	9.0114	8.9987	8.94261
MOLECULAR COMPOSITION				
H	0.0450	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0001	0.0000	0.0000	0.0000
NO	4.0452	4.02512	4.02661	3.94532
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0110	0.0000	0.0000	0.0000
H2O	3.0940	3.07062	3.0762	3.0062
N2	0.7451	0.7430	0.7315	0.7304
NH3	0.0004	0.0010	0.0045	0.0062
NO2	0.0004	0.0000	0.0000	0.0000

CASE NO			
PROPELLANT COMPOSITION	WEIGHT%	MOLE%	
H ₂	15.250		
O ₂	63.500		
N ₂	21.190		
INGREDIENT DATA:	FORMULA	HEAT OF FORM*	DENSITY
H ₂	H ₂	-1.9570	710.01-4
O ₂	O ₂	-2.0500	1.142
N ₂	N ₂	-2.3000	0.0180
ATOMIC COMPOSITION (G/M AT/100GM)			
H		10.1290	
O		1.9127	
N		0.9725	
PROPELLANT ENTHALPY	KCAL/100 GM		
PROPELLANT DENSITY	G/CM ³		
	CHAMBER	2.000	0.0122
	EXHAUST		0.2700
	EXHAUST		200.0E-4
PRESSURE (PSI)			
CHIFFING EQUILIBRIA			
ISP (SEC)		389.04	420.57
IVP(LB-SEC/OU IN)		4.7420	5.2190
TEMPERATURE (K)		600.71	500.50
CP (CAL/GM-DEG K)		0.01978	0.02090
MOL. WEIGHT EFFECTIVE		12.010	12.021
CP/OU EFFECTIVE		1.0244	1.0574
CF APPROX.		1.7634	1.9400
PEAK/T (SEC)		14.040	4.0510
WE/T APPROX.		32.012	1098.4
PROZEN EQUILIBRIA			
ISP (SEC)		382.51	410.70
TEMPERATURE (K)		772.40	298.10
CF (R/SEC)			
CF		1.7450	1.0959
PEAK/T (SEC)		14.489	5.2534
WE/T		32.830	1160.7

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.00	200.00	0.0000	0.0000
TEMPERATURE (KELVIN)	2800.00	800.00	0.0000	0.0000
ENTHALPY (KILOGCALORIES)	-22.500	-190.00	0.0000	0.0000
ENTROPY (CALORIES/DEGREE K)	430.00	430.00	3.2741	2.9952
HEAT CAPACITY (CAL/K)	69.330	67.976	0.0000	0.0000
MOLES OF GAS	0.0000	0.0000	0.0000	0.0000
MOLECULAR COMPOSITION				
H	0.0710	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
CH	0.0000	0.0000	0.0000	0.0000
CO	0.0000	0.0000	0.0000	0.0000
CO2	0.0000	0.0000	0.0000	0.0000
H2O	0.0000	0.0000	0.0000	0.0000
N2	0.0000	0.0000	0.0000	0.0000
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000

<p>CASE IN- PROPELLANT COMPOSITION N2 O2 N2 M2 O2 N2</p>	<p>WEIGHTS 13.790 04.000 21.550</p>	<p>FORMULA H- V- N- ATOMIC COMPOSITION (G/M AT 100CM) H N O</p>	<p>MOLAR REF. TEMP. DENSITY HEAT OF FORM. KCAL/100 GM GM/CC EXHAUST CHAMBER TEMP.</p>
<p>PROPELLANT DATA: M- V- N- M- O- N-</p>	<p>HEAT OF FORM. -1.0870 -2.0800 -2.7010</p>	<p>EXHAUST 2.070</p>	<p>20.400 90.200 77.400</p>
<p>PROPELLANT DENSITY TEMP (CAL/GM-DEG.K) MOL. AT. REFLECTIVE CP/CV REFLECTIVE WF APPROX. PEAK (SEC) AE/AT APPROX.</p>	<p>3009.0 0.84095 12.999 1.4224</p>	<p>EXHAUST 2.070</p>	<p>EXHAUST 200.0E-4</p>
<p>PROZON EQUILIBRIA ISP (SEC) IVSP (LBS/SEC/IN) TEMPERATURE (K) MOL. AT. REFLECTIVE CP/CV REFLECTIVE WF APPROX. PEAK (SEC) AE/AT APPROX.</p>	<p>357.98 5.0772 912.80 0.64851 13.142 1.02041 1.7848 15.447 55.335</p>	<p>EXHAUST 2.070</p>	<p>EXHAUST 200.0E-4</p>
<p>PROZON EQUILIBRIA ISP (SEC) TEMPERATURE (K) V* (FT/SEC) CF PEAK (SEC) AE/AT</p>	<p>3009.0 7000.1</p>	<p>EXHAUST 2.070</p>	<p>EXHAUST 200.0E-4</p>

CASE No
 BASIS: 100 G. PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.670	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3039.0	917.90	521.14	316.22
ENTHALPY (KILOCALORIES)	-21.362	-150.15	-220.62	-224.49
ENTROPY (CALORIES/DEG.K)	410.30	410.30	410.30	410.30
HEAT CAPACITY (CAL/K)	64.095	64.051	55.412	50.262
MOLES OF GAS	7.0920	7.0034	7.0080	7.4749
MOLECULAR COMPOSITION				
H	0.1054	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0012	0.0000	0.0000	0.0000
H2	2.7792	2.7949	2.7968	2.5371
O2	0.0007	0.0010	0.0000	0.0000
OH	0.0546	0.0010	0.0000	0.0000
H2O	3.7808	4.0412	4.0412	4.0412
H4	0.7670	0.7692	0.7684	0.6819
NH3	0.0002	0.0011	0.0015	0.1740
NO	0.0030	0.0010	0.0000	0.0000

CASE PROPELLANT COMPOSITION H ₂ O ₂ N ₂	FORMULA H ₂ O ₂ N ₂	WEIGHTS 12.280 65.790 21.930	MOLAR -1.3870 -3.0300 -2.0000	HEAT OF FORM. -1.3870 -3.0300 -2.0000	REF. ILMPO 20.400 90.200 77.400
INGREDIENT DATA:					
H N O	FORMULA H ₂ O ₂ N ₂	WEIGHTS 12.2825 1.00655 4.1119	MOLAR -1.3870 -3.0300 -2.0000	HEAT OF FORM. -1.3870 -3.0300 -2.0000	REF. ILMPO 20.400 90.200 77.400
ATOMIC COMPOSITION (GM AT/100GM)					
H N O	FORMULA H ₂ O ₂ N ₂	WEIGHTS 12.2825 1.00655 4.1119	MOLAR -1.3870 -3.0300 -2.0000	HEAT OF FORM. -1.3870 -3.0300 -2.0000	REF. ILMPO 20.400 90.200 77.400
PROPELLANT ENTHALPY					
PROPELLANT DENSITY					
PRESSURE (PSIA)					
SHIFTING EQUILIBRIA					
ISP (SEC)					
TVSP (LB-SEC/CU IN)					
TEMPERATURE (K)					
CP (CAL/GM-DEG K)					
MOL. WT. EFFECTIVE					
CP/CV EFFECTIVE					
WF APPROX.					
PEAEM (SEC)					
AE/AT APPROX.					
FROZEN EQUILIBRIA					
ISP (SEC)					
TEMPERATURE (K)					
WF (FT/SEC)					
CP					
PEAEM (SEC)					
AE/AT					

CASE N4
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3222.3	1000.1	616.34	349.55
ENTHALPY (KILOGCAL/100G)	-20.096	-194.56	-220.46	-255.25
ENTROPY (CALORIES/DEGREE K)	390.26	390.16	390.26	393.26
HEAT CAPACITY (CAL/K)	78.456	61.875	55.525	54.411
MOLES OF GAS	7.0120	6.6740	6.6739	6.8494
MOLECULAR COMPOSITION				
H	0.1301	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0047	0.0000	0.0000	0.0000
M2	1.7877	1.7794	1.7792	1.7425
O2	0.0036	0.0000	0.0000	0.0000
OH	0.1139	0.0000	0.0000	0.0000
M2O	0.7774	4.1119	4.1119	4.1119
N2	0.7860	0.7826	0.7827	0.7702
NH3	0.0001	0.0000	0.0002	0.0246
NO	0.0065	0.0000	0.0000	0.0000

CASE NO					
PROPELLANT COMPOSITION	WEIGHT%	MOLAR	REF. TEMP.		
H ₂	10.710		710.00E-4	20.400	
O ₂	66.970		1.142	90.200	
N ₂	22.320		0.0080	77.400	
INGREDIENT DATA:	FORMULA	HEAT OF FORM.			
H ₂	H ₂	-1.5870			
O ₂	O ₂	-3.0800			
N ₂	N ₂	-2.9000			
ATOMIC COMPOSITION (GM AT/100GM)					
H		10.0250			
N		1.5934			
O		4.1856			
PROPELLANT ENTHALPY		-10.781	KCAL/100 GM		
PROPELLANT DENSITY		0.4217	GM/CC		
CHAMBER		EXHAUST			
CHAMBER		2.000			
1000.0					
PRESSURE (PSI)					
SHOOTING FACILITY					
IGN (SEC)					
INJECTOR (SEC/IN)					
TEMPERATURE (K)					
CP (CAL/AN-DEG.K)					
MOL. WT. EFFECTIVE					
CF/CM EFFECTIVE					
CF - APPROX.					
PERFORM (SEC)					
AP/AT APPROX.					
PERFORM (SEC)					
AP/AT					
PROZEN QUALITY					
IGN (SEC)					
TEMPERATURE (K)					
CF (FT/SEC)					
CF					
PERFORM (SEC)					
AP/AT					

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CASE #4
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3379.3	1294.0	757.55	432.61
ENTHALPY (KILOCALORIES)	-18.781	-191.58	219.27	-235.54
ENTROPY (CALORIES/DEGREE K)	369.34	369.34	369.34	368.34
HEAT CAPACITY (CAL/K)	72.356	59.808	52.170	48.148
MOLES OF GAS	6.2377	6.1092	6.1.92	6.1087
MOLECULAR COMPOSITION				
H	0.1503	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0152	0.0000	0.0000	0.0000
H2	1.4356	1.1269	1.1968	1.1261
O2	0.0196	0.0000	0.0000	0.0000
OH	0.4153	0.0000	0.0000	0.0000
H2O	3.6941	4.1856	4.1856	4.1856
N2	0.7857	0.7967	0.7967	0.7964
HNO3	0.0000	0.0000	0.0000	0.0005
NO	0.0218	0.0000	0.0000	0.0000

<p>CASE No PROPELLANT COMPOSITION H2 O2 N2</p>	<p>WEIGHT% 9.0900 68.180 22.730</p>	<p>MOLAR</p>	<p>REF. TEMPO 20.400 90.200 77.400</p>
<p>INGREDIENT DATA: H2 O2 N2</p>	<p>FORMULA</p>	<p>HEAT OF FORM.</p>	<p>DENSITY 710.0E-4 1.142 0.6080</p>
<p>ATOMIC COMPOSITION(GM AT/100GM) H N O</p>	<p>9.0178 1.0226 4.2612</p>	<p>-1.6870 -3.0800 -2.0000</p>	<p>EXHAUST 200.0E-4</p>
<p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p>	<p>-17.424 0.4632</p>	<p>KCAL/100 GM GM/CC EXHAUST</p>	<p>0.0167 LB/CU IN 0.2000</p>
<p>PRESSURE (PSI) SHIFTING EQUILIBRIA ISP (SEC) IVSP(LB-SEC/CU IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOL. WT. EFFECTIVE CP/CV EFFECTIVE CF APPROX. PEAE/M (SEC) AE/AT APPROX.</p>	<p>1000.0 3447.4 0.62844 17.554 1.2076</p>	<p>352.47 6.4017 1525.6 0.50786 18.796 1.2286 1.0079 18.466 46.062</p>	<p>434.39 7.2706 576.50 0.44404 18.796 1.3125 2.1669 6.1257 127.9</p>
<p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) CF (FT/SEC) CF PEAE/M (SEC) AE/AT</p>	<p>3447.4 6449.6</p>	<p>350.06 1002.4 1.7762 14.696 36.654</p>	<p>389.00 477.30 1.0005 6.0432 150.73</p>

WASE N4
BASIS: 100 Gm PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.0000	200.0E-4
TEMPERATURE (KELVIN)	3447.4	1525.6	973.02	570.50
ENTHALPY (KILOCALORIES)	-17.424	-162.54	-213.72	-234.28
ENTROPY (CALORIES/DEGREEK)	341.55	341.55	341.55	341.55
HEAT CAPACITY (CAL/K)	65.844	56.786	49.783	44.404
MOLES OF GAS	5.0967	5.0203	3.0202	5.0202
MOLECULAR COMPOSITION				
H	0.1187	0.0001	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0369	0.0000	0.0000	0.0000
H2	0.0193	0.0477	0.0477	0.0477
O2	0.0891	0.0000	0.0000	0.0000
OH	0.0328	0.0000	0.0000	0.0000
H2O	3.0639	4.0612	4.0612	4.0612
N2	0.7865	0.0112	0.0113	0.0113
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0495	0.0000	0.0000	0.0000

<p>CASE N2 PROPELLANT COMPOSITION H2 O2 N2</p>	<p>WEIGHT% 7.4100 69.440 23.150</p>	<p>MULAR</p>	<p>REF. TEMP. 29.400 90.200 77.400</p>	
<p>INGREDIENT DATA: H2 O2 N2</p>	<p>FORMULA H2 O2 N2</p>	<p>HEAT OF FORM. -1.8870 -3.9800 -2.9800</p>	<p>DENSITY 710.0E-4 1.142 0.8080</p>	<p>EXHAUST 200.0E-4</p>
<p>ATOMIC COMPOSITION(GM AT/100GM) H N O</p>	<p>7.2512 1.0526 4.2400</p>	<p>KCAL/100 GM EXHAUST 2.000</p>	<p>LB/CU IN EXHAUST 200.0E-4</p>	<p>0.0186 0.2000</p>
<p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p>	<p>-16.016 0.2159 CHAMBER 1000.0</p>	<p>356.27 6.6412 1446.4 0.59659 20.685 1.2340 1.8963 16.968 4.2159</p>	<p>386.42 7.2032 908.39 0.44342 20.686 1.2766 2.0568 9.8249 20.647</p>	<p>403.69 7.2251 528.18 0.29743 20.686 1.2186 2.1487 5.2407 1474.9</p>
<p>PRESSURE (PSI) SHIFTING EQUILIBRIA ISP (SEC) IVSP(LB-SEC/CU IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOL. WT. EFFECTIVE CP/CV EFFECTIVE CF APPROX. PEAE/M (SEC) AE/AT APPROX.</p>	<p>3375.6 0.58971 19.562 1.2081</p>	<p>352.62 10.28.0</p>	<p>364.31 469.80</p>	<p>1.9817 5.8593 94.190</p>
<p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) CF (FT/SEC) CF PEAE/M (SEC) AE/AT</p>	<p>3375.6 6044.8</p>	<p>1.7757 12.759 36.616</p>	<p>1.9391 5.6993 121.67</p>	<p>298.10</p>

CASE N4
BASIS: 100 GA PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.0000	200.0E-4
TEMPERATURE (KELVIN)	3375.6	1446.4	909.59	525.18
ENTHALPY (KILOCALORIES)	-16.010	-197.89	-187.62	-203.30
ENTROPY (CALORIES/DEGREE K)	312.45	312.45	312.45	312.45
HEAT CAPACITY (CAL/K)	58.971	50.650	44.342	39.743
MOLES OF GAS	5.1118	4.8343	4.8341	4.8341
MOLECULAR COMPOSITION				
H	0.0580	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0532	0.0000	0.0000	0.0000
H2	0.2322	0.0000	0.0000	0.0000
O2	0.0021	0.2314	0.2322	0.2322
OH	0.2658	0.0000	0.0000	0.0000
H2O	3.2314	3.0752	3.0756	3.0756
N2	0.1837	0.0257	0.0263	0.0263
NH2	0.0000	0.0000	0.0000	0.0000
NO	0.0852	0.0013	0.0000	0.0000

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CASE NZ
BASIS 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3277.2	1301.2	797.72	462.43
ENTHALPY (KILOCALORIES)	-15.287	-140.34	-160.37	-181.52
ENTROPY (CALORIE/DEGREE K)	226.70	290.79	290.79	296.79
HEAT CAPACITY (CAL/K)	55.392	46.956	40.943	37.139
MOLES OF GAS	4.8387	4.0460	4.0465	4.0465
MOLECULAR COMPOSITION				
H	0.0322	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0497	0.0000	0.0000	0.0000
H2	0.1237	0.0000	0.0000	0.0000
O2	0.4930	0.2679	0.2683	0.5683
OH	0.2252	0.0002	0.0000	0.0000
H2O	2.9416	3.2439	3.2440	3.2440
N2	0.7851	0.0338	0.0342	0.0342
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0080	0.0007	0.0000	0.0000

CASE N4
BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.0000	0.0000
TEMPERATURE (KELVIN)	2926.3	970.97	0.0000	0.0000
ENTHALPY (KILOCALORIES)	-13.795	-114.58	0.0000	0.0000
ENTROPY (CALORIES/DEG K)	262.27	262.27	0.0000	0.0000
HEAT CAPACITY (CAL/K)	47.959	38.450	1.0516	1.0516
MOLES OF GAS	4.2291	4.2226	0.0000	0.0000
MOLECULAR COMPOSITION				
H	0.0048	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0222	0.0000	0.0000	0.0000
H2	0.0214	0.0000	0.0000	0.0000
O2	0.0634	1.0516	1.0516	1.0516
OH	0.0645	0.0000	0.0000	0.0000
H2O	2.4551	2.2611	2.2611	2.2611
N2	0.0020	0.0000	0.0000	0.0000
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0957	0.0001	0.0000	0.0000

CASE NO.				
PROPELLANT COMPOSITION	WEIGHT%	MOLAR	DENSITY	REF. TEMP.
H2	20.000		710.0E-4	20.400
O2	56.000		1.142	90.200
N2	24.000		0.8080	77.400
INGREDIENT DATA:	FORMULA	HEAT OF FORM.		
H2	H2	-1.2970		
O2	O2	-3.0400		
N2	N2	-2.9000		
ATOMIC COMPOSITION(GM AT/100GM)				
H	19.6413			
N	1.7133			
O	3.5000			
PROPELLANT ENTHALPY	-26.594	KCAL/100 GM		
PROPELLANT DENSITY	0.2774	GM/CC		
CHAMBER	EXHAUST			
1000.0	2.000			
PRESSURE (PSI)				
SHIFTING EQUILIBRIA				
ISP (SEC)	372.24		394.82	401.47
IVSP(LB-SEC/CU IN)	3.7314		3.7578	4.0244
TEMPERATURE (K)	514.10		347.05	298.16
CP (CAL/GM-DEG.K)	0.80535		0.7572	0.73524
MOL. WT.-EFFECTIVE	9.2196		9.6832	10.987
CP/CV -EFFECTIVE	1.5601		1.5625	1.5660
CF -APPROX.	1.7106		1.6144	1.8449
PEAE/M (SEC)	12.702		7.7337	6.5654
AE/AT -APPROX.	29.324		177.70	1462.6
FROZEN EQUILIBRIA				
ISP (SEC)	27.90		390.63	390.63
TEMPERATURE (K)	504.22		298.16	298.16
CF* (FT/SEC)	1.7090		1.7951	1.7051
CF	12.643		7.1134	7.1134
PEAE/M (SEC)	20.950		162.45	1630.5
AE/AT				

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2211.4	514.10	347.05	298.16
ENTHALPY (KILOCALORIES)	-26.594	-182.84	-202.75	-211.83
ENTROPY (CALORIES/DEG.K)	500.88	500.88	500.38	527.86
HEAT CAPACITY (CAL/K)	104.10	80.535	75.572	73.524
MOLES OF GAS	10.770	10.730	10.118	9.9136
MOLECULAR COMPOSITION				
H	0.0060	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.4160	6.3479	3.4319	5.1250
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0005	0.0000	0.0000	0.0000
H2O	3.4995	3.2600	3.2000	0.0000
N2	0.0560	0.0331	0.0271	0.4048
NH3	0.0012	0.0472	0.0591	0.8437
NO	0.0000	0.0000	0.0000	0.0000

CASE N2									
PROPELLANT COMPOSITION		WEIGHT%		MOLAR					
H2		14.000							
O2		58.800							
N2		25.200							
INGREDIENT DATA:	FORMULA		HEAT OF FORM.		DENSITY	REF. TEMP.			
H2	H2		-1.8870		710.0E-4	90.400			
O2	O2		-3.0900		1.142	90.200			
N2	N2		-2.9000		0.0080	77.400			
ATOMIC COMPOSITION(GM AT/100GM)									
H		15.8730							
O		1.7090							
N		3.6750							
PROPELLANT ENTHALPY		-23.244	KCAL/100 GM						
PROPELLANT DENSITY		0.3246	GM/CC						
PRESSURE (PSI)		1000.0	EXHAUST CHAMBER	2.000	0.0117	LB/CU IN			
SHIFTING EQUILIBRIA					0.2000	EXHAUST	200.0E-4		
ISP (SEC)					400.55		413.15		
IVSP(LB-SEC/CU IN)					4.0983		4.8840		
TEMPERATURE (K)		2658.0			390.43		298.16		
CP (CAL/GM-DEG.K)		0.01382			0.60585		0.61617		
MOL. WT.-EFFECTIVE		11.292			11.461		12.193		
CP/CV -EFFECTIVE		1.2385			1.0594		1.03596		
CF -APPROX.					1.0485		1.09066		
PEAE/M (SEC)					7.0528		5.1173		
AE/AT -APPROX.					107.66		1180.6		
FROZEN EQUILIBRIA					390.33		403.31		
ISP (SEC)		2658.2			360.22		298.16		
TEMPERATURE (K)		6971.7							
C* (FT/SEC)									
CF									
PEAE/M (SEC)									
AE/AT									

WADD TN 60-254

CASE Nz
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2628.2	679.63	390.43	298.16
ENTHALPY (KILOCALORIES)	-23.244	-180.82	-207.64	-219.41
ENTROPY (CALORIES/DEG.K)	440.68	440.68	446.68	450.60
HEAT CAPACITY (CAL/K)	91.382	62.271	63.585	61.617
MOLES OF GAS	8.6558	8.6543	8.7251	8.2716
MOLECULAR COMPOSITION:				
H	0.0332	0.0600	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0600	0.0000	0.0000
H2	4.2481	4.2590	4.0951	3.3799
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0071	0.0000	0.0000	0.0000
H2O	3.6676	3.6750	3.6750	3.6750
N2	0.0991	0.0987	0.0440	0.5823
NH3	0.0004	0.0016	0.1109	0.6744
NO	0.0002	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST I	EXHAUST	EXHAUST
PRESSURE (PSIA)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3097.8	947.88	542.61	541.35
ENTHALPY (KILOCALORIES)	-20.128	-189.24	-209.71	-222.01
ENTROPY (CALORIES/DEG.K)	392.16	392.16	392.16	392.16
HEAT CAPACITY (CAL/K)	78.262	60.771	55.300	52.395
MOLES OF GAS	7.1176	7.0296	7.0288	6.9110
MOLECULAR COMPOSITION:				
F	0.1019	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0017	0.0000	0.0000	0.0000
H2	2.2415	2.2518	2.2596	2.0738
O2	0.0012	0.0000	0.0000	0.0000
OH	0.0640	0.0000	0.0000	0.0000
H2O	3.7668	2.8374	3.0394	3.8594
N2	0.7561	0.7384	0.7330	0.8790
NH3	0.0001	0.0000	0.0008	0.1187
NO	0.0044	0.0000	0.0000	0.0000

WADD TN 60-254

CASE NZ
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3338.8	1208.3	724.50	411.54
ENTHALPY (KILOCALORIES)	-18.210	-161.58	-207.35	-222.10
ENTROPY (CALORIE/DEG.K)	350.20	356.27	350.29	356.29
HEAT CAPACITY (CAL/K)	60.531	57.527	49.950	46.726
MOLES OF GAS	6.1200	5.9240	5.7240	5.9230
MOLECULAR COMPOSITION:				
H	0.1272	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0123	0.0000	0.0000	0.0000
H2	1.1187	1.0928	1.0228	1.0213
O2	0.0164	0.0000	0.0000	0.0000
OH	0.1254	0.0000	0.0000	0.0000
H2O	3.6852	3.7375	3.7375	3.9375
N2	0.9531	0.9637	0.9637	0.9632
NH3	0.0000	0.0000	0.0000	0.0010
NO	0.0213	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2005.7	474.13	342.88	295.16
ENTHALPY (KILOCALORIES)	-26.624	-175.32	-194.34	-196.57
ENTROPY (CALORIES/DEG.K)	490.95	496.96	490.98	529.16
HEAT CAPACITY (CAL/K)	103.12	80.452	74.994	73.465
MOLES OF GAS	10.020	10.789	10.030	0.9188
MOLECULAR COMPOSITION:				
H	0.0026	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.0568	6.4739	5.0358	5.2138
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0001	0.0000	0.0000	0.0000
H2O	3.2498	3.2500	3.2500	3.2500
N2	0.0985	0.0338	0.0545	0.0518
NH3	0.0015	0.1312	0.0899	0.09712
NO	0.0000	0.0000	0.0000	0.0000

CASE NO							
PROPELLANT COMPOSITION	WEIGHT*	MOLAR					
H2	16.000						
O2	54.400						
N2	29.400						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.			DENSITY	REF. TEMP.	
H2		-1.6870			710.0E-4	20.400	
O2		-3.0800			1.142	90.200	
N2		-2.7900			0.0080	77.400	
ATOMIC COMPOSITION(GM AT/100GM)							
H	15.6730						
N	2.0980						
O	3.4125						
PROPELLANT ENTHALPY	-23.275	KCAL/100 GM					
PROPELLANT DENSITY	0.2230	GM/CC					
	CHAMBER	EXHAUST			0.0117	LB/CC IN	
	1000.00	2.000			0.2000	EXHAUST	200.0E-4
PRESSURE (PSI)							
SHIFTING EQUILIBRIA							
ISP (SEC)							
IVSP(LB-SEC/CC IN)							
TEMPERATURE (K)	2473.4						
CP (CAL/GM-DEG.K)	0.00680						
MOL. WT.-EFFECTIVE	11.117						
CP/CV -EFFECTIVE	1.2455						
CF -APPROX.							
PEAE/M (SEC)							
AE/AT -APPROX.							
FROZEN EQUILIBRIA							
ISP (SEC)							
TEMPERATURE (K)	2473.4						
CF (FT/SEC)	6769.7						
CF							
PEAE/M (SEC)							
AE/AT							

WADD TN 60-254

CASE N2
 BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.00	2.0000	0.2000	200.00E-4
TEMPERATURE (KELVIN)	2173.4	609.67	370.42	298.16
ENTHALPY (KILOCALORIES)	-23.276	-170.29	-190.43	-200.23
ENTROPY (CALORIES/DEGREE K)	440.90	440.79	440.99	450.25
HEAT CAPACITY (CAL/K)	90.686	69.035	65.340	61.887
MOLES OF GAS	8.9050	6.7804	8.7254	8.2617
MOLECULAR COMPOSITION:				
H	0.0172	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	4.0154	4.0157	4.0132	3.4377
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0027	0.0000	0.0000	0.0000
H2O	3.0097	3.0120	3.0125	3.0405
N2	1.0490	1.0460	0.07191	0.6873
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0001	0.0000	0.0000	0.0000

WADD TN 60-254

CASE NZ
 BASIS: 1.0 GM PROPELLANT

PRESSURE (PSI)
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEGREE-K)
 HEAT CAPACITY (CAL/K)
 MOLES OF GAS

MOLECULAR COMPOSITION:

H
 N
 O
 H2
 O2
 OH
 H2O
 H2
 NH2
 NO

CHAMBER	EXHAUST	EXHAUST	EXHAUST
1000.0	2.000	200.05-4	0.0000
2070.8	862.16	309.84	0.0000
-19.026	-175.08	-206.62	2.0225
320.45	380.42	386.42	0.0000
74.037	59.120	51.501	0.0000
7.1084	7.0415	6.8172	0.0000
0.0723	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000
0.0007	0.0000	0.0000	0.0000
2.2632	2.2772	2.0225	0.0000
0.0004	0.0000	0.0000	0.0000
0.0767	0.0000	0.0000	0.0000
3.2344	3.2750	3.5750	0.0000
1.0080	1.0925	0.9821	0.0000
0.0002	0.0001	0.2346	0.0000
0.0024	0.0000	0.0000	0.0000

CASE NO					
PROPELLANT COMPOSITION	WEIGHT%	MOLE%			
H2	10.000				
O2	59.500				
N2	31.500				
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.	
H2	H2	-1.0870	710.0E-4	20.000	
O2	O2	-3.0400	1.142	90.000	
N2	N2	-2.9000	0.0080	77.000	
ATOMIC COMPOSITION(GM AT/100GM)					
H		9.9206			
N		2.2487			
O		3.6562			
PROPELLANT ENTHALPY	-18.251	KCAL/100 GM			
PROPELLANT DENSITY	0.4724	GM/CC			
	CHAMBER	EXHAUST			
PRESSURE (PSI)	1000.0	2.000			
SHIFTING EQUILIBRIA					
ISP (SEC)		300.02	392.07	407.43	
IVSP(LB-SEC/CU IN)		5.7320	6.1454	6.3709	
TEMPERATURE (K)		1066.1	622.81	351.75	
CP (CAL/GM-DEG.K)		0.69464	0.42337	0.46476	
MOL. WT.-EFFECTIVE		16.106	16.435	16.478	
CP/CJ -EFFECTIVE		1.2160	1.2246	1.3704	
.CF -APPROX.		1.0162	1.0470	2.0187	
PEAE/M (SEC)		33.297	40.485	4.5207	
AE/AT -APPROX.		37.897	200.33	1122.2	
FROZEN EQUILIBRIA					
ISP (SEC)		350.19	384.69	392.18	
TEMPERATURE (K)		913.17	402.59	305.43	
CJ* (FT/SEC)					
CF		1.7649	1.9061	1.9481	
PEAE/M (SEC)		14.214	6.4963	4.1700	
AE/AT		35.214	100.24	1033.1	

CASE Nz
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	3222.0	1906.1	622.81	351.75
ENTHALPY (KILOCALORIES)	-18.251	-174.72	-192.82	-209.03
ENTROPY (CALORIES/DEG.K)	352.51	352.51	352.51	352.51
HEAT CAPACITY (CAL/K)	60.464	55.129	49.337	46.476
MOLES OF GAS	6.2082	6.2082	6.2082	6.2082
MOLECULAR COMPOSITION				
H	0.1037	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0051	0.0000	0.0000	0.0000
H2	1.2750	1.2740	1.2039	1.2798
O2	0.0055	0.0000	0.0000	0.0000
OH	0.1117	0.0000	0.0000	0.0000
H2O	3.2166	3.0362	3.0562	3.0562
N2	1.1152	1.1244	1.1243	1.1163
NH3	0.0001	0.0000	0.0001	0.0041
NO	0.0114	0.0000	0.0000	0.0000

<p>CASE NO</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>ATOMIC COMPOSITION (GM AT/100GM)</p> <p>H</p> <p>O</p> <p>C</p> <p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p> <p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP (LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT -APPROX.</p> <p>FFOZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF*</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>WEIGHT%</p> <p>8.5000</p> <p>59.480</p> <p>32.020</p> <p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0800</p> <p>-2.7000</p> <p>HEAT OF FORM.</p> <p>KCAL/100 GM</p> <p>GM/CC</p> <p>EXHAUST</p> <p>2.000</p> <p>1000.0</p> <p>3341.0</p> <p>0.65560</p> <p>17.015</p> <p>1.2114</p> <p>-</p> <p>-</p> <p>-</p> <p>3341.0</p> <p>62/0.0</p>	<p>MOLAR</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0030</p> <p>EXHAUST</p> <p>2.000</p> <p>354.00</p> <p>6.2202</p> <p>1275.9</p> <p>0.52400</p> <p>15.660</p> <p>1.2491</p> <p>-0.0622</p> <p>10.241</p> <p>41.610</p> <p>549.77</p> <p>1010.0</p> <p>1.7717</p> <p>14.095</p> <p>30.115</p>	<p>DENSITY</p> <p>REF. TEMP.</p> <p>0.0171 LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>200.0E-4</p> <p>392.55</p> <p>6.7076</p> <p>775.25</p> <p>0.40285</p> <p>18.660</p> <p>1.2989</p> <p>2.0113</p> <p>9.1629</p> <p>234.76</p> <p>370.65</p> <p>457.10</p> <p>1.9605</p> <p>3.7953</p> <p>969.79</p>
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CASE N2
 BASIS: 1.0 GM PROPULSANT

PRESSURE (PSI)
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEGREE K)
 HEAT CAPACITY (CAL/K)
 MOLES OF GAS

MOLECULAR COMPOSITION:

CHARB	EXHAUST	EXHAUST	EXHAUST	EXHAUST
1000.0	2.000	0.2000	200.0E-4	0.0000
3341.3	1275.9	770.25	445.78	0.0000
-14.090	-112.27	-194.07	-208.73	0.0000
331.12	334.12	334.12	331.12	0.0000
67.564	53.400	46.285	42.426	0.0000
5.2020	5.2572	5.2592	5.2590	0.0000
0.0054	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0173	0.0000	0.0000	0.0000	0.0000
0.0784	0.4988	0.4935	0.4986	0.0000
0.0757	0.0000	0.0000	0.0000	0.0000
0.2111	0.0000	0.0000	0.0000	0.0000
3.2846	3.7175	3.7175	3.7175	0.0000
1.1260	1.1429	1.1429	1.1428	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0739	0.0000	0.0000	0.0000	0.0000

CASE: N2
 CASE: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.00E-4
TEMPERATURE (MELVIN)	1521.9	402.31	36.33	298.16
ENTHALPY (KILOCALORIES)	-31.146	-164.20	-103.71	-176.10
ENTROPY (CALORIES/DEGREE K)	553.95	553.95	553.95	635.65
HEAT CAPACITY (CAL/K)	110.21	93.579	84.038	90.162
MOLES OF GAS	13.641	12.557	11.099	12.352
MOLECULAR COMPOSITION:				
H	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0010	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	9.7725	8.1461	6.7030	7.6383
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	2.7987	2.7985	2.7989	2.7986
N2	1.0611	0.5190	0.0096	0.4164
NH3	0.0087	1.0930	2.0017	1.2982
NO	0.0000	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.0000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	1772.1	429.83	331.17	298.16
ENTHALPY (KILOCALORIES)	-27.966	-164.51	-123.18	-182.76
ENTROPY (CALORIES/DEGREE K)	51.70	51.70	51.70	51.24
HEAT CAPACITY (CAL/K)	100.28	84.200	77.884	78.520
MOLES OF GAS	11.816	11.524	10.894	10.663
MOLECULAR COMPOSITION				
H	0.0004	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	7.7524	7.0158	5.6000	6.0245
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	2.7412	2.9412	2.7412	2.9412
N2	1.1179	0.6722	0.6070	0.5416
NH3	0.0037	0.4949	1.4754	1.1558
NO	0.0000	0.0000	0.0000	0.0000

<p>LAKE N2 PROPELLANT COMPOSITION H2 O2 N2</p>	<p>WEIGHT%</p>	<p>INULAR</p>	<p>REF. TEMP.</p>
	16.670		20.400
	50.000		90.200
	33.330		77.400
<p>INGREDIENT DATA: H2 O2 N2</p>	<p>FORMULA</p>	<p>HEAT OF FORM.</p>	<p>DENSITY</p>
	H2	-1.0870	710.0E-4
	O2	-3.0800	1.142
	N2	-2.7000	0.8080
<p>ATOMIC COMPOSITION (GM AT/100GM) H N O</p>	<p>WEIGHT%</p>	<p>HEAT OF FORM.</p>	<p>DENSITY</p>
	16.5377		0.0113
	2.5794		0.2000
	3.1250		0.0113
<p>PROPELLANT ENTHALPY</p>	<p>KCAL/100 GM</p>	<p>EXHAUST</p>	<p>EXHAUST</p>
	-23.866		200.0E-4
<p>PROPELLANT DENSITY</p>	<p>GM/CC</p>	<p>EXHAUST</p>	<p>EXHAUST</p>
	0.5127		0.0113
	1000.0		0.2000
<p>PRESSURE (PSI)</p>	<p>CHAMBER</p>	<p>EXHAUST</p>	<p>EXHAUST</p>
	1000.0		0.0113
<p>SHIFTING EQUILYBRIA ICP (SPS) IVSPILAT-SEC/CC IN) TEMPERATURE (K) CP (CAL/AM-DEG.K) MOL. WT. -EFFECTIVE CS/CM -EFFECTIVE CF -APPROX. PTAF/M (SEC) AE/AT -APPROX.</p>	<p>CHAMBER</p>	<p>EXHAUST</p>	<p>EXHAUST</p>
	2200.1		0.0113
	0.91958		0.2000
	10.570		0.0113
	1.2570		0.2000
			0.0113
			0.2000
			0.0113
			0.2000
<p>PROZEN EQUILYBRIA ICP (SEC) TEMPERATURE (K) CA (FT/SEC) CF PEAF/M (SEC) AE/AT</p>	<p>CHAMBER</p>	<p>EXHAUST</p>	<p>EXHAUST</p>
	2200.1		0.0113
	6500.2		0.2000
			0.0113
			0.2000
			0.0113
			0.2000
			0.0113
			0.2000
			0.0113
			0.2000

WADD TN 60-254

CASE NZ

BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2200.1	521.47	353.47	296.16
ENTHALPY (KILOCALORIES)	-23.866	-160.85	-183.20	-190.17
ENTROPY (CALORIE/DEGREE K)	447.70	447.70	447.70	468.21
HEAT CAPACITY (CAL/K)	91.954	70.901	66.440	64.073
MOLES OF GAS	9.4604	9.4216	8.0040	8.0036
MOLECULAR COMPOSITION:				
H	0.0056	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	5.1396	5.0834	4.2370	3.8464
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0005	0.0000	0.0000	0.0000
H2O	3.4245	3.4250	3.4250	3.1250
N2	1.4491	1.4712	0.3074	0.7572
NH3	0.0011	0.0309	0.3445	0.8649
NO	0.0000	0.0000	0.0000	0.0000

CASE	N2								
PROPELLANT COMPOSITION		WEIGHT%		MOULAR		DENSITY		REF. TEMPO	
H2		13.790		-1.0870		710.000-4		20.400	
O2		51.730		-3.0800		1.142		90.200	
N2		34.480		-2.9000		0.8080		77.400	
INGREDIENT DATA:		FORMULA		HEAT OF FORM.					
H2		H2							
O2		O2							
N2		N2							
ATOMIC COMPOSITION(GM AT/100GM)									
H			13.0806						
N			2.4614						
O			3.2331						
PROPELLANT ENTHALPY			-21.456	KCAL/100 GM					
PROPELLANT DENSITY			0.2544	GM/CC					
CHAMBER									
1000.0									
PRESSURE (PSI)									
SHIFTING EQUIP (BRIA)									
ISP (SEC)									
IVSP(LA-SEC/OU IN)									
TEMPERATURE (K)			2501.3						
CP (CAL/GM-DEG.K)			0.82658						
MOL. WT. EFFECTIVE			12.371						
CP/CM EFFECTIVE			1.2412						
CF -APPROX.									
PERFORM (SEC)									
AE/AF -APPROX.									
FROZEN EQUIP (BRIA)									
ISP (SEC)									
TEMPERATURE (K)			2501.3						
CP (BT/SEC)			6527.8						
CF									
PERFORM (SEC)									
AE/AF									

CASE N2
 GASTS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.010	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2501.3	649.68	351.24	295.16
ENTHALPY (KILOCALORIES)	-21.456	-155.44	-182.66	-193.84
ENTROPY (CALORIE/DEGREE K)	410.30	410.30	410.30	415.06
HEAT CAPACITY (CAL/IN)	80.658	62.809	50.814	55.010
MOLES OF GAS	3.0834	8.0655	7.9130	7.4394
MOLECULAR COMPOSITION				
H	0.0213	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
M2	3.0981	3.0034	3.3777	2.6596
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0044	0.0000	0.0000	0.0000
M2U	3.2286	3.2331	3.2331	3.2331
N2	1.2304	1.2295	1.1542	0.9150
NH3	0.0005	0.0025	0.1730	0.6315
NO	0.0002	0.0000	0.0000	0.0000

WADD TN 60-254

CASE NZ
 CASE: 100 GR PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.0E-4
TEMPERATURE (KELVIN)	2804.4	804.61	454.31	303.42
ENTHALPY (KILOCALORIES)	-19.539	-164.49	-103.94	-195.25
ENTROPY (CALORIES/DEGREE K)	377.12	377.12	377.12	377.12
HEAT CAPACITY (CAL/K)	74.754	47.166	53.71	50.069
MOLES OF GAS	7.0044	4.9677	6.9778	6.6334
MOLECULAR COMPOSITION				
H	0.0504	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0003	0.0000	0.0000	0.0000
H2	2.3729	1.5852	2.3704	1.6839
O2	0.0002	0.0000	0.0000	0.0000
OH	0.0214	0.0800	0.0000	0.0000
H2O	3.2952	3.2187	3.2187	3.3187
N2	1.2627	1.2634	1.2685	1.0963
NH3	0.0002	0.0002	0.0002	0.0002
NO	0.0014	0.0000	0.0000	0.0000

CASE	N2								
PROPELLANT COMPOSITION									
H2		WEIGHT%		MULAR					
O2		9.0900							
N2		54.550							
		36.360							
INGREDIENT DATA									
H2		FORMULA		HEAT OF FORM.		DENSITY		REF. TEMP.	
O2				-1.0870		710.0		-4	20.400
N2				-3.0800		1.142			90.200
				-2.9000		0.8880			77.400
ATOMIC COMPOSITION(GR AT/100GM)									
H			9.0176						
O			2.0956						
N			3.4094						
PROPELLANT ENTHALPY									
			-17.522	KCAL/100 GM					
PROPELLANT DENSITY									
			0.4529	GM/CC					
PRESSURE (PSI)									
SHOOTING EQUIPMENT									
			1000.0	EXHAUST					
						0.0164	LB/CC	IN	
								EXHAUST	
						0.2000			200.0E-4
			354.48			578.72			395.43
			5.0988			6.2.35			4.4379
			1026.2			602.76			341.22
			0.52206			0.40669			0.44142
			17.221			17.022			17.289
			1.2838			1.3875			1.3521
			1.01.3			1.9009			2.0110
			14.679			7.8004			4.3370
			37.515			200.00			1108.4
PROGRAM EQUILIBRIA									
			342.09			372.03			380.82
			927.51			467.70			290.75
			3101.9			1.9016			1.9465
			6274.6			6.4056			4.0096
						104.22			1024.7

CASE NZ
 CASES: 100 GM PROPELLANT

	CHAMBER	FVHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	1000.0	2.000	0.2000	200.00E-4
TEMPERATURE (KELVIN)	3181.9	1006.2	63.76	341.22
ENTHALPY (KILOCALORIES)	-17.522	-161.35	-103.23	-195.41
ENTROPY (CALORIES/DEGREE K)	340.00	340.00	340.00	340.00
HEAT CAPACITY (CAL/K)	65.847	52.206	46.759	44.142
MOLES OF GAS	5.7118	5.6067	5.6066	5.7840
MOLECULAR COMPOSITION				
H	0.0836	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0042	0.0000	0.0000	0.0000
H2	1.1319	1.0935	1.0934	1.0654
O2	0.0050	0.0000	0.0000	0.0000
OH	0.0065	0.0000	0.0000	0.0000
H2O	3.2870	3.4094	3.4094	3.4094
N2	1.4920	1.4978	1.4978	1.4965
NH3	0.0001	0.0000	0.0001	0.0027
NO	0.0116	0.0000	0.0000	0.0000

Contrails

DATA B

CHAMBER PRESSURE 500 psia

EXHAUST PRESSURES 0.5, 0.05, and 0.005 psia

<p>CASE</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H</p> <p>C</p> <p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p> <p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. #1-EFFECTIVE</p> <p>CP/CV-EFFECTIVE</p> <p>CF-APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT-APPROX.</p> <p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>H</p> <p>C</p> <p>-34.818</p> <p>0.2067</p> <p>CHAMBER</p> <p>500.0</p> <p>KCAL/100 GM</p> <p>EXHAUST</p> <p>0.5000</p> <p>29.7619</p> <p>4.5750</p> <p>EXHAUST</p> <p>2005.7</p> <p>1.5968</p> <p>6.7187</p> <p>1.2686</p> <p>11.265</p> <p>45.709</p> <p>2005.7</p> <p>7920.4</p>	<p>WEIGHT%</p> <p>30.000</p> <p>70.000</p> <p>HEAT OF FORM.</p> <p>-1.9870</p> <p>-3.0800</p> <p>EXHAUST</p> <p>0.5000</p> <p>427.30</p> <p>3.1909</p> <p>374.14</p> <p>1.0880</p> <p>6.7200</p> <p>1.5730</p> <p>1.7338</p> <p>11.265</p> <p>45.709</p> <p>427.07</p> <p>372.50</p> <p>1.7328</p> <p>11.954</p> <p>45.664</p>	<p>MOLAR</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>EXHAUST</p> <p>500.0E-4</p> <p>0.007 LB/CU IN</p> <p>EXHAUST</p> <p>50.00E-4</p> <p>435.58</p> <p>3.2527</p> <p>298.16</p> <p>1.0715</p> <p>6.7200</p> <p>1.3912</p> <p>1.7674</p> <p>4.9067</p> <p>357.34</p> <p>432.28</p> <p>298.16</p> <p>1.7662</p> <p>4.0144</p> <p>357.62</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p>
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WADD TN 60-254

CASE
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	EXHAUST
TEMPERATURE (KELVIN)	2065.7	374.14	290.16	50.00E-4
ENTHALPY (KI-CALORIES)	-34.818	-244.66	-252.87	298.16
ENTROPY (CALORIES/DEG.K)	667.64	647.62	711.22	-252.87
HEAT CAPACITY (CAL/K)	139.68	100.85	107.15	779.31
MOLES OF GAS	14.884	14.881	14.881	107.15
MOLECULAR COMPOSITION:				14.881
H	0.0054	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
N2	10.5034	10.5060	10.5060	10.5060
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	4.3747	4.3750	4.3750	0.0000
				4.3750

CASE					
PROPELLANT COMPOSITION	WEIGHT%	MOLAR			
H2	35.000				
O2	65.000				
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.	
H2	H2	-1.8870	710.0E-4	20.400	
O2	O2	-3.0900	1.142	90.200	
ATOMIC COMPOSITION(GM AT/100GM)					
H	74.7222				
O	4.0625				
PROPELLANT ENTHALPY	-39.017	KCAL/100 GM			
PROPELLANT DENSITY	0.1818	GM/CC			
	CHAMBER	EXHAUST	0.006	LB/CU IN	
PRESSURE (PSI)	500.0		500.0E-4	50.00E-4	
SHIFTING EQUILIBRIA					
ISP (SEC)			412.75	412.75	
IVSP(LB-SEC/CU IN)			2.7120	2.7120	
TEMPERATURE (K)	1724.7		298.16	298.16	
CP (CAL/GM-DEG.K)	1.2262		1.2381	1.2381	
MOL. WT.-EFFECTIVE	5.7590		5.7600	5.7600	
CP/CV -EFFECTIVE	1.2921		1.2865	1.2865	
CF -APPROX.			1.7080	1.7080	
PEAE/M (SEC)			10.843	10.843	
AE/AT -APPROX.			44.870	44.870	
FROZEN EQUILIBRIA					
ISP (SEC)	1724.7		412.72	412.72	
TEMPERATURE (K)	7774.8		298.16	298.16	
C* (FT/SEC)					
CF			1.7079	1.7079	
PEAE/M (SEC)			10.844	10.844	
AE/AT			44.874	44.874	

WADD TN 60-254

CASE
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	1724.7	298.16	298.16	298.16
ENTHALPY (KILOCALORIES)	-39.017	-234.81	-234.81	-234.81
ENTROPY (CALORIES/DEG-K)	729.43	730.71	815.16	892.60
HEAT CAPACITY (CAL/K)	152.62	125.81	125.81	123.81
MOLES OF GAS	17.361	17.361	17.361	17.361
MOLECULAR COMPOSITION:				
H	0.0005	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	13.2984	13.2986	13.2986	13.2986
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	4.0625	4.0625	4.0625	4.0625

WADD TN 60-254

CASE N2
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.07-4	50.000E-4
TEMPERATURE (KELVIN)	319.9	1278.3	731.88	451.63
ENTHALPY (KILOCALORIES)	-20.001	-229.99	-259.74	-277.45
ENTROPY (CALORIES/DEG.K)	409.95	409.95	409.95	403.05
HEAT CAPACITY (CAL/K)	79.419	63.900	59.008	51.396
MOLES OF GAS	6.0285	6.4043	6.4043	6.4043
MOLECULAR COMPOSITION				
H	0.2576	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0409	0.0000	0.0000	0.0000
H2	1.2873	1.1569	1.1569	1.1568
O2	0.0526	0.0000	0.0000	0.0000
OH	0.3797	0.0000	0.0000	0.0000
H2O	4.2852	4.2344	4.2344	4.2344
N2	0.2015	0.2130	0.2130	0.2130
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0230	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N4
 BASIS: 100 Gm PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0	50.00E-4
TEMPERATURE (KELVIN)	3350.0	1075.8	514.71	357.70
ENTHALPY (KILOCALORIES)	-21.263	-232.72	-251.20	-277.04
ENTROPY (CALORIES/DEGREE K)	427.05	427.05	427.05	429.05
HEAT CAPACITY (CAL/K)	64.408	65.822	55.860	55.363
MOLES OF GAS	7.4497	7.4480	7.4473	7.4453
MOLECULAR COMPOSITION:				
H	0.2631	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0192	0.0000	0.0000	0.0000
H2	2.0526	1.7909	1.7903	1.9569
O2	0.0172	0.0000	0.0000	0.0000
OH	0.2555	0.0000	0.0000	0.0000
H2O	4.0282	4.0404	4.0494	4.0494
N2	0.0016	0.0077	0.0077	0.0064
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0121	0.0000	0.0000	0.0000

Contrails

WADD TN 60-254

CASE	N4								
PROPELLANT COMPOSITION		WEIGHT%		HULAK					
H2		15.250		-1.9870					
O2		76.270		-3.0800					
N2		8.4800		-2.7000					
IGNITION DATA:		FORMULA	HEAT OF FORM.		DENSITY	REF. TEMPO			
H2	H2				710.00E-4	20.400			
O2	O2				1.142	40.200			
N2	N2				0.8080	77.400			
ATOMIC COMPOSITION(GM AT/100GM)									
H		15.1290							
O		6.6054							
N		4.7669							
PROPELLANT ENTHALPY		-22.493	KCAL/100 GM						
PROPELLANT DENSITY		0.5424	GM/CC	EXHAUST	0.0124	EXHAUST			
		500.0	CHAMBER	EXHAUST	500.00E-4	EXHAUST			
PRESSURE (PSI)									
EXITING EQUILIBRIA									
ISP (SEC)									
IVSP(CAL/SEC/CG IN)									
TEMPERATURE (K)		3211.0			455.83	469.48			
GE (CAL/GM-DEG.K)		0.90046			5.0787	5.8777			
MOL. WT. EFFECTIVE		12.378			531.63	304.16			
CP/CG -EFFECTIVE		1.4170			0.62393	0.59279			
CF -APPROX.					12.711	12.800			
PEAF/M (SEC)					1.2743	1.3546			
AE/AT -APPROX.					1.8839	2.0434			
FROZEN EQUILIBRIA					7.8727	4.5737			
ISP (SEC)					342.26	1903.6			
TEMPERATURE (K)		3211.0							
CP (BT/SEC)		7392.3			442.39	445.69			
CF					342.30	298.16			
PEAF/M (SEC)									
AE/AT					1.8276	1.9398			
					5.4456	4.6706			
					237.01	2033.7			

WADD TN 60-254

CASE N4
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	3211.0	925.40	531.63	304.16
ENTHALPY (KILOCALORIES)	-22.493	-235.40	-261.28	-275.81
ENTROPY (CALORIES/DEG K)	454.66	454.66	452.66	452.66
HEAT CAPACITY (CAL/K)	90.048	68.378	63.893	59.279
MOLES OF GAS	8.0788	7.8672	7.8670	7.8386
MOLECULAR COMPOSITION				
H	0.4344	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0078	0.0000	0.0000	0.0000
H2	2.7830	2.7975	2.7973	2.7998
O2	0.0053	0.0000	0.0000	0.0000
OH	0.1568	0.0000	0.0000	0.0000
H2O	4.2858	4.7649	4.7553	4.7549
N2	0.4997	0.2007	0.2025	0.2734
NH3	0.0000	0.0000	0.0000	0.0582
NO	0.0059	0.0000	0.0000	0.0000

CASE	N2								
PROPELLANT COMPOSITION		WEIGHT%		MOLAR					
H2		16.670							
O2		75.000							
N2		8.330							
INGREDIENT DATA:		FORMULA		HEAT OF FORM.		DENSITY		REF. TEMP.	
H2		H2		-1.5870		710.0E-4		20.400	
O2		O2		-3.0800		1.142		90.200	
N2		N2		-2.3000		0.8080		77.400	
ATOMIC COMPOSITION(GM AT/100GM)									
H				16.6377					
N				0.2947					
O				4.0875					
PROPELLANT ENTHALPY				-23.684	KCAL/100 GM				
PROPELLANT DENSITY				0.2218	GM/CC				
CHAMBER				EXHAUST					
CHAMBER				0.5000					
PRESSURE (PSI)				50.00					
SHIFTING EQUILIBRIA									
ISP (SEC)				430.24					
IVSP(LB-SEC/CU IN)				5.0019					
TEMPERATURE (K)				809.12					
CP (CAL/GM-DEG.K)				0.71177					
MOL. WT. EFFECTIVE				11.674					
CP/CV EFFECTIVE				1.2113					
CF -APPROX.				1.8444					
PEAK/M (SEC)				12.926					
AE/AT -APPROX.				59.709					
FROZEN EQUILIBRIA									
ISP (SEC)				412.11					
TEMPERATURE (K)				724.17					
G* (FT/SEC)				307.9					
CF				7505.0					
PEAK/M (SEC)				1.1957					
AE/AT				13.012					
				55.704					

WADD TN 60-254

CASE N2
 CARIS: 140 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	EXHAUST
TEMPERATURE (KELVIN)	3077.9	809.12	450.15	20.00E-4
ENTHALPY (KILOCALORIES)	-23.684	-250.42	-260.64	296.16
ENTROPY (CALORIES/DEGREE-K)	470.06	470.06	470.06	-272.09
HEAT CAPACITY (CAL/K)	95.362	71.177	66.53	462.91
MOLES OF GAS	8.7119	8.0661	8.0646	75.657
MOLECULAR COMPOSITION				8.4613
H	0.4892	0.0010	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0029	0.0070	0.0000	0.0000
H2	3.0405	3.0813	3.0730	3.4240
O2	0.0015	0.0000	0.0000	0.0000
OH	0.0902	0.0000	0.0000	0.0000
H2O	4.0885	4.0875	4.0875	4.6875
N2	0.2959	0.2973	0.2965	0.2449
NH3	0.0001	0.0000	0.0015	0.1049
NO	0.0027	0.0000	0.0000	0.0000

WADD TN 60-254

CASE NZ
 BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2503.7	543.34	527.91	298.16
ENTHALPY (KILOCALORIES)	-27.796	-234.70	-253.50	-256.89
ENTROPY (CALORIES/DEGREE-K)	548.33	540.33	548.33	593.34
HEAT CAPACITY (CAL/K)	112.58	53.802	79.636	79.549
MOLES OF GAS	11.009	10.976	10.713	10.808
MOLECULAR COMPOSITION:				
H	0.0510	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.2601	5.2928	5.5907	6.0310
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0054	0.0000	0.0000	0.0000
H2O	4.4033	4.4119	4.4119	4.4119
N2	0.2797	0.2782	0.1478	0.1943
NH3	0.0002	0.0002	0.2648	0.1710
NO	0.0001	0.0000	0.0000	0.0000

CASE N= BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2252.4	431.30	298.16	298.16
ENTHALPY (KILOCALORIES)	-30.884	-200.90	-240.28	-244.95
ENTROPY (CALORIES/DEGREE)	601.17	601.17	610.27	670.55
HEAT CAPACITY (CAL/K)	124.27	94.990	90.355	91.955
MOLES OF GAS	12.857	12.781	12.340	12.645
MOLECULAR COMPOSITION:				
H	0.0120	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	0.0000	0.0000	0.0000	0.0000
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	4.1972	4.1981	4.1981	4.1981
N2	0.2661	0.2317	0.0112	0.1627
NH3	0.0004	0.0692	0.0102	0.2072
NO	0.0000	0.0000	0.0000	0.0000

CASE	N2	MIX AR			
PROPELLANT COMPOSITION					
H2					
O2					
N2					
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.	
H2		-1.0870	710.0E-4	20.400	
O2		-3.0800	1.142	90.200	
N2		-2.7000	0.0030	77.400	
ATOMIC COMPOSITION(GM AT/100GM)					
H		7.2512			
O		0.9916			
N		4.9187			
PROPELLANT ENTHALPY		-15.048	0.0190	LB/CU IN	
PROPELLANT DENSITY		0.0250	EXHAUST	EXHAUST	
		CHARGE	500.0E-4	50.00E-4	
			0.5000		
PRESSURE (PSI)		500.0			
SHIFTING EQUILIBRIA					
ISP (SEC)			391.99	400.76	
IVSP(LB-SEC/CU IN)			6.7425	7.7157	
TEMPERATURE (K)			1971.05	465.05	
CP (CAL/GM-DEG.K)			0.40934	0.38782	
MOI. WT.-EFFECTIVE			20.964	20.964	
CP/CV -EFFECTIVE			1.2417	1.3256	
CF -APPROX.			1.9681	2.1973	
PE/PM (SEC)			14.625	4.7796	
AE/AT -APPROX.			78.657	2548.7	
FROZEN EQUILIBRIA					
ISP (SEC)			330.44	367.36	
TEMPERATURE (K)			845.70	298.16	
C* (FT/SEC)			3315.1	1.9755	
CF			5983.1	3.5796	
PL/EN (SEC)			1.0200	1921.9	
AE/AT			11.281		
			60.604		

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.0000	500.0E-4	0.000E-4
TEMPERATURE (KELVIN)	3315.1	1291.5	790.80	465.23
ENTHALPY (KILOCALORIES)	-15.048	-149.89	-192.50	-206.10
ENTROPY (CALORIES/DEGREE K)	316.58	310.28	310.58	318.58
HEAT CAPACITY (CAL/K)	59.703	48.939	42.819	38.782
MOLES OF GAS	5.1019	4.7920	4.7930	4.7930
MOLECULAR COMPOSITION:				
H	0.0664	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0854	0.0000	0.0000	0.0000
H2	0.2057	0.0000	0.0000	0.0000
O2	0.0442	0.0012	0.0016	0.0016
OH	0.4517	0.0000	0.0000	0.0000
H2O	3.2100	3.0724	3.0756	3.6756
N2	0.4547	0.4955	0.4958	0.4958
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0822	0.0000	0.0000	0.0000

CASE	Nz								
PROPELLANT COMPOSITION		WEIGHT%	MIXAR						
H2		9.0900							
O2		77.270							
N2		13.640							
INGREDIENT DATA:		FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.				
H2	H2		-1.0870	710.0E-4	20.400				
O2	O2		-3.0800	1.142	90.200				
N2	N2		-2.9000	0.0080	77.400				
ATOMIC COMPOSITION(GM AT/100GM)									
H		9.0178							
N		0.2737							
O		4.0294							
PROPELLANT ENTHALPY		-17.357	KCAL/100 GM						
PROPELLANT DENSITY		0.4704	GM/CC						
									0.1170 LB/CU IN
PRESSURE (PSI)		500.0	CHAMBER	EXHAUST	EXHAUST	EXHAUST			
SHIFTING EQUILIBRIA				0.5000	500.0E-4	50.00E-4			
ISP (SEC)				390.60	427.74	448.01			
IVSP(LB-SEC/CU IN)				6.7728	7.2042	7.6117			
TEMPERATURE (K)		3417.4		1344.8	391.14	596.43			
CP (CAL/GM-DEG.K)		0.65560		0.56506	0.47457	0.45712			
MOI. WT.-EFFECTIVE		17.645		19.391	19.395	19.395			
CP/CV -EFFECTIVE		1.20711		1.2223	1.2613	1.3941			
CF -APPROX.				2.0024	2.1586	2.2503			
PEAE/M (SEC)				17.270	10.291	5.9345			
AE/AT -APPROX.				86.779	516.41	2987.9			
FROZEN EQUILIBRIA									
ISP (SEC)				362.70	391.17	394.57			
TEMPERATURE (K)		3417.4		900.01	367.11	298.16			
C* (FT/SEC)		6105.4							
CF									
PEAE/M (SEC)				1.0221	1.7648	1.9819			
AE/AT				12.150	4.0235	7.7026			
				61.061	232.24	1853.8			

02047 3.4022850 01
 02067 -9.0954076-09

WADD TN 60-254

CASE N₂
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	3417.4	1544.8	991.14	596.43
ENTHALPY (KILOCALORIES)	-17.357	-200.01	-227.60	-248.03
ENTROPY (CALORIES/DEGREE-K)	349.03	349.03	347.03	349.03
HEAT CAPACITY (CAL/DEGREE-K)	65.560	56.306	49.457	43.742
MOLES OF GAS	5.0673	5.1569	5.1560	5.1560
MOLECULAR COMPOSITION:				
H	0.1387	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	0.4001	0.0000	0.0000	0.0000
O2	0.2472	0.1592	0.1602	0.1442
OH	0.4882	0.0026	0.0000	0.0000
H2O	3.7054	4.2672	4.2089	4.5039
N2	0.4563	0.4863	0.4868	0.4869
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0611	0.0611	0.0000	0.0000

WADD TN 60-254

CASE No
BASIS: 100 GM PROPELLANT

	CHARGER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.00	0.5000	500.00E-4	50.00E-4
TEMPERATURE (KELVIN)	3359.00	1144.99	684.34	388.62
ENTHALPY (KILOCALORIES)	-20.033	-221.99	-242.00	-264.74
ENTROPY (CALORIES/DEG.K)	402.92	402.92	402.92	403.92
HEAT CAPACITY (CAL/K)	78.440	62.045	55.145	51.117
MOLES OF GAS	6.8893	6.2610	6.2610	6.5604
MOLECULAR COMPOSITION:				
H	0.2371	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0058	0.0000	0.0000	0.0000
H2	1.2610	1.4315	1.4312	1.4304
O2	0.0287	0.0000	0.0000	0.0000
OH	0.2006	0.0000	0.0000	0.0000
H2O	4.2663	4.0600	4.0600	4.6400
N2	0.4594	0.4697	0.4697	0.4604
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0192	0.0000	0.0000	0.0000

<p>CASE N2 PROPELLANT COMPOSITION H2 O2 N2</p> <p>INGREDIENT DATA: H2 O2 N2</p> <p>ATOMIC COMPOSITION(GM AT/100GM) H O</p> <p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p> <p>PRESSURE (PSI) SHIFTING EQUILIBRIA</p> <p>ISP (SEC) IVSP(LB-SEC/GU IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOI. I.EFFECTIVE CP/CV -EFFECTIVE CF -APPROX. PEAE/M (SEC) AE/AT -APPROX.</p> <p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) C* (FT/SEC) CF PEAE/M (SEC) AE/AT</p>	<p>FORMULA H2 O2 N2</p> <p>WEIGHT%</p> <p>13.79%</p> <p>73.28%</p> <p>12.93%</p> <p>HEAT OF FORM. -1.6870 -3.0300 -2.7000</p> <p>MOLAR</p> <p>0.5000</p> <p>0.5000</p> <p>3246.5</p> <p>0.84344</p> <p>13.286</p> <p>1.2156</p> <p>3246.5</p> <p>7177.8</p>	<p>DENSITY</p> <p>710.0UE-4</p> <p>1.142</p> <p>0.0080</p> <p>0.0132 LB/GU IN</p> <p>EXHAUST</p> <p>500.0UE-4</p> <p>442.83</p> <p>5.0703</p> <p>561.24</p> <p>0.50532</p> <p>13.695</p> <p>1.0290</p> <p>1.0984</p> <p>1.0850</p> <p>14.542</p> <p>65.184</p> <p>402.27</p> <p>801.47</p> <p>1.0070</p> <p>12.924</p> <p>57.970</p> <p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p> <p>EXHAUST</p> <p>50.00E-4</p> <p>459.61</p> <p>6.0E05</p> <p>317.23</p> <p>0.55512</p> <p>13.718</p> <p>1.0521</p> <p>2.0398</p> <p>4.3415</p> <p>1945.0</p> <p>434.26</p> <p>290.16</p> <p>1.9466</p> <p>4.4522</p> <p>2002.8</p>
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CASE NZ
BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	3246.5	967.01	561.24	317.23
ENTHALPY (KILOCALORIES)	-21.290	-224.67	-247.73	-263.97
ENTROPY (CALORIE/DEGREE-K)	420.66	420.69	420.69	428.69
HEAT CAPACITY (CAL/K)	84.744	64.654	58.532	55.512
MOLES OF GAS	7.2273	7.2013	7.2017	7.2739
MOLECULAR COMPOSITION:				
H	0.2247	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0104	0.0000	0.0000	0.0000
H2	2.2739	2.2603	2.2601	2.2194
O2	0.0082	0.0000	0.0000	0.0000
OH	0.1795	0.0000	0.0000	0.0000
H2O	4.3642	4.2800	4.2800	4.5800
N2	0.4568	0.4415	0.4615	0.4476
NH3	0.0000	0.0000	0.0001	0.0279
NO	0.0094	0.0000	0.0000	0.0000

<p>CASE N2 PROPELLANT COMPOSITION H2 O2 N2</p>	<p>WFLIGHT* 15.250 72.040 12.710</p>	<p>MOLAR -1.6870 -3.0800 -2.7000</p>	<p>HEAT OF FORM. 710.0E-4 1.142 0.6080</p>	<p>REF. TEMP. 20.400 90.200 77.400</p>
<p>INGREDIENT DATA: H2 O2 N2</p>	<p>FORMULA H2 O2 N2</p>			
<p>ATOMIC COMPOSITION(GM AT/100GM) H N O</p>	<p>15.1290 0.9073 4.5025</p>			
<p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p>	<p>-22.524 0.3406</p>	<p>KCAL/100 GM GM/CC</p>		
<p>CHAMBER PRESSURE (PSI) SHIFTING EQUILIBRIA</p>	<p>500.0</p>	<p>FXHAUST 0.5000</p>	<p>0.0123 LB/CU IN FXHAUST EXHAUST 500.0E-4</p>	<p>455.97 5.6111 298.16 0.59667 12.647 1.3575 2.0070 4.4701 1967.6</p>
<p>ISP (SEC) IVSP(LB-SEC/CU IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOLE WT.-EFFECTIVE CP/CV -EFFECTIVE CF -APPROX. PEAE/M (SEC) AE/AT -APPROX.</p>	<p>3110.8 0.89874 12.230 1.2205</p>	<p>420.71 2.1772 837.17 0.67418 12.472 1.2095 1.6518 13.794 60.710</p>	<p>444.36 5.4682 474.19 0.62385 12.473 1.2430 1.2559 7.2968 322.58</p>	<p>437.66 298.16</p>
<p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) CF (FT/SEC) CF PLAE/M (SEC) AE/AT</p>	<p>3110.8 7300.0</p>	<p>408.80 740.38 1.7994 12.793 56.712</p>	<p>432.24 470.34 1.2069 6.0383 262.78</p>	<p>1.9264 4.8123 2118.2</p>

WADD TN 60-254

CASE No
 BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	3110.8	837.17	474.19	298.16
ENTHALPY (KILOCALORIES)	-22.524	-222.94	-247.45	-261.46
ENTROPY (CALORIE/DEG*G)	451.99	451.99	451.99	456.39
HEAT CAPACITY (CAL/GK)	89.874	67.416	62.385	59.447
MOLES OF GAS	8.1703	8.0181	8.0172	7.9769
MOLECULAR COMPOSITION:				
H	0.1864	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0037	0.0000	0.0000	0.0000
H2	3.0320	3.0619	3.0605	2.8951
O2	0.0022	0.0000	0.0000	0.0000
OH	0.1018	0.0000	0.0000	0.0000
H2O	4.3882	4.2625	4.2025	4.5725
N2	0.4515	0.4536	0.4532	0.3980
NH3	0.0001	0.0000	0.0010	0.1113
NO	0.0042	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5600	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2006.0	734.40	410.56	298.16
ENTHALPY (KI-CALORIES)	-23.714	-220.34	-240.58	-257.11
ENTROPY (CALORIES/DEGREE-K)	474.06	474.06	474.06	488.27
HEAT CAPACITY (CAL/K)	95.072	70.531	60.385	64.209
MOLES OF GAS	8.0151	8.7149	3.7052	8.5749
MOLECULAR COMPOSITION:				
H	0.1406	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0012	0.0000	0.0000	0.0000
H2	3.0020	3.0418	3.0288	3.6718
O2	0.0006	0.0000	0.0000	0.0000
OH	0.0544	0.0000	0.0000	0.0000
H2O	4.0683	4.4269	4.4269	4.4269
N2	0.4452	0.4461	0.4418	0.3761
NH3	0.0001	0.0001	0.0038	0.1401
NO	0.0014	0.0000	0.0000	0.0000

CASE N- PROPELLANT COMPOSITION H2 O2 N2	WEIGHT% 21.570 66.670 11.760	MOLE% -1.6370 -3.0300 -2.9700	HEAT OF FORM. -1.6370 -3.0300 -2.9700	DENSITY 710.0E-4 1.142 0.6080	REF. TEMP. 20.400 90.200 77.400
INGREDIENT DATA: H2 O2 N2	FORMULA H2 O2 N2				
ATOMIC COMPOSITION(GM AT/100GR) H N O	21.570 0.6395 4.1669				
PROPELLANT ENTHALPY PROPELLANT DENSITY	-27.824 0.654 CHAMBER 500.0	KCAL/100 GM EXHAUST 0.5000	0.010 EXHAUST 500.0E-4	L3/CU IN EXHAUST 50.00E-4	1.5300 0.1520 0.98010 0.79970 0.1772 1.3713 1.8404 2.4871 2770.8
PRESSURE (PSI) SHIFTING EQUILIBRIA ISF (SEC) IVLP(LB-SEC/CU IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOL. WT.-EFFECTIVE CP/CV -EFFECTIVE CF -APPROX. PENE/M (SEC) RE/AT -APPROX.	2401.4 1.1165 8.9790 1.2471	412.33 3.9539 501.35 0.83904 9.0022 1.2570 1.7654 11.547 49.757	420.62 290.16	1.6307 6.0976 280.07	420.62 290.16
FROZEN EQUILIBRIA ISF (SEC) TEMPERATURE (K) CF (BT/SEC) CF PENE/M (SEC) RE/AT	2401.4 752.7	411.87 497.01	1.6307 11.044 49.505	1.6307 6.0976 280.07	420.62 290.16

WADD TN 60-254

CASE N₂
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2461.4	501.35	521.09	298.16
ENTHALPY (KILOCALORIES)	-27.824	-224.16	-243.90	-243.30
ENTROPY (CALORIES/DEG.K)	540.19	540.19	540.19	597.52
HEAT CAPACITY (CAL/K)	11.60	83.904	79.284	79.970
MOLES OF GAS	11.130	11.108	10.678	10.896
MOLECULAR COMPOSITION:				
H	0.0308	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.2188	6.2164	5.6702	6.1985
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0040	0.0000	0.0000	0.0000
H2O	4.1628	4.1669	4.1669	4.1669
N2	0.4196	0.4144	0.1990	0.3084
NH3	0.0003	0.0106	0.4416	0.2226
NO	0.0001	0.0000	0.0000	0.0000

WADD TN 60-254

CASE NO
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.00	0.5000	500.00E-4	50.00E-4
TEMPERATURE (KELVIN)	2119.4	409.41	290.16	298.16
ENTHALPY (KILOCALORIES)	-31.011	-220.23	-237.41	-232.11
ENTROPY (CALORIES/DEGREE-K)	500.12	590.12	607.23	681.05
HEAT CAPACITY (CAL/DEGREE-K)	122.27	91.866	89.754	92.284
MOLES OF GAS	12.087	12.081	12.234	12.714
MOLECULAR COMPOSITION:				
H	0.0064	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	8.0160	8.3660	7.4954	9.21E2
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0004	0.0000	0.0000	0.0000
H2O	3.7640	3.7544	3.7644	3.9544
N2	0.0094	0.0000	0.0000	0.0000
NH3	0.0006	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000

WADD TN 60-254

CASE No
 BASIS: 100 gm PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSIA)	500.0	0.5000	500.00E-4	EXHAUST
TEMPERATURE (KELVIN)	3376.9	1235.1	751.15	50.00E-4
ENTHALPY (KCALORIES)	-18.748	-509.40	-230.04	431.66
ENTROPY (CALORIES/DEGREE K)	377.36	377.36	377.36	-251.80
HEAT CAPACITY (CAL/K)	72.200	59.044	51.479	37.30
MOLES OF GAS	6.7154	5.9500	5.9500	47.381
MOLECULAR COMPOSITION:				
H	0.1970	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0348	0.0000	0.0000	0.0000
H2	1.0837	0.0481	0.0481	0.0480
O2	0.0520	0.0000	0.0000	0.0000
OH	0.2281	0.0000	0.0000	0.0000
H2O	3.9659	4.4644	4.4644	4.4644
N2	0.0217	0.0375	0.0375	0.0374
NH3	0.0000	0.0000	0.0000	0.0001
NO	0.0315	0.0000	0.0000	0.0000

CASE NO.					
PROPELLANT COMPOSITION	WEIGHT%	MOLAR			
H2	12.280				
O2	70.180				
N2	17.540				
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.	
H2	H2	-1.8570	710.00E-4	20.400	
O2	O2	-3.0800	1.142	90.200	
N2	N2	-2.9000	0.8080	77.100	
ATOMIC COMPOSITION(GM AT/100GM)					
H		12.1825			
N		1.4521			
O		4.3862			
PROPELLANT ENTHALPY		-20.065	KCAL/100 GM		
PROPELLANT DENSITY		0.3904	GM/CC		
PRESSURE (PSI)	CHAMBER		EXHAUST		
SHIFTING FUEL/TBRIA	500.00		0.5900		
ISP (SEC)					
IVP(LB-SEC/CU IN)					
TEMPERATURE (K)					
CP (CAL/GM-DEG.K)					
MOL. WT. EFFECTIVE					
CF/CM EFFECTIVE					
CF -APPROX.					
PEAF/M (SEC)					
AE/AT -APPROX.					
PROZEN EQUILIBRIA					
ISP (SEC)					
TEMPERATURE (K)					
CF (FT/SEC)					
CF					
PEAF/M (SEC)					
AE/AT					

			0.0141	LB/CU IN	
			EXHAUST	EXHAUST	
			500.00E-4	50.000E-4	
			432.11	448.89	
			6.1780	6.3323	
			590.43	326.53	
			0.54617	0.51579	
			14.887	14.906	
			1.0735	1.3186	
			2.0166	2.0904	
			7.9874	4.3484	
			370.19	2015.3	
			410.20	421.54	
			359.52	298.10	
			1.7782	1.9537	
			5.4737	4.2566	
			239.78	1972.8	

WADD TN 60-254

CASE N4
 BASIS: 100 GR PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	0.5000	50.00E-4
TEMPERATURE (KELVIN)	3251.1	1042.6	598.43	330.53
ENTHALPY (KILCALORIES)	-20.065	-212.19	-237.65	-231.64
ENTROPY (CALORIES/DEGREE-K)	402.58	402.58	402.58	403.58
HEAT CAPACITY (CAL/K)	78.418	60.879	54.017	51.579
MOLES OF GAS	0.2607	6.7173	6.7173	6.7087
MOLECULAR COMPOSITION:				
H	0.2082	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0144	0.0000	0.0000	0.0000
H2	1.7614	1.7030	1.7150	1.6921
O2	0.0138	0.0000	0.0000	0.0000
OH	0.2076	0.0000	0.0000	0.0000
H2O	4.1220	4.2842	4.2862	4.3362
N2	0.0187	0.0261	0.0260	0.0218
NH2	0.0000	0.0000	0.0000	0.0036
NO	0.0148	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N4
 U/SIS: 100 GM PROPELLANT

PRESSURE (PSI)
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEG·K)
 HEAT CAPACITY (CAL/K)
 MOLES OF GAS
 MOLECULAR COMPOSITION
 H
 N
 O
 H2
 O2
 OH
 H2O
 N2
 NH3
 NO

CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
500.0	500.0E-4	500.0E-4	0.5000	EXHAUST
3145.7	495.71	495.71	870.11	50.00E-4
-21.330	-257.83	-257.83	-215.04	295.16
426.01	426.01	426.01	426.01	-250.31
84.212	58.633	58.633	65.588	429.36
7.0157	7.4551	7.4551	7.4556	55.634
0.1809	0.0000	0.0000	0.0000	7.3501
0.0000	0.0000	0.0000	0.0000	0.0000
0.0050	0.0000	0.0000	0.0000	0.0000
2.2154	2.2288	2.2288	2.2285	2.3714
0.0034	0.0000	0.0000	0.0000	0.0000
0.1164	0.0000	0.0000	0.0000	0.0000
4.1762	4.2106	4.2106	4.2106	0.0000
0.0122	0.0151	0.0151	0.0154	4.3105
0.0000	0.0005	0.0005	0.0000	0.5626
0.0063	0.0000	0.0000	0.0000	0.1055
				0.0000

CASE NO				
PROPELLANT COMPOSITION	WEIGHT%	MULAR		
H2	15.250			
O2	67.800			
N2	16.950			
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.
H2	H4	-1.0870	710.07-4	20.100
O2	O2	-3.0800	1.142	90.200
N2	N4	-2.7000	0.8080	77.400
ATOMIC COMPOSITION(GM AT/100GM)				
H		15.1290		
N		1.4100		
O		4.4375		
PROPELLANT ENTHALPY		-22.554 KCAL/100 GM		
PROPELLANT DENSITY		0.5388 GM/CC		
CHAMBER		EXHAUST		
500.00		0.5000		
PRESSURE (PSI)				
SHIFTING EQUILIBRIA				
ISP (SEC)		410.07	432.25	441.44
IVP(LB-SEC/CU IN)		5.0200	5.6915	5.4737
TEMPERATURE (K)		754.80	424.92	298.19
CP (CAL/SM-DEG.K)		0.87617	0.60670	0.60257
MOL. WT.-EFFECTIVE		12.088	14.241	12.457
CP/CV -EFFECTIVE		1.4246	1.5219	1.3501
CF -APPROX.			1.8304	1.9704
PEAF/M (SEC)			13.000	4.6882
AE/AT -APPROX.			58.071	2092.7
FROZEN EQUILIBRIA				
ISP (SEC)		40.69	424.87	428.09
TEMPERATURE (K)		695.86	347.21	296.16
CP (FT/SEC)				
CF				
PEAF/M (SEC)		1.7930	1.0065	1.9109
AE/AT		12.344	5.9785	4.9815
		55.009	266.40	223.6

WADD TN 60-254

CASE N4
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0000	50.0000E-4
TEMPERATURE (KELVIN)	2974.7	754.80	404.92	290.10
ENTHALPY (KILOCALORIES)	-22.554	-210.81	-237.28	-246.48
ENTROPY (CALORIES/DEG-K)	450.96	450.96	450.96	461.99
HEAT CAPACITY (CAL/K)	89.617	66.670	62.093	60.057
VELOCITIES OF GAS	8.4726	8.4694	8.4637	8.0078
MOLECULAR COMPOSITION:				
H	0.4385	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0015	0.0000	0.0000	0.0000
H2	3.4935	3.3268	3.3183	3.1145
O2	0.0008	0.0000	0.0000	0.0000
OH	0.0605	0.0000	0.0000	0.0000
H2O	4.4713	4.4375	4.4275	4.42375
N2	0.0037	0.0050	0.0021	0.05342
NH3	0.0001	0.0001	0.0056	0.1410
NO	0.0026	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N4
 CASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	200.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2842.0	665.19	375.59	298.16
ENTHALPY (KILOCALORIES)	-23.736	-215.02	-256.33	-242.76
ENTROPY (CALORIES/DEGREE K)	472.54	472.54	472.54	493.28
HEAT CAPACITY (CAL/K)	94.652	70.00E	65.161	64.732
MOLES OF GAS	8.0235	8.0585	8.0160	8.0844
MOLECULAR COMPOSITION:				
H	0.0974	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0004	0.0000	0.0000	0.0000
H2	4.0649	4.0964	4.0727	3.6353
O2	0.0002	0.0000	0.0000	0.0000
OH	0.0300	0.0000	0.0000	0.0000
H2O	4.1351	4.1649	4.1669	4.1569
N2	0.0944	0.0946	0.0736	0.0978
NH3	0.0001	0.0004	0.0009	0.0145
NO	0.0010	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSIA)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2374.0	461.92	510.04	298.16
ENTHALPY (KILOCALORIES)	-27.852	-210.48	-232.31	-229.66
ENTROPY (CALORIES/DEGREE-K)	540.60	240.60	240.60	601.72
HEAT CAPACITY (CAL/K)	110.87	84.110	78.857	80.414
MOLES OF GAS	11.268	11.224	10.621	10.989
MOLECULAR COMPOSITION:				
H	0.0172	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
F2	0.7692	0.7243	0.0211	0.0000
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0017	0.0000	0.0000	0.0000
F2O	3.3201	3.9219	3.9219	3.9219
N2	0.0594	0.0420	0.0409	0.04246
NH3	0.0004	0.0353	0.0376	0.02700
NO	0.0000	0.0000	0.0000	0.0000

CASE NAME			
PROPELLANT COMPOSITION	WEIGHTS	MOLES	
H2	25.370		
O2	59.700		
N2	14.930		
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	REF. TEMP.
H2	H2	-1.5870	20.400
O2	O2	-3.0300	90.200
N2	N2	-2.9000	77.400
ATOMIC COMPOSITION (GM AT/100GM)			
H	25.1680		
N	1.0650		
O	3.7312		
PROPELLANT ENTHALPY	-31.030	KCAL/100 GM	
PROPELLANT DENSITY	0.2330	GM/CC	
	CHAMBER	EXHAUST	
	500.00	0.5000	
PRESSURE (PSI)			
SHIFTING EQUILIBRIA			
ISF (SEC)			
IVOP (LB-SEC/CU IN.)			
TEMPERATURE (K)			
CP (CAL/GM-DEG.K)			
MOLE FRACTION EFFECTIVE			
CP/CV EFFECTIVE			
CF APPROX.			
PERFORM (SEC)			
AE/AT APPROX.			
FROZEN EQUILIBRIA			
ISF (SEC)			
TEMPERATURE (K)			
CF (FI/SEC)			
CF			
PERFORM (SEC)			
AE/AT			

	0.008	LB/CU IN.	
	EXHAUST	EXHAUST	
	500.00E-4	50.000E-4	
	412.36	404.69	
	3.4804	3.4150	
	290.10	290.10	
	0.89208	0.92650	
	0.2380	7.8170	
	1.5700	1.5781	
	1.0100	1.7760	
	7.0883	8.1480	
	330.10	3377.4	
	400.63	400.62	
	290.10	290.10	
	1.7590	1.7590	
	0.4400	8.4400	
	370.58	3705.8	

WADD TN 60-254

CASE NAME
 CASIS: 1.0 GM PROPELLANT

PROPERTY	CHARACTER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2004.0	395.88	295.10	298.16
ENTHALPY (KILO-CALORIES)	-31.038	-210.25	-220.46	-219.26
ENTROPY (CALORIES/DEGREE)	594.56	594.56	604.37	665.46
HEAT CAPACITY (CAL/K)	12.14	94.845	69.208	92.650
MOLES OF GAS	15.116	12.795	12.139	12.792
MOLECULAR COMPOSITION:				
H	0.0031	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	0.0502	0.0701	7.0854	0.0646
O2	0.0000	0.0000	0.0000	0.0000
CH	0.0001	0.0000	0.0000	0.0000
H2O	3.7311	3.7312	3.7312	3.7312
N2	0.0324	0.0719	0.0457	0.0701
NH3	0.0000	0.0220	0.0784	0.0257
NO	0.0000	0.0000	0.0000	0.0000

WADD TN 60-254

WIRE IN
CALIB: 100 gm PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.00-4	50.00E-4
TEMPERATURE (KELVIN)	3305.9	1300.5	337.02	495.69
CENTRIFUGAL FORCE (G)	-17.424	-192.35	-224.88	-257.92
WEIGHT (CALORIES/GR)	347.43	347.43	347.43	347.43
WEIGHT CAPACITY (CAL/K)	60.720	65.142	4.0000	42.415
WEIGHT OF GAS	5.7405	5.2213	5.2200	5.3202
MOLECULAR COMPOSITION:				
H	0.425	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
C	0.0451	0.0000	0.0000	0.0000
N2	0.0519	0.2477	0.2477	0.2477
O2	0.0019	0.0000	0.0000	0.0000
OH	0.0547	0.0000	0.0000	0.0000
H2O	0.0000	0.2612	0.2612	0.2612
N2	0.7807	0.0113	0.0113	0.0113
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0491	0.0000	0.0000	0.0000

WADD TN 60-254

CASE: N2
 BASIS: 100 GR PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
TEMPERATURE (KELVIN)	50.0	0.0000	0.0000	0.0000
ENTHALPY (KILOCALORIES)	312.5	91.08	522.47	302.47
ENTROPY (CALORIE/DEG-K)	-20.096	-203.67	-223.73	-238.22
HEAT CAPACITY (CAL/K)	40.094	402.94	402.94	402.94
VELOCITY OF GAS	78.333	59.072	54.785	51.663
MOLECULAR COMPOSITION	7.0446	6.0740	6.0738	6.0733
H	0.1713	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0069	0.0000	0.0000	0.0000
H2	1.9890	1.9794	1.9790	1.8733
O2	0.0056	0.0000	0.0000	0.0000
OH	0.1353	0.0000	0.0000	0.0000
H2O	3.9489	4.1119	4.1119	4.1119
N2	0.780	0.7808	0.7826	0.7474
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0095	0.0000	0.0000	0.0000

WADD TN 60-254

CASE Nz
 BASIS: 100 Gm PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.000E-4
TEMPERATURE (KELVIN)	3026.0	778.54	437.60	298.16
ENTHALPY (KILOCALORIES)	-21.362	-204.20	-225.56	-235.05
ENTROPY (CALORIES/DEGREE-K)	426.99	420.89	420.99	435.11
HEAT CAPACITY (CAL/K)	83.994	62.709	58.799	56.251
MOLES OF GAS	7.7161	7.0094	7.0061	7.4754
MOLECULAR COMPOSITION:				
H	0.1351	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0020	0.0000	0.0000	0.0000
H2	2.7735	2.7989	2.7039	2.5995
O2	0.0012	0.0000	0.0000	0.0000
OH	0.0685	0.0000	0.0000	0.0000
H2O	3.7650	4.0412	4.0412	4.0412
N2	0.7675	0.7602	0.7675	0.7927
NH3	0.0001	0.0001	0.00034	0.1330
NO	0.0036	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5070	0.0000	0.0000
TEMPERATURE (KELVIN)	2802.7	670.18	380.34	298.16
ENTHALPY (KILOCALORIES)	-22.585	-202.50	-224.86	-251.51
ENTROPY (CALORIES/DEGREE K)	447.56	447.56	447.56	467.36
HEAT CAPACITY (CAL/K)	89.260	66.149	62.614	60.042
MOLES OF GAS	8.2857	8.2205	8.2282	8.1478
MOLECULAR COMPOSITION:				
H	0.0948	0.0070	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0005	0.0000	0.0000	0.0000
F2	3.2629	3.2915	3.2731	3.3325
Cl2	0.0002	0.0000	0.0000	0.0000
OH	0.0323	0.0000	0.0000	0.0000
H2O	3.2378	3.2705	3.2725	3.2925
N2	0.7558	0.7562	0.7001	0.6699
NH3	0.0001	0.0003	0.0026	0.0170
NO	0.0013	0.0000	0.0000	0.0000

CASE	N2								
PROPELLANT COMPOSITION		WEIGHTS		MOLAR		DENSITY		REF. TEMP.	
H2		16.670		-1.0870		710.0E-4		20.400	
O2		62.500		-3.0800		1.142		90.200	
N2		20.830		-2.0000		0.0080		77.400	
INGREDIENT DATA:		FORMULA		HEAT OF FORM.					
H2	H2								
O2	O2								
N2	N2								
ATOMIC COMPOSITION(GM AT/100GM)									
H		16.6377							
N		1.4870							
O		3.0062							
PROPELLANT ENTHALPY		-23.775	KCAL/100 GM						
PROPELLANT DENSITY		0.2172	GM/CC						
CHAMBER			EXHAUST						
500.00			500.000						
PRESSURE (PSI)									
SHIFTING EQUILIBRIA									
ISP (SEC)		397.74				417.36		421.64	
IVSP(LB/SEC/CU IN)		4.2571				4.7025		4.8315	
TEMPERATURE (K)		599.66				347.19		298.16	
CP (CAL/GM-DEG.K)		0.69910				0.69917		0.65310	
MOL. WT.-EFFECTIVE		11.049				11.072		11.360	
CP/CV -EFFECTIVE		1.2360				1.2614		1.3659	
CF -APPROX.						1.0809		1.9002	
PEAF/M (SEC)						0.4173		5.3820	
AE/AT -APPROX.						207.21		2425.9	
FROZEN EQUILIBRIA									
ISP (SEC)						412.31		414.81	
TEMPERATURE (K)		2703.0				317.57		298.16	
CF (FT/SEC)		7129.1							
CF									
PEAF/M (SEC)						1.0627		1.8094	
AE/AT						6.0002		5.6244	
						272.66		2534.8	

WADD TN 60-254

CASE NZ
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.00	500.00	50.00E-4
TEMPERATURE (KELVIN)	2703.0	597.66	347.19	347.19	298.16
ENTHALPY (KILOCALORIES)	-23.773	-207.22	-227.96	-227.96	-228.09
ENTROPY (CALORIES/DEGREE-K)	470.92	470.92	470.92	470.92	498.57
HEAT CAPACITY (CAL/K)	94.194	69.910	66.417	66.417	65.318
MOLES OF GAS	9.0507	9.0110	8.9714	8.9714	8.8030
MOLECULAR COMPOSITION					
H	0.0616	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000	0.0000
O	0.0001	0.0000	0.0000	0.0000	0.0000
H2	4.2395	4.2606	4.1512	4.1512	4.0425
O2	0.0000	0.0000	0.0000	0.0000	0.0000
OH	0.0145	0.0000	0.0000	0.0000	0.0000
H2O	3.8909	3.7862	3.7062	3.7062	3.5062
N2	0.7432	0.7426	0.6730	0.6730	0.6328
NH3	0.0002	0.0013	0.0040	0.0040	0.02094
NO	0.0005	0.0000	0.0000	0.0000	0.0000

WADD TN 60-254

CASE NAME
 BASIS: 100 gm PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.00	0.0000	0.0000	0.0000	0.0000
TEMPERATURE (KELVIN)	1800.00	382.62	0.0000	0.0000	0.0000
ENTHALPY (KILOCALORIES)	-31.063	-200.01	0.0000	0.0000	0.0000
ENTROPY (CALORIES/DEGREE K)	590.00	950.53	0.0000	0.0000	0.0000
HEAT CAPACITY (CAL/K)	120.00	94.068	0.0000	0.0000	0.0000
MOLES OF GAS	13.000	12.734	0.0000	0.0000	0.0000
MOLECULAR COMPOSITION:					
H	0.0014	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000	0.0000
F2	0.0000	0.0000	0.0000	0.0000	0.0000
O2	0.0000	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000	0.0000
H2O	0.0000	0.0000	0.0000	0.0000	0.0000
N2	0.0000	0.0000	0.0000	0.0000	0.0000
HF	0.0000	0.0000	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	3273.8	1048.4	617.56	347.45
ENTHALPY (KILOCALORIES)	-19.219	-190.44	-214.62	-225.38
ENTROPY (CALORIES/DEG.K)	364.75	364.75	364.75	364.75
HEAT CAPACITY (CAL/K)	49.408	54.429	48.596	45.709
MOLES OF GAS	6.1563	5.9240	5.9240	5.9240
MOLECULAR COMPOSITION:				
H	0.1541	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0168	0.0000	0.0000	0.0000
H2	1.1344	1.0228	1.0228	1.0178
O2	0.0220	0.0000	0.0000	0.0000
OH	0.2099	0.0000	0.0000	0.0000
H2O	3.6430	3.9375	3.9375	3.9375
N2	0.9522	0.9637	0.9637	0.9621
NH3	0.0000	0.0000	0.0000	0.0033
NO	0.0230	0.0000	0.0000	0.0000

CASE N2
BASIS: 100 Gm PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	70.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	3061.4	807.79	456.10	298.16
ENTHALPY (KILOCALORIS)	-20.128	-192.61	-212.47	-223.18
ENTROPY (CALORIES/DEG.K)	40.198	701.98	401.96	407.41
HEAT CAPACITY (CAL/K)	78.102	56.694	54.380	52.152
MOLES OF GAS	7.1412	7.0295	7.0280	6.9145
MOLECULAR COMPOSITION:				
H	0.1297	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0027	0.0000	0.0000	0.0000
H2	2.2382	2.2516	2.2495	2.0791
O2	0.0019	0.0000	0.0000	0.0000
OH	0.0790	0.0000	0.0000	0.0000
H2O	3.7486	3.6394	3.6394	3.6394
N2	0.7357	0.7384	0.7375	0.6808
NH3	0.0001	0.0000	0.0017	0.1152
HC	0.0055	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2629.0	569.57	341.77	298.16
ENTHALPY (KILOCALORIES)	-23.244	-194.38	-211.91	-214.01
ENTROPY (CALORIES/DEG.K)	450.89	460.89	450.89	488.93
HEAT CAPACITY (CAL/K)	91.340	67.970	64.489	63.768
MOLES OF GAS	8.0634	8.0635	8.0278	8.6096
MOLECULAR COMPOSITION:				
H	0.0452	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0001	0.0000	0.0000	0.0000
H2	4.2438	4.2578	3.7493	3.9218
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0096	0.0000	0.0000	0.0000
H2O	3.0650	3.0750	3.0750	3.6750
N2	0.0092	0.0083	0.7954	0.7963
NH3	0.0002	0.0024	0.2081	0.2244
NO	0.0003	0.0000	0.0000	0.0000

CASE N2									
PROPELLANT COMPOSITION									
H2			WTGHT%						
O2			20.000						
N2			56.000						
			24.000						
INGREDIENT DATA:		FURNISH A		HEAT OF FORM.		DENSITY		REF. TEMP.	
H2	H2			-1.0870		710.0E-4		20.400	
O2	O2			-3.0800		1.142		90.200	
N2	N2			-2.0000		0.0080		77.400	
ATOMIC COMPOSITION(GM AT/100GM)									
H			19.0413						
N			1.7133						
O			3.5000						
PROPELLANT ENTHALPY				-26.594	KCAL/100 GM				
PROPELLANT DENSITY				0.2774	GM/CC				
				CHARPER					
				500.0					
PRESSURE (PSI)									
SHIFTING EQUILIBRIA									
ISP (SEC)									
IVSP(LB-SEC/CU IN)									
TEMPERATURE (K)									
CP (CAL/GM-DEG.K)									
MOL. WT.-EFFECTIVE									
CP/CV -EFFECTIVE									
CF -APPROX.									
PEAE/M (SEC)									
AE/AT -APPROX.									
FROZEN EQUILIBRIA									
ISP (SEC)									
TEMPERATURE (K)									
C* (FT/SEC)									
CF									
PEAE/M (SEC)									
AE/AT									

WADD TN 60-254

CASE N2
 BASIC: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2200.0	433.14	315.39	298.16
ENTHALPY (KILOCALORIES)	-26.594	-102.74	-210.00	-205.89
ENTROPY (CALORIES/DEGREE-K)	515.72	515.72	515.72	575.89
HEAT CAPACITY (CAL/K)	104.18	79.495	74.145	76.360
MOLES OF GAS	10.781	10.681	9.9639	10.451
MOLECULAR COMPOSITION:				
H	0.0085	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.4158	6.2763	5.2005	5.9318
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0007	0.0000	0.0000	0.0000
H2O	3.4993	3.2000	3.2000	3.5000
N2	0.0563	0.0085	0.4500	0.6237
NH3	0.0004	0.0002	0.0134	0.3259
NO	0.0000	0.0000	0.0000	0.0000

<p>CASE N2</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>WEIGHT%</p> <p>8.5000</p> <p>59.480</p> <p>32.020</p>	<p>MULAR</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0080</p>	<p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p>
<p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0800</p> <p>-2.9900</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0080</p>	<p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p>
<p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H</p> <p>N</p> <p>O</p>	<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0800</p> <p>-2.9900</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0080</p>	<p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p>
<p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p>	<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0800</p> <p>-2.9900</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0080</p>	<p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p>
<p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT -APPROX.</p>	<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0800</p> <p>-2.9900</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0080</p>	<p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p>
<p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>C* (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0800</p> <p>-2.9900</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0080</p>	<p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>EXHAUST</p>	<p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p> <p>50.00E-4</p>

WADD TN 60-254

CASE NZ

BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	3270.8	1114.1	664.93	376.51
ENTHALPY (KILOCALORIES)	-14.096	-177.69	-197.14	-211.62
ENTROPY (CALORIES/DEG.K)	330.83	330.83	330.83	338.03
HEAT CAPACITY (CAL/K)	63.455	50.599	44.867	41.709
MOLES OF GAS	5.0172	5.2592	5.2592	5.3588
MOLECULAR COMPOSITION:				
H	0.1156	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0225	0.0000	0.0000	0.0000
H2	0.7024	0.4985	0.4988	0.4982
O2	0.0437	0.0000	0.0000	0.0000
OH	0.2328	0.0000	0.0000	0.0000
H2O	3.2396	3.7175	3.7175	3.7175
N2	1.1253	1.1429	1.1429	1.1427
NH3	0.0000	0.0000	0.0000	0.0004
NO	0.0352	0.0000	0.0000	0.0000

CASE N2	PROPPELLANT COMPOSITION	WEIGHT%	MULAR	
	H2	10.600		
	O2	59.500		
	N2	31.500		
INGREDIENT DATA:		FORMULA	HEAT OF FORM.	DENSITY
	H2		-1.5970	717.00E-4
	O2		-3.0800	1.142
	N2		-2.9800	0.00080
ATOMIC COMPOSITION(GM AT/100GM)				
	H	9.9206		
	N	2.2487		
	O	3.0562		
PROPPELLANT ENTHALPY		-19.251	KCAL/100 GM	
PROPPELLANT DENSITY		0.4728	GM/CC	
PRESSURE (PSI)		CHAFFER	EXHAUST	0.0150
SHIFTING EQUILIBRIA		500.0	0.5000	500.0E-4
ISP (SEC)				410.24
IVSP(LB-SEC/CU IN)				6.4149
TEMPERATURE (K)		3171.6		302.80
CP (CAL/GM-DEG.K)		0.69360		0.45960
MOI. WT.-EFFECTIVE		15.033		16.572
CP/CM -EFFECTIVE		1.2176		1.3541
CF -APPROX.				2.0450
PEAE/M (SEC)				3.8507
AE/AT -APPROX.				1919.6
FROZEN EQUILIBRIA				
ISP (SEC)				389.84
TEMPERATURE (K)		3171.6		293.16
C* (FT/SEC)		6450.2		
CF				
PEAE/M (SEC)				1.9434
AE/AT				4.1242
				2055.9

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CASE N4
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	0.0000	0.0000
TEMPERATURE (KELVIN)	3171.6	910.44	0.0000	0.0000
ENTHALPY (KILOCALORIES)	-12.251	-12.251	527.38	0.0000
ENTROPY (CALORIES/DEG.K)	364.00	364.00	-200.52	0.0000
HEAT CAPACITY (CAL/K)	69.360	53.179	364.00	1.2286
MOLES OF GAS	6.2370	6.0947	48.25d	0.0000
MOLECULAR COMPOSITION:			6.00845	0.0000
H	0.1285	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0075	0.0000	0.0000	0.0000
H2	1.5425	1.5040	1.5038	0.0000
O2	0.0060	0.0000	0.0000	0.0000
OH	0.1314	0.0000	0.0000	0.0000
H2O	3.4875	3.0562	3.0562	0.0000
N2	1.1176	1.1244	1.1243	3.6562
NH3	0.0000	0.0000	0.0002	1.0032
NO	0.0135	0.0000	0.0000	0.0503
				0.0000

CASE NAME	N2	WEIGHT%	MILAK	DENSITY	REF. TEMP.
PROPELLANT COMPOSITION					
H2	12.000			710.00E-4	20.400
O2	57.200			1.142	90.200
N2	30.800			0.0080	77.400
INGREDIENT DATA:					
H2	FORMULA	HEAT OF FORM.			
O2		-1.8870			
N2		-3.0900			
		-2.9000			
ATOMIC COMPOSITION(GM AT/100GM)					
H	11.9048				
N	2.1987				
O	3.5750				
PROPELLANT ENTHALPY					
	-19.926	KCAL/100 GM			
PROPELLANT DENSITY					
	0.3688	GM/CC			
	CHAMBER		EXHAUST		
	500.0		0.5000		
PRESSURE (PSI)					
SHIFTING EQUILIBRIA					
ISP (SEC)			370.41	390.65	404.64
IVSP(LB-SEC/CU IN)			5.2872	5.5715	5.6938
TEMPERATURE (K)	2948.4		735.50	410.58	298.16
CP (CAL/GM-DEG.K)	0.76860		0.57320	0.5713	0.51020
MOL. WT.-EFFECTIVE	14.034		14.181	14.198	14.455
CP/CV -EFFECTIVE	1.2258		1.2530	1.2524	1.3602
CF -APPROX.			1.0952	1.0233	1.09521
PEAE/M (SEC)			11.877	6.2034	4.4072
AE/AT -APPROX.			57.590	302.64	2137.0
FROZEN EQUILIBRIA					
ISP (SEC)			369.76	390.75	393.78
TEMPERATURE (K)	2948.4		682.40	347.65	298.16
CF (FT/SEC)					
CF			1.7930	1.0947	1.09094
PEAE/M (SEC)			11.309	5.2122	4.6644
AE/AT			55.125	267.26	2261.7

WADD TN 60-254

CASE NZ
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	50.00E-4
TEMPERATURE (KELVIN)	2948.4	735.30	410.58	298.16
ENTHALPY (KILOCALORIES)	-19.026	-184.70	-200.74	-208.10
ENTROPY (CALORIES/DEGREE K)	300.22	390.22	390.22	407.04
HEAT CAPACITY (CAL/K)	76.860	57.320	53.713	51.000
MOLES OF GAS	7.1254	7.0510	7.0435	6.9102
MOLECULAR COMPOSITION:				
H	0.0942	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0011	0.0000	0.0000	0.0000
H2	2.3591	2.3772	2.3650	2.1770
O2	0.0007	0.0000	0.0000	0.0000
OH	0.0466	0.0000	0.0000	0.0000
H2O	3.5228	3.3750	3.3750	3.5750
N2	1.0978	1.0993	1.0952	1.0326
NH3	0.0001	0.0001	0.0033	0.1336
NO	0.0030	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHANGED	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.00E-4	0.0000
TEMPERATURE (KELVIN)	2869.6	509.87	330.26	298.16
ENTHALPY (KILOCALORIES)	-23.275	-182.18	-197.44	-200.12
ENTROPY (CALORIES/DEG.K)	450.38	450.38	450.38	493.06
HEAT CAPACITY (CAL/K)	90.662	68.900	64.162	64.308
MOLES OF GAS	8.7991	8.7760	8.0076	8.7247
MOLECULAR COMPOSITION:				
H	0.0038	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	4.2136	4.2091	3.7461	4.1322
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0037	0.0000	0.0000	0.0000
H2O	3.4087	3.4125	3.4125	3.4123
N2	1.0192	1.0444	0.0568	0.9188
NH3	0.0003	0.0000	0.0000	0.0000
NO	0.0001	0.0000	0.0000	0.0000

WADD TN 60-254

CASE No.
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	0.5000	500.0E-4	500.0E-4
TEMPERATURE (KELVIN)	2005.0	400.52	311.28	298.16
ENTHALPY (KILOCALORIES)	-26.624	-181.72	-190.38	-191.00
ENTROPY (CALORIE/DEG.K)	512.02	512.02	512.02	580.16
HEAT CAPACITY (CAL/K)	103.12	79.265	73.578	76.052
MOLES OF GAS	10.021	10.690	9.0780	10.553
MOLECULAR COMPOSITION:				
H	0.0036	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
F2	6.6676	6.2250	5.1094	6.1203
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0002	0.0000	0.0000	0.0000
H2O	3.2498	3.2500	3.2500	3.2500
N2	0.0000	0.0844	0.4787	0.8160
NH3	0.0000	0.2300	1.0415	0.3669
NO	0.0000	0.0000	0.0000	0.0000

Contrails

DATA C

CHAMBER PRESSURE 500 psia

EXHAUST PRESSURES 7.35, 0.735, and 0.0735 psia

CASE	N ₂	WEIGHTS	MOLAR
PROPELLANT COMPOSITION			
H ₂		9.0900	
O ₂		81.890	
N ₂		9.0900	
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY
H ₂		-1.0870	710.0E-4
O ₂		-3.0900	1.142
N ₂		-2.900	0.8080
ATOMIC COMPOSITION(GM AT/100GM)			REF. TEMP.
H		9.0178	20.400
N		0.8489	90.200
O		5.1137	77.400
PROPELLANT ENTHALPY		-17.304	
PROPELLANT DENSITY		0.4741	
	CHAMBER	KCAL/100 GM	LB/CU IN
	500.0	EXHAUST	EXHAUST
		7.350	735.0E-4
PRESSURE (PSI)			
SHIFTING EQUILIBRIA			
ISP (SEC)		322.43	391.58
IVSP(LB-SEC/QU IN)		5.7157	8.7074
TEMPERATURE (K)		2305.4	1857.7
CP (CAL/GM-DEG.K)		0.61447	0.57139
MOL. WT.-EFFECTIVE		19.259	19.465
CP/CV -EFFECTIVE		1.2021	1.2176
CF -APPROX.		1.0851	1.9671
PEAE/M (SEC)		30.900	18.800
AE/AT -APPROX.		10.562	84.259
FROZEN EQUILIBRIA			
ISP (SEC)		312.43	362.41
TEMPERATURE (K)		1296.0	916.35
C* (FT/SEC)			
CF		1.0947	1.0206
PEAE/M (SEC)		24.678	12.328
AE/AT		8.4335	42.129

WADD TN 60-254

W/SE N2

BASIS: 100 GM PROPELLANT

PROPERTY	CHARB-K	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3451.5	2205.4	1957.7	1077.1
ENTHALPY (KILOCALORIES)	-17.324	-140.62	-192.54	-25.37
ENTROPY (CALORIES/DEGREE)	340.51	340.51	349.51	348.51
HEAT CAPACITY (CAL/K)	65.478	61.447	57.139	50.520
MOLES OF GAS	5.0315	5.1789	5.1380	5.1358
MOLECULAR COMPOSITION:				
H	0.1310	0.0070	0.0030	0.0000
N	0.0010	0.0000	0.0030	0.0000
O	0.0974	0.0090	0.0032	0.0000
Cl	0.7350	0.0562	0.0010	0.0000
CO	0.2414	0.2971	0.3005	0.3024
CO2	0.2410	0.0090	0.0054	0.0000
NO	0.7350	4.0392	4.0040	4.0000
NO2	0.2974	0.0180	0.0235	0.0244
NH3	0.0010	0.0000	0.0000	0.0000
NO	0.0514	0.0125	0.0000	0.0000

WADD TN 60-254

U/SF NL
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.750	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3419.9	2093.9	1579.2	852.69
ENTHALPY (KILOGRAMS)	-20.01	-174.95	-225.48	-255.74
ENTROPY (CALORIES/EGM-K)	405.75	405.95	405.75	405.95
HEAT CAPACITY (CAL/K)	78.419	74.174	65.152	67.120
MOLES OF GAS	6.0272	6.0715	6.07045	6.07045
MOLECULAR COMPOSITION:				
H	0.2576	1.0117	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0479	0.0000	0.0000	0.0000
H2	1.2872	1.2544	1.1569	1.1569
O2	0.0578	0.0001	0.0000	0.0000
OH	0.0777	0.0060	0.0000	0.0000
H2O	4.0822	1.0281	4.07344	4.07344
N2	0.0015	0.0150	0.0150	0.0150
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0020	0.0001	0.0000	0.0000

CASE N ₂			
PROPELLANT COMPOSITION:	WEIGHTS	MOLAR	
N ₂	13.790		
O ₂	77.590		
N ₂	8.620		
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	REF. TEMP.
N ₂	N ₂	-1.5370	20.400
O ₂	O ₂	-3.0900	90.200
N ₂	N ₂	-2.9900	77.100
ATOMIC COMPOSITION(C ₂ H ₄ AT/100GM)			
H	13.080		
C	0.0184		
O	4.8474		
PROPELLANT ENTHALPY	-21.235	KCAL/100 GM	
PROPELLANT DENSITY	0.7645	GM/CC	
	CHAMBER	EXHAUST	
	500.0	7.750	
PRESSURE (PSI)			
CHIFFING EQUILIBRIA			
ISF (SEC)	370.42		455.44
IVSP(LB-SEC/100 IN)	4.9752		6.0046
TEMPERATURE (K)	1671.4		696.06
CP (CAL/GM-DEG.K)	0.73801		0.59748
MOL. WT. EFFECTIVE	13.987		13.990
CP/CM -EFFECTIVE	1.2307		1.2687
CP -APPROX.	1.0460		1.0834
PLATE/M (SEC)	30.725		17.039
WE/AT -APPROX.	0.2019		51.522
WE/AT -MULTIPLIER			
ISF (SEC)	300.47		407.97
TEMPERATURE (K)	1211.7		634.11
CP (BT/SEC)			
CP	1.0901		1.0134
PLATE/M (SEC)	27.390		13.168
WE/AT	1.2323		39.800
			184.30

CASE No.	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
STATUS: 100 GM PROPELLANT	500.0	7.350	0.7350	735.0UE-4	
PRESSURE (PSI)	3300.0	1041.4	1108.2	696.08	
TEMPERATURE (KELVIN)	-21.260	-170.90	-227.59	-257.56	
ENTHALPY (KILOCALORIES)	429.05	429.05	429.05	429.05	
ENTROPY (CALORIES/DEGREE K)	34.400	70.801	67.077	59.748	
HEAT CAPACITY (CAL/K)	7.4497	7.4497	7.1480	7.1479	
MOLES OF GAS					
MOLECULAR COMPOSITION:					
H	0.2631	0.0027	0.0000	0.0000	
N	0.0000	0.0000	0.0000	0.0000	
O	0.0192	0.0000	0.0000	0.0000	
H2	2.0508	1.7996	1.7999	1.7999	
O2	0.0172	0.0000	0.0000	0.0000	
OH	0.2555	0.0000	0.0000	0.0000	
H2O	4.0232	4.0048	4.0044	4.0044	
N2	0.0016	0.0077	0.0077	0.0077	
NH3	0.0000	0.0000	0.0000	0.0000	
NO	0.0101	0.0000	0.0000	0.0000	

<p>CASE No</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H</p> <p>O</p> <p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p> <p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PERA/N (SEC)</p> <p>RE/AT -APPROX.</p> <p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF (FT/SEC)</p> <p>CF</p> <p>PERA/N (SEC)</p> <p>RE/AT</p>	<p>WEIGHTS</p> <p>15.230</p> <p>76.270</p> <p>8.480</p> <p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>HEAT OF FORM.</p> <p>-1.0570</p> <p>-3.0300</p> <p>-2.0000</p> <p>KCAL/100 GM</p> <p>GM/CC</p> <p>EXHAUST</p> <p>CHAMBER</p> <p>500.0</p> <p>321.0</p> <p>0.9000</p> <p>12.376</p> <p>1.2170</p> <p>321.0</p> <p>7392.5</p>	<p>MOLAR</p> <p>DENSITY</p> <p>REF. TEMP.</p> <p>710.00E-4</p> <p>1.142</p> <p>0.0080</p> <p>20.400</p> <p>20.200</p> <p>77.400</p> <p>0.0124</p> <p>0.7350</p> <p>424.69</p> <p>2.2536</p> <p>1009.7</p> <p>0.69805</p> <p>12.711</p> <p>1.2886</p> <p>1.0484</p> <p>16.171</p> <p>47.879</p> <p>414.11</p> <p>790.67</p> <p>1.0023</p> <p>13.336</p> <p>39.486</p> <p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>735.00E-4</p> <p>452.61</p> <p>5.0989</p> <p>585.19</p> <p>0.60800</p> <p>12.711</p> <p>1.3295</p> <p>1.07699</p> <p>8.7941</p> <p>260.37</p> <p>459.94</p> <p>394.30</p> <p>1.9146</p> <p>6.2602</p> <p>185.35</p>
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WADD TN 60-254

CASE No.
BASIS: 100 GR PROPELLANT

	CHAMBER	EXHAUST	F EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3211.0	1008.0	1009.7	585.19
ENTHALPY (KILOCALORIES)	-22.403	-182.73	-229.78	-257.92
ENTROPY (CALORIES/DEGREE K)	452.66	452.66	452.66	452.66
HEAT CAPACITY (CAL/K)	90.040	79.009	99.893	63.080
MOLES OF GAS	8.0750	7.0674	7.0672	7.0671
MOLECULAR COMPOSITION:				
H	0.2304	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0076	0.0000	0.0000	0.0000
N2	2.7850	2.7974	2.7976	2.7975
O2	0.0000	0.0000	0.0000	0.0000
OH	0.1508	0.0000	0.0000	0.0000
N2O	4.5855	4.7669	4.7669	4.7669
N2	0.2907	0.0027	0.0027	0.0026
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000

<p>CASE N2 PROPELLANT COMPOSITION H2 O2 N2</p>	<p>WEIGHTS 16.670 75.000 8.330</p>	<p>MOLAR</p>	<p>REF. TEMP. 20.400 90.200 77.400</p>	<p>DENSITY 710.0E-4 1.142 0.8080</p>
<p>INGREDIENT DATA: H2 O2 N2</p>	<p>FORMULA H2 O2 N2</p>	<p>HEAT OF FORM. -1.0970 -3.0000 -2.0000</p>		
<p>ATOMIC COMPOSITION(GM AT/100GM) H N O</p>	<p>16.0377 0.5967 4.6875</p>			
<p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p>	<p>-23.634 0.2218</p>	<p>KCAL/100 GR GM/CC</p>	<p>EXHAUST EXHAUST</p>	<p>0.0116 0.7350</p>
<p>CHAMBER 500.0</p>	<p>7.350</p>			
<p>SHIFTING EQUILIBRIA ISP (SEC) IVSP(LB-SEC/CU IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOL. WT.-EFFECTIVE CP/CV -EFFECTIVE CF -APPROX. PLAE/M (SEC) AE/AT -APPROX.</p>	<p>307.9 0.9362 11.479 1.2218</p>	<p>375.03 4.5601 1474.2 0.81080 11.674 1.2621 1.0070 29.111 8.4899</p>	<p>EXHAUST EXHAUST EXHAUST EXHAUST EXHAUST EXHAUST EXHAUST EXHAUST EXHAUST</p>	<p>735.0E-4 51.04 5.2438 503.23 0.66822 1.1675 1.3418 1.9530 8.2624 340.96</p>
<p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) CF* (FT/SEC) CF PLAE/M (SEC) AE/AT</p>	<p>307.9 7505.0</p>	<p>307.04 1347.0</p>	<p>EXHAUST EXHAUST</p>	<p>442.91 377.02</p>
<p>AE/AT</p>	<p>1.0735 27.653 8.0551</p>	<p>1.7897 13.451 39.228</p>	<p>EXHAUST EXHAUST EXHAUST</p>	<p>1.8988 6.4114 186.90</p>

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.00E-4
TEMPERATURE (KELVIN)	3077.9	1474.2	885.47	505.25
ENTHALPY (KILOCALORIES)	-23.604	-185.35	-255.86	-257.49
ENTROPY (CALORIES/DEGREE-K)	475.00	475.00	475.00	475.00
HEAT CAPACITY (CAL/K)	95.352	81.085	72.515	66.822
MOLES OF GAS	6.7116	6.5662	6.5661	6.5655
MOLECULAR COMPOSITION:				
H	0.1872	0.0001	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0009	0.0000	0.0000	0.0000
H2	3.3405	3.3315	3.3315	3.3305
O2	0.0015	0.0000	0.0000	0.0000
OH	0.0002	0.0000	0.0000	0.0000
H2O	4.0895	4.0875	4.0875	4.0875
N2	0.2959	0.2975	0.2975	0.2970
NH3	0.0001	0.0000	0.0000	0.0000
NO	0.0027	0.0000	0.0000	0.0000

CASE	N2								
PROPELLANT COMPOSITION		WEIGHT*	MOLAR						
H2		21.570							
O2		70.590							
N2		7.840							
INGREDIENT DATA:	FORMULA	HEAT OF FORM•	DENSITY	REF. TEMP.					
H2		-1.0870	710.0E-4	90.400					
O2		-3.0300	1.142	90.200					
N2		-2.0700	0.0080	77.400					
ATOMIC COMPOSITION(GM AT/100GM)									
H		21.5988							
O		0.5597							
N		4.4114							
PROPELLANT ENTHALPY		-27.796	KCAL/100 GM						
PROPELLANT DENSITY		0.2664	CM/CC						
CHARGE		EXHAUST							
CHARBER		EXHAUST							
500.0		7.350	0.7350	735.0E-4					
0.010		EXHAUST							
EXHAUST		EXHAUST							
735.0E-4		EXHAUST							
442.45		EXHAUST							
1.2592		EXHAUST							
348.73		EXHAUST							
0.80510		EXHAUST							
1.2471		EXHAUST							
1.5641		EXHAUST							
1.8522		EXHAUST							
7.5692		EXHAUST							
209.87		EXHAUST							
429.40		EXHAUST							
322.92		EXHAUST							
1.8309		EXHAUST							
6.9930		EXHAUST							
199.10		EXHAUST							
1.7470		EXHAUST							
13.200		EXHAUST							
57.535		EXHAUST							
199.10		EXHAUST							

WADD TN 60-254

CASE NAME
 3/SIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2507.7	1006.8	602.39	345.75
ENTHALPY (KILOCALORIS)	-27.796	-186.89	-227.86	-252.77
ENTROPY (CALORIE/DEG.K)	540.33	540.33	540.33	540.33
HEAT CAPACITY (CAL/K)	114.59	92.469	64.490	90.510
MOLES OF GAS	11.009	10.977	10.978	10.814
MOLECULAR COMPOSITION:				
F	0.0510	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.2661	6.2873	6.2851	6.0399
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0084	0.0000	0.0000	0.0000
H2O	4.4033	4.4117	4.4119	4.4119
N2	0.2797	0.2798	0.2790	0.1973
NH3	0.0002	0.0001	0.0010	0.1651
NO	0.0001	0.0000	0.0000	0.0000

CASE No.					
PROPELLANT COMPOSITION	WEIGHTS	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.
H2	25.340		-1.5270	710.0E-4	20.400
O2	67.170		-3.0490	1.142	20.200
N2	7.460		-2.7000	0.3080	77.400
INGREDIENT DATA:					
H2		H2			
O2		O2			
N2		N2			
ATOMIC COMPOSITION (GRAMS AT/100GM)					
H	25.166				
N	0.336				
O	4.191				
PROPELLANT ENTHALPY	-30.934	KCAL/100 GM			
PROPELLANT DENSITY	0.4351	GM/CC			
PRESSURE (PSI)					
SHIFTING EQUILIBRIA					
ISP (SEC)		CHAMBER	EXHAUST	EXHAUST	EXHAUST
IVP (LB-SEC/CU IN)	500.0		7.350	0.008	735.0E-4
TEMPERATURE (K)					
CP (CAL/GM-DEG.K)	222.4				
MOL. WT.-EFFECTIVE	1.447				
CP/CM -EFFECTIVE	7.771				
CP -APPROX.	1.2548				
PE/AT (SEC)					
AE/AT -APPROX.					
FROZEN EQUILIBRIA					
ISP (SEC)					
TEMPERATURE (K)	222.4				
C* (FT/SEC)	7602.0				
CF					
PLA/M (SEC)					
AE/AT					

WADD TN 60-254

CASE NO.	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
	500.0	7.350	0.7350	735.0E-4	
	22.2.4	255.98	475.09	300.34	
	-30.994	-188.50	-226.47	-248.17	
	60.17	601.17	601.17	601.17	
	124.27	101.31	95.655	90.366	
	12.857	12.950	12.819	12.332	
	0.0100	0.0000	0.0000	0.0000	
	0.0000	0.0000	0.0000	0.0000	
	0.0000	0.0000	0.0000	0.0000	
	8.5870	8.5849	8.5388	7.6094	
	0.0000	0.0000	0.0000	0.0000	
	0.0009	0.0000	0.0000	0.0000	
	4.1972	4.1981	4.1981	4.1981	
	0.2661	0.2558	0.2505	0.0070	
	0.0004	0.0009	0.0316	0.5185	
	0.0000	0.0000	0.0000	0.0000	

BASIS: 100 GM PROPELLANT
 PRESSURE (PSI)
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEGREE K)
 HEAT CAPACITY (CAL/K)
 MOLES OF GAS
 MOLECULAR COMPOSITION:
 H
 N
 O
 H2
 O2
 OH
 H2O
 NZ
 NH3
 NO

CASE NAME							
PROPELLANT COMPOSITION		WEIGHT%		HEAT OF FORM.	DENSITY	REF. TEMP.	
H2		20.010		-1.5370	710.0E-4	20.400	
O2		63.010		-3.0300	1.142	20.200	
N2		7.0000		-2.0000	0.6080	77.400	
INGREDIENT DATA:							
	FORMULA						
	H2						
	O2						
	N2						
ATOMIC COMPOSITION(GRAM AT/100GM)							
	H		29.7619				
	O		0.4947				
	N		3.7375				
PROPELLANT ENTHALPY							
			-34.849	ICAL/100 GM			
PROPELLANT DENSITY							
			0.2086	GM/CC			
PRESSURE (PSI)							
SHIFTING EQUILIBRIA							
	ISF (SEC)			EXHAUST	0.007	LB/CC IN	
	IVAP(LB-SEC/CC IN)			CHAMBER	0.7350	EXHAUST	735.0E-4
	TEMPERATURE (K)						
	CP (CAL/GM-DEG.K)	1874.5			402.63	415.25	
	MOL. WT. EFFECTIVE	1.2728			2.7909	3.0847	
	CP/CM EFFECTIVE	6.0001			390.30	296.16	
	CP APPROX.	1.2804			1.0880	1.0579	
	PE/AT (SEC)				6.7520	6.8321	
	AE/AT APPROX.				1.5708	1.5792	
FROZEN EQUILIBRIA							
	ISF (SEC)				1.7065	1.7400	
	TEMPERATURE (K)	1874.5			12.415	9.0864	
	CP (FI/SEC)	7571.0			35.797	261.99	
	CP						
	PE/AT (SEC)				402.68	409.42	
	AE/AT				360.92	296.10	
					1.7042	1.7352	
					11.742	9.5260	
					33.857	274.65	

WADD TN 60-254

CASE: N2
BASIS: 100 G4 PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	1874.5	672.10	390.39	296.16
ENTHALPY (KILOCALORIES)	-34.569	-186.04	-221.17	-253.04
ENTROPY (CALORIES/DEGREE K)	662.17	691.17	691.17	693.97
HEAT CAPACITY (CAL/K)	137.76	712.59	109.80	103.79
MOLES OF GAS	15.170	12.122	14.810	14.637
MOLECULAR COMPOSITION:				
H	0.0014	0.0000	0.0000	0.0000
N	0.0010	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	10.7415	11.7303	10.4630	10.2024
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	3.7374	3.7373	3.7373	3.7373
N2	0.2474	0.2450	0.2377	0.2326
NH3	0.0000	0.0084	0.0203	0.0440
NO	0.0000	0.0000	0.0000	0.0000

CASE N2					
PROPELLANT COMPOSITION	WEIGHT	MOLAR			
N2	9.0910				
O2	77.270				
N2	13.640				
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.	
N2	N2	-1.5370	710.0E-4	30.400	
O2	O2	-3.0490	1.142	90.200	
N2	N2	-2.7700	0.0080	77.400	
ATOMIC COMPOSITION(GM AT/100GM)					
H	9.0178				
N	0.9757				
O	4.8284				
PROPELLANT ENTHALPY	-17.357	KCAL/100 GM			
PROPELLANT DENSITY	0.4704	GM/CC	0.0170	LB/CC	IN
PRESSURE (PSI)	CHAMBER	EXHAUST	EXHAUST	EXHAUST	
SHIFTING EQUILIBRIA	500.0	7.350	0.7350	735.0E-4	
ISP (SEC)		330.52	391.71	425.60	
IVP(LB-SEC/CC IN)		5.7020	0.0577	7.2330	
TEMPERATURE (K)	347.4	227.0	102.7	102.0	
CF (CAL/GM-DEG.K)	0.6560	0.0532	0.57257	0.50561	
MOL. WT.-EFFECTIVE	17.645	19.150	19.337	19.395	
CP/CV -EFFECTIVE	1.2074	1.2025	1.2191	1.2542	
CF -APPROX.		1.0455	1.07675	2.1378	
PE/EM (SEC)		30.920	13.810	1.234	
WE/AT -APPROX.		10.565	04.294	305.00	
FOOTEN EQUILIBRIA					
ISP (SEC)		310.40	302.25	300.17	
TEMPERATURE (K)		3205.7	900.54	450.49	
C* (FT/SEC)					
CF		1.5842	1.0196	1.9497	
PE/EM (SEC)		24.637	12.239	5.4340	
WE/AT		0.4184	41.991	105.68	

WADD TN 60-254

CASE N2
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3417.4	2297.8	1822.7	1072.2
ENTHALPY (KILOCALORIES)	-17.317	-140.73	-193.69	-225.53
ENTROPY (CALORIES/DEG.K)	349.2	349.03	349.72	349.03
HEAT CAPACITY (CAL/K)	65.500	61.532	57.257	50.561
MOLES OF GAS	5.0675	5.2219	5.1541	5.1560
MOLECULAR COMPOSITION:				
H	0.1317	0.0082	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0812	0.0064	0.0001	0.0000
H2	0.4911	0.0712	0.0014	0.0000
O2	0.2472	0.1583	0.1587	0.1502
OH	0.4812	0.0833	0.0053	0.0000
H2O	3.7024	4.3919	4.5049	4.5089
N2	0.4513	0.4812	0.4860	0.4868
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0011	0.0112	0.0017	0.0000

CASE	IN-	MOLAR	
PROPELLANT COMPOSITION			
H2	12.240		
O2	74.530		
N2	13.130		
INGREDIENT DATA:	HEAT OF FORM.	DENSITY	REF. TEMP.
H2	-1.6970	710.0E-4	20.400
O2	-3.0900	1.142	90.200
N2	-2.3000	0.8090	77.400
ATOMIC COMPOSITION(GM AT/100GM)			
H	12.1805		
O	69.395		
N	4.06.0		
PROPELLANT ENTHALPY	-20.033	KCAL/100 G	
PROPELLANT DENSITY	0.9999	GM/CC	
CHAMBER	EXHAUST		
500.0	7.350		
PRESSURE (PSI)			
SHIFTING EQUILIBRIA			
ISP (SEC)	322.97	LB/CU IN	442.83
IVP(LB-SEC/CU IN)	3.1097	EXHAUST	6.2856
TEMPERATURE (K)	1929.7	EXHAUST	749.04
CP (CAL/GM-DEG.K)	0.71214	0.94045	0.96091
MOL. WT.-EFFECTIVE	15.233	15.242	15.242
CP/CV -EFFECTIVE	1.2242	1.2556	1.3026
CF -APPROX.	1.0562	1.0928	1.0373
PE/AT (SEC)	30.404	17.033	0.5949
AE/AT -APPROX.	9.9135	22.316	300.27
FROZEN EQUILIBRIA			
ISP (SEC)	343.62	394.96	421.06
TEMPERATURE (K)	1223.0	640.15	406.40
CF (FT/SEC)			
CF	1.2912	1.0172	1.9371
PLAE/M (SEC)	20.582	12.794	5.7772
AE/AT	9.3192	40.041	180.81

WADD TN 60-254

CASE N4
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3329.0	1928.7	1240.0	749.04
ENTHALPY (KILOCALORIES)	-20.073	-100.97	-210.01	-245.40
ENTROPY (CALORIES/DEGREE K)	405.62	405.92	405.92	405.92
HEAT CAPACITY (CAL/K)	76.440	71.214	64.043	56.091
MOLES OF GAS	6.3873	6.2655	6.2610	6.2610
MOLECULAR COMPOSITION:				
H	0.2371	0.0042	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0258	0.0000	0.0000	0.0000
H2	1.0610	1.0295	1.0431	1.0431
O2	0.0207	0.0000	0.0000	0.0000
OH	0.2906	0.0012	0.0000	0.0000
H2O	4.2663	3.0587	4.2660	4.2660
N2	0.4515	0.4597	0.4637	0.4697
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0158	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N4
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3246.5	1096.3	1055.6	617.15
ENTHALPY (KILOCALORIES)	-21.299	-175.65	-219.01	-246.44
ENTROPY (CALORIES/DEG.K)	420.69	420.69	420.69	428.69
HEAT CAPACITY (CAL/K)	84.344	74.678	66.005	59.255
MOLES OF GAS	7.5273	7.5222	7.5218	7.5217
MOLECULAR COMPOSITION:				
H	0.2247	0.0008	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0104	0.0000	0.0000	0.0000
H2	2.2739	2.2599	2.2603	2.2602
O2	0.0002	0.0000	0.0000	0.0000
OH	0.1795	0.0001	0.0000	0.0000
H2O	4.5642	4.5799	4.5800	4.5800
N2	0.4568	0.4615	0.4615	0.4615
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0004	0.0000	0.0000	0.0000

CASE	N2								
PROPELLANT COMPOSITION		WEIGHT%	HEAT OF FORM.	DENSITY	REF. TEMP.				
H2		15.250	-1.8970	710.0E-4	90.400				
O2		72.040	-3.0300	1.142	90.200				
N2		12.710	-2.0700	0.8080	77.400				
INGREDIENT DATA:	FORMULA								
H2	H2								
O2	O2								
N2	N2								
ATOMIC COMPOSITION (GM AT/100GM)									
H		15.1290							
N		0.9073							
O		4.5025							
PROPELLANT ENTHALPY		-22.524	KCAL/100 GM						
PROPELLANT DENSITY		0.3406	GM/CC						
PRESSURE (PSI)		500.0	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST	EXHAUST	EXHAUST
SHIFTING EQUILIBRIA				7.350	0.7350	0.0123	0.0123	0.0123	0.0123
ISP (SEC)									
IVSP (LB-SEC/CU IN)									
TEMPERATURE (K)		5110.8							
CP (CAL/GM-DEG.K)		0.89874							
MOL. WT. -EFFECTIVE		12.239							
CP/CV -EFFECTIVE		1.2205							
CF -APPROX.									
PEAE/M (SEC)									
AE/AT -APPROX.									
FROZEN EQUILIBRIA									
ISP (SEC)									
TEMPERATURE (K)		5110.8							
C* (FT/SEC)		7309.6							
CF									
PEAE/M (SEC)									
AE/AT									

WADD TN 60-254

CASE NAME	CHAMBER	EXHAUST	EXHAUST	EXHAUST
BASIS: 100 GM PROPELLANT	500.0	7.350	0.7350	735.0E-4
PRESSURE (PSI)	31.0.8	1512.8	916.18	522.88
TEMPERATURE (KELVIN)	-22.524	-170.68	-220.56	-246.39
ENTHALPY (KILOCALORIES)	451.09	451.99	451.99	451.99
ENTROPY (CALORIES/DEG.K)	89.874	77.820	68.741	62.959
HEAT CAPACITY (CAL/K)	8.1703	8.0182	8.0181	8.0177
MOLES OF GAS				
MOLECULAR COMPOSITION:				
H	0.1864	0.0001	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0037	0.0000	0.0000	0.0000
H2	3.0300	3.0619	3.0619	3.0613
O2	0.0002	0.0000	0.0000	0.0000
OH	0.1018	0.0000	0.0000	0.0000
H2O	4.2892	4.2025	4.2025	4.2025
N2	0.4515	0.4537	0.4536	0.4534
NH3	0.0001	0.0000	0.0000	0.0004
NO	0.0002	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N₂
 BASIS: 1.00 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2906.0	1503.2	600.66	452.77
ENTHALPY (KILOCALORIES)	-23.714	-170.67	-221.20	-245.70
ENTROPY (CALORIES/DEG.K)	474.75	474.06	474.06	474.06
HEAT CAPACITY (CAL/K)	95.072	80.897	71.678	46.905
MOLES OF GAS	0.0151	0.7150	0.7149	0.7110
MOLECULAR COMPOSITION:				
H	0.446	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0012	0.0000	0.0000	0.0000
H ₂	3.6079	3.0419	3.0418	3.0369
O ₂	0.0016	0.0000	0.0000	0.0000
OH	0.0574	0.0000	0.0000	0.0000
H ₂ O	4.0683	4.04269	4.04257	4.04267
N ₂	0.4452	0.4462	0.4451	0.4445
NH ₂	0.0001	0.0000	0.0001	0.0004
NO	0.0018	0.0000	0.0000	0.0000

WADD TN 60-254

CASE Nz
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2401.4	990.35	553.78	337.94
ENTHALPY (KILOCALORIES)	-27.824	-181.34	-217.68	-241.19
ENTROPY (CALORIES/DEG.K)	540.19	540.19	540.19	546.19
HEAT CAPACITY (CAL/K)	11.175	91.570	94.505	10.227
MOLES OF GAS	11.175	11.119	11.114	10.799
MOLECULAR COMPOSITION:				
H	0.0306	0.0000	0.0070	0.0000
N	0.0070	0.0000	0.0000	0.0000
O	0.0070	0.0000	0.0000	0.0000
H2	0.0145	6.0321	6.0250	6.0527
O2	0.0070	0.0000	0.0000	0.0000
OH	0.0070	0.0000	0.0000	0.0000
H2O	4.1670	4.1669	4.1659	4.1669
N2	0.4106	0.4196	0.4172	0.4598
NH2	0.0000	0.0000	0.0050	0.3139
NO	0.0000	0.0000	0.0000	0.0000

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CASE N4
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2119.4	790.11	445.56	300.94
ENTHALPY (KILOCALORIES)	-31.011	-180.74	-216.36	-237.34
ENTROPY (CALORIES/DEGREE)	590.12	590.12	590.12	590.12
HEAT CAPACITY (CAL/K)	120.27	100.65	95.690	89.744
MOLES OF GAS	12.947	14.082	12.895	12.219
MOLECULAR COMPOSITION:				
H	0.0064	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
F2	8.0160	8.0170	8.4869	7.4719
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0074	0.0000	0.0000	0.0000
H2O	3.7610	3.7544	3.7644	3.7644
N2	0.0004	0.0000	0.0000	0.0000
NH3	0.0006	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000

CASE	N4				
PROPELLANT COMPOSITION		WEIGHTS		MOLAL	
H2		9.0900			
O2		72.770			
N2		18.140			
INGREDIENT DATA:	FORMULA	HEAT OF FORM.		DENSITY	REF. TEMP.
H2	H2	-1.0970		710.00E-4	20.400
O2	O2	-2.0300		1.142	0.200
N2	N2	-2.7000		0.0090	77.400
ATOMIC COMPOSITION (GRAM/100GM)					
H		9.09178			
O		4.2978			
N		4.3410			
PROPELLANT ENTHALPY		-17.370	KCAL/100 GM		
PROPELLANT DENSITY		0.4618	GM/CC		
PRESSURE (PSI)		500.0	CHAMBER	0.0169	EXHAUST
SHIFTING EQUILIBRIA			EXHAUST	0.7350	735.00E-4
ISP (SEC)					
IVP(LJ-SEC/CG I)		300.25		391.48	425.52
TEMPERATURE (K)		500.40		0.0029	7.1769
CP (CAL/GM-DEG.K)		2277.0		1052.0	1072.1
MOL. WT. -EFFECTIVE		0.65610		0.57414	0.50552
CP/CG -EFFECTIVE		17.505		19.309	19.319
CF -APPROX.		1.20 6		1.2184	1.2548
PE/F/H (SEC)				1.07672	2.1383
AE/AT -APPROX.				10.875	11.275
FROZEN EQUILIBRIA				64.591	585.45
ISP (SEC)		310.10		301.35	187.40
TEMPERATURE (K)		1570.9		097.28	425.95
C* (FT/SEC)					
CF		1.0535		1.0182	1.0470
PE-F/H (SEC)		74.567		12.221	5.4179
AE/AT		8.5081		41.778	165.21

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CASE N2
 BASIS: 100 GM PROPELLANT
 PRESSURE (PSI)
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEGREE K)
 HEAT CAPACITY (CAL/K)
 MOLES OF GAS
 MOLECULAR COMPOSITION:
 H
 N
 O
 H2
 O2
 OH
 H2O
 N2
 NH2
 NO

CHAMBER	EXHAUST	EXHAUST	EXHAUST
500.0	7.350	0.7350	735.0E-4
3376.9	2277.0	1652.0	1072.1
-17.390	-140.57	-195.52	-225.48
347.74	347.34	347.34	349.34
65.603	61.576	57.414	50.652
5.7075	5.2542	5.1790	5.1762
0.1416	0.0092	0.0090	0.0090
0.0070	0.0000	0.0000	0.0000
0.0676	0.0035	0.0090	0.0000
0.0670	0.1097	0.0039	0.0000
0.1672	0.0557	0.0192	0.0185
0.4259	0.0584	0.0031	0.0000
3.0631	4.0654	4.0034	4.0089
0.0201	0.0453	0.0430	0.0489
0.0070	0.0000	0.0090	0.0000
0.0575	0.0071	0.0037	0.0090

CASE No.					
PROPELLANT COMPOSITION	WEIGHT%	MOLAR			
H2	12.280				
O2	70.180				
N2	17.540				
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.	
H2	H2	-1.5370	710.0E-4	20.400	
O2	O2	-3.0800	1.142	90.200	
N2	N2	-2.9900	0.6080	77.400	
ATOMIC COMPOSITION(GM AT/100GM)					
H	12.1825				
N	1.2521				
O	4.2862				
PROPELLANT ENTHALPY	-20.005	KCAL/100 GM			
PROPELLANT DENSITY	0.994	GM/CC			
	CHAMBER	EXHAUST			
	500.0	7.350	0.0141	LB/CC IN	
			EXHAUST	EXHAUST	
			0.7350	735.0E-4	
PRESSURE (PSI)			404.07	431.87	
SHIFTING EQUILIBRIA			2.7001	6.0922	
ISP (SEC)			111.8	657.09	
IVSP(LB-SEC/CC IN)	3201.1		0.02081	0.55386	
TEMPERATURE (K)	0.70418		14.887	14.887	
CP (CAL/GM-DEG.K)	14.360		1.2739	1.3172	
MOL. WT.-EFFECTIVE	1.2142		1.6727	2.0010	
CP/CC -EFFECTIVE			15.980	8.6362	
CF -APPROX.			50.384	276.59	
PEAE/M (SEC)					
AE/AT -APPROX.					
FROZEN EQUILIBRIA					
ISP (SEC)	3201.1		390.79	412.62	
TEMPERATURE (K)	6942.0		819.24	406.09	
C* (FT/SEC)					
CF					
PEAE/M (SEC)			1.0112	1.9263	
AE/AT			12.616	5.6801	
			39.777	185.39	

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3251.1	1756.3	1111.8	657.09
ENTHALPY (KILOCALORIES)	-20.065	-164.04	-207.71	-234.42
ENTROPY (CALORIES/DEG.K)	403.58	403.58	403.58	403.58
HEAT CAPACITY (CAL/K)	78.418	70.149	62.081	55.388
MOLFS OF GAS	6.9617	6.7181	6.7173	6.7173
MOLECULAR COMPOSITION:				
H	0.2042	0.0013	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0184	0.0000	0.0000	0.0000
H2	1.7614	1.7043	1.7050	1.7050
O2	0.0138	0.0000	0.0000	0.0000
OH	0.2070	0.0002	0.0000	0.0000
H2O	4.1220	4.3360	4.3862	4.3862
N2	0.0117	0.0061	0.0251	0.0260
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0118	0.0000	0.0000	0.0000

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CASE N4
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	F EXHAUST	E EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3145.7	1227.0	950.98	546.26
ENTHALPY (KILOCALORIES)	-21.370	-197.69	-207.34	-234.86
ENTROPY (CALORIES/DEGREE K)	428.01	428.01	428.01	428.01
HEAT CAPACITY (CAL/K)	84.212	72.511	64.884	59.021
MOLES OF GAS	7.017	7.4557	7.4550	7.4554
MOLECULAR COMPOSITION:				
H	0.1809	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0050	0.0000	0.0000	0.0000
H2	2.5154	2.5295	2.5296	2.5295
O2	0.0004	0.0000	0.0000	0.0000
OH	0.1134	0.0000	0.0000	0.0000
H2O	4.4742	4.5100	4.5106	4.5100
N2	0.0172	0.0154	0.0154	0.0152
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000

<p>CASE N2 PROPELLANT COMPOSITION H2 O2 N2</p>	<p>WEIGHT % 15.240 67.800 16.960</p>	<p>FORMULA</p>	<p>HEAT OF FORM. -1.6370 -3.0300 -2.7900</p>	<p>DENSITY REF. TEMP. 710.0E-4 20.400 1.142 90.200 0.6080 77.400</p>	<p>MOLAR</p>
<p>INGREDIENT DATA: H2 O2 N2</p>	<p>FORMULA H2 O2 N2</p>	<p>HEAT OF FORM. -1.6370 -3.0300 -2.7900</p>	<p>DENSITY REF. TEMP. 710.0E-4 20.400 1.142 90.200 0.6080 77.400</p>	<p>MOLAR</p>	
<p>ATOMIC COMPOSITION(GM AT/100GM) H O C</p>	<p>15.240 1.2170 4.2375 -22.574</p>	<p>KCAL/100 GM GM/CC EXHAUST CHAMBER 500.0 7.350</p>	<p>DENSITY REF. TEMP. 710.0E-4 20.400 1.142 90.200 0.6080 77.400</p>	<p>MOLAR</p>	
<p>PROPELLANT ENTHALPY PROPELLANT DENSITY</p>	<p>2994.7 0.89617 12.080 1.4280</p>	<p>KCAL/100 GM GM/CC EXHAUST CHAMBER 500.0 7.350</p>	<p>DENSITY REF. TEMP. 710.0E-4 20.400 1.142 90.200 0.6080 77.400</p>	<p>MOLAR</p>	
<p>PRESSURE (PSI) SHIFTING EQUILIBRIA ISP (SEC) IVSP(LB-SEC/CU IN) TEMPERATURE (K) CP (CAL/GM-DEG.K) MOL. WT.-EFFECTIVE CP/CV -EFFECTIVE CF -APPROX. PEAE/M (SEC) AE/AT -APPROX.</p>	<p>2994.7 0.89617 12.080 1.4280</p>	<p>KCAL/100 GM GM/CC EXHAUST CHAMBER 500.0 7.350</p>	<p>DENSITY REF. TEMP. 710.0E-4 20.400 1.142 90.200 0.6080 77.400</p>	<p>MOLAR</p>	
<p>FROZEN EQUILIBRIA ISP (SEC) TEMPERATURE (K) C* (FT/SEC) CF PEAE/M (SEC) AE/AT</p>	<p>2994.7 727.9</p>	<p>KCAL/100 GM GM/CC EXHAUST CHAMBER 500.0 7.350</p>	<p>DENSITY REF. TEMP. 710.0E-4 20.400 1.142 90.200 0.6080 77.400</p>	<p>MOLAR</p>	

WADD TN 60-254

CASE	Nz	CHAMBER	EXHAUST	EXHAUST	EXHAUST
		500.0	7.350	0.7350	735.0E-4
		2974.7	1592.0	829.38	466.55
		-22.534	-170.05	-210.87	-234.50
		450.0	450.90	450.96	450.96
		89.617	79.703	67.819	42.996
		8.2728	8.1595	8.1694	8.1672
		0.1586	0.0000	0.0000	0.0000
		0.0000	0.0000	0.0000	0.0000
		0.0015	0.0000	0.0000	0.0000
		3.2975	3.2767	3.2269	3.3235
		0.0000	0.0000	0.0000	0.0000
		0.0603	0.0000	0.0000	0.0000
		4.1713	4.2375	4.2375	4.2375
		0.0007	0.0050	0.6050	0.6038
		0.0001	0.0000	0.0001	0.0025
		0.0000	0.0000	0.0000	0.0000

WASIS: 100 GM PROPELLANT

PRESSURE (PSI)
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEGREE K)
 HEAT CAPACITY (CAL/K)
 MOLES OF GAS
 MOLECULAR COMPOSITION:

H
 N
 O
 H2
 O2
 OH
 H2O
 N2
 NH3
 NO

<p>CASE N₂</p> <p>PROPELLANT COMPOSITION</p> <p>H₂ 16.640</p> <p>O₂ 66.670</p> <p>N₂ 16.670</p>	<p>WEIGHTS</p> <p>16.640</p> <p>66.670</p> <p>16.670</p>	<p>MOLAR</p>	
<p>INGREDIENT DATA:</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0300</p> <p>-2.7900</p>	<p>DENSITY REF. TEMP.</p> <p>710.0E-4 20.400</p> <p>1.142 20.200</p> <p>0.0080 77.400</p>
<p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H 16.0278</p> <p>N 1.1910</p> <p>O 4.1659</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0300</p> <p>-2.7900</p>	<p>DENSITY REF. TEMP.</p> <p>710.0E-4 20.400</p> <p>1.142 20.200</p> <p>0.0080 77.400</p>
<p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0300</p> <p>-2.7900</p>	<p>DENSITY REF. TEMP.</p> <p>710.0E-4 20.400</p> <p>1.142 20.200</p> <p>0.0080 77.400</p>
<p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOLE WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT -APPROX.</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0300</p> <p>-2.7900</p>	<p>DENSITY REF. TEMP.</p> <p>710.0E-4 20.400</p> <p>1.142 20.200</p> <p>0.0080 77.400</p>
<p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>C* (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0300</p> <p>-2.7900</p>	<p>DENSITY REF. TEMP.</p> <p>710.0E-4 20.400</p> <p>1.142 20.200</p> <p>0.0080 77.400</p>
<p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0300</p> <p>-2.7900</p>	<p>DENSITY REF. TEMP.</p> <p>710.0E-4 20.400</p> <p>1.142 20.200</p> <p>0.0080 77.400</p>
<p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOLE WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT -APPROX.</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0300</p> <p>-2.7900</p>	<p>DENSITY REF. TEMP.</p> <p>710.0E-4 20.400</p> <p>1.142 20.200</p> <p>0.0080 77.400</p>
<p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>C* (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>FORMULA</p> <p>H₂</p> <p>O₂</p> <p>N₂</p>	<p>HEAT OF FORM.</p> <p>-1.0870</p> <p>-3.0300</p> <p>-2.7900</p>	<p>DENSITY REF. TEMP.</p> <p>710.0E-4 20.400</p> <p>1.142 20.200</p> <p>0.0080 77.400</p>

WADD TN 60-254

CASE NL
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2842.0	1297.6	732.29	408.80
ENTHALPY (KILOCALORIES)	-23.726	-174.60	-211.19	-253.69
ENTROPY (CALORIES/DEG.K)	472.54	472.54	472.54	472.54
HEAT CAPACITY (CAL/K)	94.652	80.181	71.034	67.009
MOLES OF GAS	8.9236	5.5585	8.8587	8.8419
MOLECULAR COMPOSITION:				
H	0.0974	0.0000	0.0000	0.0000
N	0.0010	0.0000	0.0000	0.0000
O	0.0004	0.0000	0.0000	0.0000
H2	4.0519	4.0969	4.0967	4.0715
O2	0.0032	0.0000	0.0000	0.0000
OH	0.0310	0.0000	0.0000	0.0000
H2O	4.1321	4.1569	4.1669	4.1669
N2	0.0584	0.0950	0.0949	0.0965
NH3	0.0011	0.0000	0.0002	0.00170
NO	0.0010	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2354.0	915.94	508.62	320.52
ENTHALPY (KILOCALORIES)	-27.852	-175.58	-209.32	-229.67
ENTROPY (CALORIES/DEGREE K)	545.60	545.60	545.60	545.60
HEAT CAPACITY (CAL/K)	110.87	90.524	84.596	79.838
MOLES OF GAS	11.258	11.255	11.243	10.755
MOLECULAR COMPOSITION:				
H	0.0172	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.7692	6.7765	6.7535	6.0215
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0017	0.0000	0.0000	0.0000
H2O	3.9201	3.9219	3.9219	3.9219
N2	0.0594	0.0594	0.0517	0.0377
NH3	0.0004	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000

CASE No							
PROPELLANT COMPOSITION	WEIGHT%	MOLAR					
H2	25.370						
O2	59.710						
N2	14.930						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.			
H2		-1.6970	710.0E-4	20.400			
O2		-3.0900	1.142	90.200			
N2		-2.9000	0.8030	77.400			
ATOMIC COMPOSITION(GM AT/100GM)							
H	25.1696						
O	1.0608						
N	3.7312						
PROPELLANT ENTHALPY	-31.038	KCAL/100 GM					
PROPELLANT DENSITY	0.2336	GM/CC					
PRESSURE (PSI)	500.0	CHAMBER					
SHIFTING EQUILIBRIA		EXHAUST	0.008	LB/CC	IN		
ISP (SEC)		EXHAUST	0.7350		EXHAUST		
IVSP(LB-SEC/CC IN)							
TEMPERATURE (K)	2004.8						
CP (CAL/GM-DEG.K)	1.2214						
MOL. WT.-EFFECTIVE	7.0231						
CP/CV -EFFECTIVE	1.2713						
CF -APPROX.							
PEAE/M (SEC)							
AE/AT -APPROX.							
FROZEN EQUILIBRIA							
ISP (SEC)							
TEMPERATURE (K)	2004.8						
C* (FT/SEC)	7328.2						
CF							
PEAE/M (SEC)							
AE/AT							

WADD TN 60-254

CASE NZ
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2004.6	730.03	421.19	421.19	300.27
ENTHALPY (KILOCALORIES)	-31.038	-172.86	-206.24	-206.24	-226.61
ENTROPY (CALORIES/DEG.K)	594.78	594.58	594.58	594.58	594.58
HEAT CAPACITY (CAL/K)	122.14	100.14	95.525	95.525	89.103
MOLES OF GAS	13.116	13.113	12.917	12.917	12.106
MOLECULAR COMPOSITION:					
H	0.0031	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000	0.0000
H2	8.0502	8.0464	8.0529	8.0529	7.3394
O2	0.0000	0.0000	0.0000	0.0000	0.0000
OH	0.0001	0.0000	0.0000	0.0000	0.0000
H2O	3.7311	3.7312	3.7312	3.7312	3.7312
N2	0.0000	0.0000	0.0000	0.0000	0.0000
NH3	0.0000	0.0000	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	1679.2	586.51	375.44	298.16
ENTHALPY (KILOCALORIES)	-34.920	-170.57	-202.43	-213.07
ENTROPY (CALORIES/DEG.K)	652.40	652.40	652.40	687.10
HEAT CAPACITY (CAL/K)	134.37	115.48	107.64	104.48
MOLES OF GAS	15.378	15.333	14.640	14.405
MOLECULAR COMPOSITION:				
H	0.0003	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	11.2775	11.2094	10.2703	9.9169
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	3.2000	3.2000	3.2000	3.5000
N2	0.4986	0.4759	0.1295	0.0117
NH3	0.0022	0.0477	0.7404	0.9760
NO	0.0000	0.0000	0.0000	0.0000

CASE No.							
PROPELLANT COMPOSITION	WEIGHT%	MOLAR					
H2	9.0900						
O2	68.180						
N2	22.730						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.			
H2	H2	-1.0970	/10.0E-4	20.400			
O2	O2	-3.0900	1.142	90.200			
N2	N2	-2.9000	0.0080	77.400			
ATOMIC COMPOSITION(GM AT/100GM)							
H	9.09178						
N	1.0226						
O	4.2612						
PROPELLANT ENTHALPY	-17.424	KCAL/100 GM					
PROPELLANT DENSITY	0.4632	GM/CC					
PRESSURE (PSI)	500.0	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST	
SHIFTING EQUILIBRIA			7.350	0.7350	0.0167	735.0E-4	
ISP (SEC)	355.81				387.06	418.06	
IVSP(LB-SEC/CU IN)	5.5872				6.4785	6.9975	
TEMPERATURE (K)	2175.3				1463.8	921.17	
CP (CAL/GM-DEG.K)	0.6790				0.56137	0.49066	
MOL. WT.-EFFECTIVE	17.421				18.796	18.796	
CP/CV -EFFECTIVE	1.2100				1.2320	1.2747	
CF -APPROX.					1.9480	2.1040	
PEAE/M (SEC)					17.395	10.135	
AE/AT -APPROX.					59.555	347.00	
FROZEN EQUILIBRIA							
ISP (SEC)	314.47				361.38	387.15	
TEMPERATURE (K)	1349.1				875.27	398.90	
C* (FT/SEC)							
CF	1.0827				1.5138	1.9485	
PEAE/M (SEC)	24.448				11.993	5.1134	
AE/AT	8.5705				41.059	175.07	

WADD TN 60-254

CASE Nz
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3305.9	2175.3	1463.8	921.17
ENTHALPY (KILOCALORIES)	-17.424	-140.40	-187.60	-210.28
ENTROPY (CALORIES/DEGREE-K)	347.43	347.43	347.43	349.43
HEAT CAPACITY (CAL/K)	65.700	51.270	50.137	49.066
MOLES OF GAS	5.74.3	5.3572	5.3203	5.3202
MOLECULAR COMPOSITION:				
H	0.1423	0.0081	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0451	0.0000	0.0000	0.0000
H2	0.0519	0.2399	0.2477	0.2477
O2	0.1019	0.0027	0.0000	0.0000
OH	0.2507	0.0181	0.0000	0.0000
H2O	3.0085	4.2359	4.2612	4.2612
N2	0.7807	0.0100	0.0113	0.0113
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0041	0.0014	0.0000	0.0000

CASE N2							
PROPELLANT COMPOSITION	WEIGHT%	INCLAN					
H2	10.710						
O2	66.970						
N2	22.320						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.			
H2	H2	-1.8870	710.0E-4	20.400			
O2	O2	-3.0400	1.142	60.200			
N2	N2	-2.9000	0.6080	77.400			
ATOMIC COMPOSITION(GM AT/100GM)							
H	10.6250						
N	1.5934						
O	4.1856						
PROPELLANT ENTHALPY	-18.781	KCAL/100 GM					
PROPELLANT DENSITY	0.4217	GM/CC					
PRESSURE (PSI)	500.0	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST	EXHAUST
SHIFTING EQUILIBRIA			7.350	0.7350	0.0152	735.0E-4	
ISP (SEC)					392.38	420.26	
IVSP(LB-SEC/OU IN)					5.9789	6.4038	
TEMPERATURE (K)	3310.0				1164.1	709.51	
CP (CAL/GM-DEG.K)	0.72291				0.58006	0.51503	
MOL. WT.-EFFECTIVE	15.679				16.369	16.369	
CP/CV -EFFECTIVE	1.2128				1.2647	1.2084	
CF -APPROX.					1.0938	2.0251	
PEAE/M (SEC)					15.940	8.9171	
AE/AT -APPROX.					52.251	292.30	
FROZEN EQUILIBRIA							
ISP (SEC)					370.83	400.83	
TEMPERATURE (K)	3310.0				632.05	414.46	
C* (FT/SEC)	6676.9						
CF					1.6158	1.9315	
PEAE/M (SEC)					12.176	5.7018	
AE/AT					39.912	186.90	

WADD TN 60-275

CASE Nz
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3310.0	1854.7	1184.1	709.51
ENTHALPY (KILOCALORIES)	-18.781	-155.76	-195.72	-221.76
ENTROPY (CALORIES/DEG.K)	377.10	377.10	377.10	377.10
HEAT CAPACITY (CAL/K)	72.221	65.387	58.006	51.505
MOLES OF GAS	6.5761	6.1105	6.1092	5.1092
MOLECULAR COMPOSITION:				
H	0.1809	0.0021	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0204	0.0000	0.0000	0.0000
H2	1.2522	1.1261	1.1269	1.1269
O2	0.0256	0.0000	0.0000	0.0000
OH	0.2415	0.0005	0.0000	0.0000
H2O	3.0491	4.1850	4.1856	4.1856
N2	0.7850	0.7967	0.7967	0.7967
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0235	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3162.5	1011.1	993.31	575.23
ENTHALPY (KILOCALORIES)	-20.096	-156.27	-196.66	-222.85
ENTROPY (CALORIES/DEG.K)	402.94	402.94	402.94	402.94
HEAT CAPACITY (CAL/K)	78.333	69.021	60.922	54.996
MOLES OF GAS	7.0446	6.6742	6.6740	6.6739
MOLECULAR COMPOSITION:				
H	0.1715	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0069	0.0000	0.0000	0.0000
H2	1.9890	1.9792	1.9794	1.9792
O2	0.0056	0.0000	0.0000	0.0000
OH	0.1353	0.0000	0.0000	0.0000
H2O	3.9429	4.1116	4.1119	4.1119
N2	0.7730	0.7826	0.7826	0.7827
NH3	0.0000	0.0000	0.0000	0.0001
NO	0.0045	0.0000	0.0000	0.0000

CASE N2							
PROPELLANT COMPOSITION	WEIGHTS	MOLES					
H2	13.790						
O2	64.660						
N2	21.550						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.			
H2		-1.6970	710.0E-4	20.400			
O2		-3.0300	1.142	90.200			
N2		-2.7000	0.8080	77.400			
ATOMIC COMPOSITION(GM AT/100GM)							
H	13.0806						
N	1.5384						
O	4.0412						
PROPELLANT ENTHALPY	-21.362	KCAL/100 GM					
PROPELLANT DENSITY	0.3603	GM/CC					
PRESSURE (PSI)	500.0	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST	
SHIFTING EQUILIBRIA			7.350	0.7350	0.0130	735.0E-4	
ISP (SEC)							
IVSP(LB-SEC/CU IN)	348.71				394.42	418.75	
TEMPERATURE (K)	4.0398				5.1350	5.4517	
CP (CAL/GM-DEG.K)	1424.9				853.61	482.79	
MOL. WT.-EFFECTIVE	0.83994				0.63872	0.58992	
CP/CV -EFFECTIVE	12.960				13.142	13.144	
CF -APPROX.	1.2233				1.3102	1.3448	
PEAE/M (SEC)					1.8128	1.9248	
AE/AT -APPROX.					44.238	7.5837	
FROZEN EQUILIBRIA					44.518	37.11	
ISP (SEC)	342.23				388.87	410.78	
TEMPERATURE (K)	1321.2				735.45	401.93	
C* (FT/SEC)							
CF	1.0729				1.7873	1.8880	
PEAE/M (SEC)	23.754				12.617	6.5275	
AE/AT	8.0523				39.448	204.09	

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3026.0	1424.9	853.61	482.79
ENTHALPY (KILOCALORIES)	-21.362	-161.11	-200.15	-222.89
ENTROPY (CALORIES/DEG.K)	420.99	426.99	426.99	426.99
HEAT CAPACITY (CAL/K)	93.934	72.387	63.872	58.992
MOLES OF GAS	7.7161	7.6095	7.6094	7.6081
MOLECULAR COMPOSITION:				
H	0.1551	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0020	0.0000	0.0000	0.0000
H2	2.7735	2.7990	2.7990	2.7969
O2	0.0012	0.0000	0.0000	0.0000
OH	0.0625	0.0000	0.0000	0.0000
H2O	3.9650	4.0412	4.0412	4.0412
N2	0.7673	0.7592	0.7692	0.7685
NH3	0.0001	0.0000	0.0000	0.0014
NO	0.0036	0.0000	0.0000	0.0000

<p>CASE NO.</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>WEIGHTS</p> <p>15.250</p> <p>63.560</p> <p>21.170</p>	<p>MOLE%</p> <p>-1.5970</p> <p>-3.0080</p> <p>-2.0000</p>	<p>HEAT OF FORM.</p> <p>-1.5970</p> <p>-3.0080</p> <p>-2.0000</p>	<p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0030</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>20.200</p> <p>77.400</p>
<p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p>				
<p>ATOMIC COMPOSITION(GM AT/100GM)</p> <p>H</p> <p>V</p> <p>O</p>	<p>15.1290</p> <p>1.5127</p> <p>3.9725</p>				
<p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p>	<p>-22.585 KCAL/100 GM</p> <p>0.3371 GM/CC</p>	<p>EXHAUST</p> <p>EXHAUST</p>	<p>0.0122 LB/CC IN</p> <p>735.0E-4</p>		
<p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT -APPROX.</p>	<p>CHAMBER</p> <p>500.0</p> <p>2802.7</p> <p>0.87260</p> <p>11.905</p> <p>1.4235</p>	<p>7.350</p> <p>347.49</p> <p>4.2563</p> <p>1275.2</p> <p>0.75922</p> <p>12.015</p> <p>1.2784</p> <p>1.5371</p> <p>20.270</p> <p>8.1152</p>	<p>0.7350</p> <p>393.75</p> <p>4.7953</p> <p>740.20</p> <p>0.67114</p> <p>12.015</p> <p>1.5269</p> <p>1.7831</p> <p>13.635</p> <p>42.115</p>	<p>EXHAUST</p> <p>EXHAUST</p>	<p>735.0E-4</p> <p>116.90</p> <p>5.0772</p> <p>416.92</p> <p>0.63120</p> <p>12.030</p> <p>1.5542</p> <p>1.6932</p> <p>7.1834</p> <p>241.91</p>
<p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>C* (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>2802.7</p> <p>7005.1</p>	<p>340.41</p> <p>1420.5</p>	<p>390.42</p> <p>660.51</p>		
<p>TEMPERATURE (K)</p> <p>C* (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>7005.1</p>	<p>1.0580</p> <p>25.617</p> <p>7.0136</p>	<p>1.7729</p> <p>12.637</p> <p>39.036</p>		

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2862.7	1276.2	746.20	416.92
ENTHALPY (KILOCALORIES)	-22.585	-102.95	-200.77	-222.35
ENTROPY (CALORIES/DEG*G)	447.56	447.56	449.56	449.56
HEAT CAPACITY (CAL/K)	89.260	75.922	67.114	65.120
MOLES OF GAS	8.5897	8.5208	8.5206	8.3081
MOLECULAR COMPOSITION:				
H	0.0946	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0005	0.0000	0.0000	0.0000
H2	3.5229	3.5219	3.5217	3.5729
O2	0.0002	0.0000	0.0000	0.0000
OH	0.0323	0.0000	0.0000	0.0000
H2O	3.7378	3.7725	3.7725	3.9725
N2	0.7556	0.7563	0.7562	0.7500
NH3	0.0001	0.0000	0.0002	0.0127
NO	0.0013	0.0000	0.0000	0.0000

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.7350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2723.0	1124.0	0.7350	374.44
ENTHALPY (KILOCALORIES)	-23.775	-104.20	-200.87	-221.50
ENTROPY (CALORIES/DEG.K)	470.92	470.92	470.92	470.92
HEAT CAPACITY (CAL/K)	94.194	78.062	70.668	67.085
MOLES OF GAS	9.0507	9.0122	9.0110	8.9399
MOLECULAR COMPOSITION:				
H	0.0616	0.0700	0.0000	0.0000
N	0.0000	0.0700	0.0000	0.0000
O	0.0001	0.0000	0.0000	0.0000
H2	4.2305	4.3624	4.3613	4.2539
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0146	0.0000	0.0000	0.0000
H2O	3.0919	3.0064	3.0052	3.0062
N2	0.7472	0.7434	0.7431	0.7075
NH3	0.0002	0.0001	0.0007	0.0025
NO	0.0005	0.0700	0.0000	0.0000

GASF	N ₂								
PROPELLANT COMPOSITION		WEIGHTS		MOLAR		DENSITY		REF. TEMP.	
H ₂		25.370		-1.5870		710.0E-4		20.400	
O ₂		55.970		-3.05400		1.142		90.200	
N ₂		18.660		-2.99000		0.8080		77.400	
INGREDIENT DATA:		FORMULA		HEAT OF FORM.					
H ₂									
O ₂									
N ₂									
ATOMIC COMPOSITION(GM AT/100GM)									
H		25.1656							
N		1.3321							
O		3.4931							
PROPELLANT ENTHALPY		-31.065		KCAL/100 GM					
PROPELLANT DENSITY		0.2329		GM/CC					
PRESSURE (PSI)		CHAMBER		EXHAUST					
SHIFTING EQUILIBRIA		500.0		7.350					
ISP (SEC)									
IVSP(LB-SEC/CU IN)								0.008 LB/CU IN	
TEMPERATURE (K)		1888.5						EXHAUST	
CP (CAL/GM-DEG.K)		1.2098						0.7350	
MOL. WT.-EFFECTIVE		7.5475							
CP/CV -EFFECTIVE		1.2785							
CF -APPROX.									
PEAE/M (SEC)									
AE/AT -APPROX.									
FROZEN EQUILIBRIA									
ISP (SEC)		1808.5							
TEMPERATURE (K)		7124.0							
C* (FT/SEC)									
CF									
PEAE/M (SEC)									
AE/AT									

WADD TN 60-254

CASE N2
 BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	1828.5	581.89	405.12	396.80
ENTHALPY (KILOCALORIES)	-31.065	-164.82	-196.15	-216.00
ENTROPY (CALORIES/DEG.K)	590.15	590.55	590.53	590.53
HEAT CAPACITY (CAL/K)	120.3	99.822	95.154	88.422
MOLES OF GAS	13.20	12.240	12.834	11.994
MOLECULAR COMPOSITION:				
H	0.0014	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	0.0805	0.0703	0.0366	0.0000
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	0.0000	0.0000	0.0000	0.0000
N2	0.0000	0.0000	0.0000	0.0000
N2O	0.0000	0.0000	0.0000	0.0000
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000

<p>CASE NAME</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>ATOMIC COMPOSITION (GM AT/100GM)</p> <p>H</p> <p>N</p> <p>O</p> <p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p> <p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVJP (LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT -APPROX.</p> <p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>C* (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>WEIGHTS</p> <p>30.000</p> <p>52.500</p> <p>17.500</p> <p>HEAT OF FURY.</p> <p>-1.0370</p> <p>-3.0000</p> <p>-2.0000</p> <p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>KCAL/100 GM</p> <p>GM/CC</p> <p>CHAMBER</p> <p>500.0</p> <p>29.7619</p> <p>1.2475</p> <p>3.2812</p> <p>-34.945</p> <p>0.2080</p> <p>EXHAUST</p> <p>7.350</p> <p>1500.0</p> <p>1.2274</p> <p>6.4510</p> <p>1.3002</p> <p>1500.0</p> <p>1500.0</p> <p>7012.0</p>	<p>MULAI</p> <p>HEAT OF FURY.</p> <p>-1.0370</p> <p>-3.0000</p> <p>-2.0000</p> <p>DENSITY</p> <p>710.0E-4</p> <p>1.142</p> <p>0.8030</p> <p>0.007</p> <p>0.7350</p> <p>271.13</p> <p>2.7350</p> <p>360.60</p> <p>1.0630</p> <p>0.8860</p> <p>1.2698</p> <p>1.7028</p> <p>2.4094</p> <p>38.710</p> <p>360.95</p> <p>290.10</p> <p>1.0830</p> <p>10.891</p> <p>33.991</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>30.200</p> <p>77.400</p> <p>EXHAUST</p> <p>EXHAUST</p> <p>735.0E-4</p> <p>382.44</p> <p>2.9189</p> <p>298.10</p> <p>1.0380</p> <p>4.0962</p> <p>1.3764</p> <p>1.7540</p> <p>9.6344</p> <p>300.70</p> <p>360.95</p> <p>290.10</p> <p>1.0830</p> <p>10.891</p> <p>33.991</p>
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WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0UE-4
TEMPERATURE (KELVIN)	1500.0	547.25	366.66	299.16
ENTHALPY (KILOCALORIS)	-34.945	-162.74	-193.24	-203.03
ENTROPY (CALORIES/DEG-K)	647.16	647.16	647.16	683.59
HEAT CAPACITY (CAL/K)	132.74	113.43	106.90	103.80
MOLES OF GAS	15.512	13.395	14.522	14.293
MOLECULAR COMPOSITION:				
H	0.0011	0.0000	0.0000	0.0000
N	0.0010	0.0000	0.0000	0.0000
O	0.0010	0.0000	0.0000	0.0000
H2	11.5947	11.4377	10.1240	9.7814
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	3.2812	3.2812	3.2812	3.2812
N2	0.0210	0.0205	0.1330	0.0185
NH3	0.0015	0.1080	0.0834	1.2122
NO	0.0010	0.0000	0.0000	0.0000

<p>CASE NO.</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>INGREDIENT DATA:</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>ATOMIC COMPOSITION (GM AT/100GM)</p> <p>H</p> <p>N</p> <p>O</p> <p>PROPELLANT ENTHALPY</p> <p>PROPELLANT DENSITY</p> <p>PRESSURE (PSI)</p> <p>SHIFTING EQUILIBRIA</p> <p>ISP (SEC)</p> <p>IVSP (LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PEAE/M (SEC)</p> <p>AE/AT -APPROX.</p> <p>FROZEN EQUILIBRIA</p> <p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF* (FT/SEC)</p> <p>CF</p> <p>PEAE/M (SEC)</p> <p>AE/AT</p>	<p>WEIGHT%</p> <p>10.000</p> <p>63.000</p> <p>27.000</p> <p>HEAT OF FORM.</p> <p>-1.0970</p> <p>-7.0800</p> <p>-2.0700</p> <p>KCAL/100 GM</p> <p>GM/CC</p> <p>EXHAUST</p> <p>CHAMBER</p> <p>500.0</p> <p>3273.6</p> <p>0.67408</p> <p>16.243</p> <p>1.2140</p> <p>3275.6</p> <p>1.6</p>	<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p> <p>EXHAUST</p> <p>7.350</p> <p>300.73</p> <p>0.2555</p> <p>1794.9</p> <p>0.62630</p> <p>10.970</p> <p>1.2310</p> <p>1.0464</p> <p>07.550</p> <p>9.2401</p> <p>320.25</p> <p>1404.9</p> <p>1.03900</p> <p>24.579</p> <p>8.2925</p>	<p>MOLAR</p> <p>DENSITY</p> <p>REF. TEMP.</p> <p>710.0E-4</p> <p>1.142</p> <p>0.0030</p> <p>0.0157 LB/CU IN</p> <p>EXHAUST</p> <p>735.0E-4</p> <p>381.50</p> <p>0.0078</p> <p>1158.0</p> <p>0.50529</p> <p>10.880</p> <p>1.2600</p> <p>1.0821</p> <p>15.260</p> <p>51.302</p> <p>367.71</p> <p>620.15</p> <p>1.0141</p> <p>11.871</p> <p>39.841</p> <p>0.0010</p> <p>0.4277</p> <p>277.50</p> <p>0.49350</p> <p>10.880</p> <p>1.0135</p> <p>0.0137</p> <p>0.5015</p> <p>085.32</p> <p>590.98</p> <p>409.94</p> <p>1.0288</p> <p>5.5807</p> <p>167.29</p>
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WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	3273.8	1794.9	1138.6	677.50
ENTHALPY (KILOCALORIES)	-18.219	-146.22	-185.48	-209.68
ENTROPY (CALORIES/DEGREE K)	364.75	64.75	364.75	64.75
HEAT CAPACITY (CAL/K)	69.408	62.635	55.529	49.350
MOLES OF GAS	6.1563	5.9248	5.9240	5.9240
MOLECULAR COMPOSITION:				
H	0.1541	0.0012	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0168	0.0000	0.0000	0.0000
H2	1.1344	1.0224	1.0228	1.0228
O2	0.0220	0.0000	0.0000	0.0000
OH	0.2099	0.0003	0.0000	0.0000
H2O	3.0439	3.7372	3.7375	3.9375
N2	0.7502	0.7557	0.7637	0.9637
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0230	0.0000	0.0000	0.0000

CASE	N ₂								
PROPELLANT COMPOSITION		WEIGHT%		FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.		
H ₂		16.000		H ₂	-1.0970	710.0E-4	90.400		
O ₂		58.800		O ₂	-3.00900	1.142	90.200		
N ₂		25.200		N ₂	-2.09000	0.8080	77.400		
INGREDIENT DATA:									
H ₂									
O ₂									
N ₂									
ATOMIC COMPOSITION(GM AT/100GM)									
H		15.0730							
N		1.7960							
O		3.0750							
PROPELLANT ENTHALPY		-23.244	KCAL/100 GM						
PROPELLANT DENSITY		0.0246	GM/CC						
CHAMBER		500.0		EXHAUST		0.0117	LB/CU IN		
PRESSURE (PSI)						0.7350	EXHAUST		
SHIFTING EQUILIBRIA							735.0E-4		
ISP (SEC)									
IVSP(LB-SEC/CU IN)									
TEMPERATURE (K)		2629.0							
CP (CAL/GM-DEG.K)		0.91340							
MOL. WT.-EFFECTIVE		11.282							
CP/CV -EFFECTIVE		1.0239							
CF -APPROX.									
PEAE/M (SEC)									
AE/AT -APPROX.									
FROZEN EQUILIBRIA									
ISP (SEC)									
TEMPERATURE (K)		2629.0							
C* (FT/SEC)		6901.6							
CF									
PEAE/M (SEC)									
AE/AT									

WADD TN 60-254

CASE NL
BASIS: 100 GM PROPELLANT

PROPERTY	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2629.0	1104.1	620.64	762.97
ENTHALPY (KILOCALORIS)	-23.204	-150.04	-190.33	-209.57
ENTROPY (CALORIES/DEG.K)	450.09	726.89	450.89	450.89
HEAT CAPACITY (CAL/K)	91.340	70.607	68.645	65.193
MOLES OF GAS	8.0604	8.0350	6.0347	6.7128
MOLECULAR COMPOSITION:				
H	0.0432	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0001	0.0000	0.0000	0.0000
H2	4.2433	4.2613	4.2596	4.0767
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	3.0600	3.0750	3.0750	3.0750
N2	0.0902	0.0904	0.0988	0.0379
NH3	0.0002	0.0001	0.0013	0.1232
NO	0.0003	0.0000	0.0000	0.0000

CASE NO.							
PROPELLANT COMPOSITION	WEIGHT%	MOLAL					
H ₂	20.000						
O ₂	56.000						
N ₂	24.000						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.			
H ₂	H ₂	-1.5870	710.0E-4	20.400			
O ₂	O ₂	-3.00900	1.142	60.200			
N ₂	N ₂	-2.9700	0.8080	77.400			
ATOMIC COMPOSITION(CM AT/100GM)							
H	19.0413						
O	1.7133						
C	3.5070						
PROPELLANT ENTHALPY	-26.594	KCAL/100 GM					
PROPELLANT DENSITY	0.2774	GM/CC					
PRESSURE (PSI)	500.0	CHAMBER	EXHAUST	0.0100	LB/CU IN		
SHIFTING EQUILIBRIA				0.7350	EXHAUST	735.0E-4	
ISP (SEC)	327.39			375.96		96.78	
IVSP(LB-SEC/CU IN)	3.5721			5.7637		9.774	
TEMPERATURE (K)	849.21			472.26		328.00	
CP (CAL/GM-DEG.K)	0.85115			0.80134		0.75101	
MOL. WT.-EFFECTIVE	9.2799			7.5192		6.9002	
CP/CV -EFFECTIVE	1.5362			1.5620		1.5648	
CF -APPROX.	1.5509			1.7282		1.8239	
PEAE/M (SEC)	25.450			11.654		7.2192	
AE/AT -APPROX.	7.5326			50.441		225.74	
FROZEN EQUILIBRIA							
ISP (SEC)	327.06			375.65		390.48	
TEMPERATURE (K)	846.35			462.71		298.16	
C* (FT/SEC)							
CF	1.5495			1.7267		1.7946	
PEAE/M (SEC)	25.405			11.482		7.1177	
AE/AT	7.5188			55.905		222.57	

WADD TN 60-254

CASE No
 BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	229.9	849.21	0.7350	328.00
ENTHALPY (KILOCALORIES)	-26.514	-157.42	472.26	-207.53
ENTROPY (CALORIES/DEGREE)	515.72	515.72	-187.04	515.72
HEAT CAPACITY (CAL/K)	104.16	55.115	515.72	75.101
MOLES OF GAS	10.771	10.775	80.134	10.101
MOLECULAR COMPOSITION:				
H	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	6.4188	6.4188	0.0000	0.0000
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0007	0.0000	0.0000	0.0000
H2O	3.4983	3.4983	0.0000	0.0000
NO	0.0500	0.0500	0.0000	0.0000
NH3	0.0000	0.0000	0.0000	0.0000
NO2	0.0000	0.0000	0.0000	0.0000

```

CASE NO
PROPELLANT COMPOSITION
  H2
  O2
  N2
INGREDIENT DATA:
  H2
  O2
  N2
FORMULA
HEAT OF FORM
  -1.5570
  -2.0300
  -2.7000
MOLE WT
DENSITY
  710.0E-4
  1.1142
  0.0040
RLF, TEMP
  20.400
  90.200
  77.400
ATOMIC COMPOSITION(GM AT/100GM)
  H 8.4325
  N 2.2550
  O 3.7175
PROPELLANT ENTHALPY
PROPELLANT DENSITY
  -16.090 KCAL/100 GM
  0.4730 G/CC
  EXHAUST
  7.350
PRESSURE (PSI)
SHIFTING EQUILIBRIA
  ISP (SEC)
  IVSP(LB-SEC/CU I )
TEMPERATURE (K)
CP (CAL/GM-DEG.K)
MOL. WT.-EFFECTIVE
CP/CV -EFFECTIVE
CF -APPROX.
PEAF/M (SEC)
AE/AT -APPROX.
PROPER EQUILIBRIA
  ISP (SEC)
TEMPERATURE (K)
C* (FT/SEC)
CF
PEAF/M (SEC)
AE/AT
  321.20
  3.4387
  1877.4
  0.57958
  18.655
  1.2525
  1.00589
  27.089
  9.5176
  300.04
  1487.8
  1.5800
  20.642
  8.5065
  0.0171 LB/CU IN
  EXHAUST
  0.7350
  300.75
  9.2945
  1207.0
  0.22868
  13.660
  1.2525
  1.0040
  15.125
  33.340
  351.91
  821.16
  1.0175
  11.330
  39.831
  494.98
  6.7495
  720.05
  0.45661
  18.560
  1.5042
  2.0400
  8.5405
  300.07
  375.05
  395.70
  1.9370
  5.0980
  179.12
  
```


WADD TN 60-254

CASE No
 CASES: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.00	7.352	0.7370	75.00E-4
TEMPERATURE (KELVIN)	3272.6	1677.4	127.0	729.03
ENTHALPY (KILOCALORIES)	-16.093	-133.90	-172.95	-196.29
ENTROPY (CALORIES/OLEM)	336.89	336.87	336.83	336.82
HEAT CAPACITY (CAL/K)	65.455	37.955	22.863	45.661
MOLES OF GAS	5.0172	5.5704	5.5572	5.5592
MOLEFRAC COMPOSITION:				
H	0.1150	0.0112	0.0070	0.0000
C	0.0000	0.0000	0.0000	0.0000
O	0.0222	0.0300	0.0070	0.0000
H2	0.7024	0.4332	0.4943	0.4955
O2	0.0457	0.0000	0.0000	0.0000
OH	0.2320	0.0000	0.0000	0.0000
O2H	3.2791	2.7162	5.7173	7.7175
N2	1.1753	1.2127	1.1429	1.1429
CH2	0.0000	0.0000	0.0000	0.0000
CO	0.0352	0.0300	0.0070	0.0000

```

CASE N2
PROPELLANT COMPOSITION
H2 10.000
O2 58.633
N2 31.500
HEIGHT 10.000
WEIGHT 58.633
FORMULA H2 O2 N2
HEAT OF FORM -1.0570
DENSITY 710.0E-4
REF. TEMP. 20.400
H2 1.142
O2 1.142
N2 0.0080
77.400

ATOMIC COMPOSITION(GM T/100G)
H 9.9700
N 4.2487
O 3.0562
PROPELLANT ENTHALPY -18.251
PROPELLANT DENSITY 0.4724
COAL/100 GM 7.300
EXHAUST

PRESSURE (PSI) 500.0
SHIFTING EQUILIBRIA
ISP (SEC) 320.12
IVSP(LB-SEC/OU I ) 300.390
TEMPERATURE (K) 1013.0
CP (CAL/GM-DEGREE) 0.54310
MOL. WT.-EFFECTIVE 10.435
CP/CV -EFFECTIVE 1.2444
CF -APPROX. 1.0237
PERF/N (SEC) 20.132
WEIGHT -APPROX. 0.0087
EXHAUST
PROPER EQUILIBRIA
ISP (SEC) 310.40
TEMPERATURE (K) 1421.62
CP (BT/SEC) 1.0775
PERF/N (SEC) 24.200
WEIGHT 3.2065
EXHAUST
DENSITY 730.75
REF. TEMP. 192.00

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WADD TN 60-254

CASE Nz
BASIS: 100 GM PROPELLANT

	CHARGE	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4	
TEMPERATURE (KELVIN)	3171.0	1613.0	997.43	580.48	
ENTHALPY (KILOCALORIES)	-18.251	-140.48	-170.37	-197.94	
ENTROPY (CALORIES/DEGREE K)	364.08	504.08	304.08	364.08	
HEAT CAPACITY (CAL/K)	69.30	61.560	54.375	46.836	
MOLES OF GAS	6.2370	6.0340	6.0347	6.0346	
MOLECULAR COMPOSITION:					
H	0.1200	0.0000	0.0000	0.0000	
N	0.0000	0.0000	0.0000	0.0000	
O	0.0070	0.0000	0.0000	0.0000	
H2	1.2425	1.2037	1.2040	1.2039	
O2	0.0080	0.0000	0.0000	0.0000	
OH	0.1310	0.0000	0.0000	0.0000	
H2O	2.4970	2.0562	3.0552	3.6562	
N2	1.1170	1.1244	1.1244	1.1243	
NH3	0.0000	0.0000	0.0000	0.0000	
NO	0.0035	0.0000	0.0000	0.0000	

WADD TN 60-254

CASE N2
BASIS: 100 GM PROPELLANT

	CHAMPER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2948.4	1355.0	805.08	452.62
ENTHALPY (KILOCALORIES)	-19.926	-144.53	-176.61	-198.42
ENTROPY (CALORIES/DEG.K)	390.22	390.22	390.22	390.22
HEAT CAPACITY (CAL/K)	76.860	66.290	58.299	54.146
MOLES OF GAS	7.1254	7.0517	7.0517	7.0485
MOLECULAR COMPOSITION:				
H	0.0042	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0011	0.0000	0.0000	0.0000
H2	2.3591	2.3773	2.3773	2.3725
O2	0.0007	0.0000	0.0000	0.0000
OH	0.0466	0.0000	0.0000	0.0000
H2O	3.0226	3.0750	3.0750	3.0750
N2	1.0076	1.0094	1.0093	1.0076
NH3	0.0001	0.0000	0.0001	0.0032
NO	0.0030	0.0000	0.0000	0.0000

CASE No.							
PROPELLANT COMPOSITION:	WEIGHT:	MOLES:					
H2	16.0000						
O2	54.6000						
N2	22.4000						
INGREDIENT DATA:							
H2	H2	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.		
O2	O2		-1.0970	710.00 FT-4	20.400		
N2	N2		-3.0300	1.142	90.200		
			-2.2000	0.5080	77.400		
ATOMIC COMPOSITION(GM AT/100GM)							
H	12.0730						
O	40.0800						
N	2.4125						
PROPELLANT ENTHALPY							
			-23.275 KCAL/100 GM				
PROPELLANT DENSITY							
		CHAMBER	EXHAUST	EXHAUST	EXHAUST		
		500.0	7.350	0.7350	735.00E-4		
PRESSURE (PSI)							
SHIFTING EQUILIBRIA							
ISP (SEC)			229.50	303.62	787.02		
IVSP(LB-SEC/CU FT)			3.0401	4.2033	4.5400		
TEMPERATURE (K)		2400.0	1002.4	502.71	746.23		
CP (CAL/GM-DEG.K)		0.90662	0.74722	0.60547	0.64936		
MOL. WT.-EFFECTIVE		11.112	11.127	11.134	11.484		
CP/CV -EFFECTIVE		1.2457	1.2140	1.2520	1.2032		
CF -APPROX.			1.25620	1.27485	1.28449		
PEAF/M (SEC)			22.631	11.850	6.7000		
AE/AT -APPROX.			7.0240	33.247	216.18		
FROZEN EQUILIBRIA							
ISP (SEC)			320.52	357.94	387.11		
TEMPERATURE (K)		2400.0	991.94	542.34	301.92		
C* (FT/SEC)		6704.2					
CF			1.2580	1.27450	1.28358		
PEAF/M (SEC)			22.492	11.610	4.0687		
AE/AT			7.2791	37.477	195.79		

WADD TN 60-254

CASE No
 CASES: 100 ON PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.00	7.350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2400.00	1000.00	562.00	546.00
ENTHALPY (KILOCALORIES)	-23.000	-140.00	-170.50	-197.20
ENTROPY (CALORIES/DEGREE)	450.00	450.00	450.00	456.00
HEAT CAPACITY (CAL/K)	90.000	74.722	68.547	64.930
MOLES OF GAS	0.0000	0.0000	0.0000	0.0000
MOLECULAR COMPOSITION:				
H	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	4.0000	4.0000	4.0000	4.0000
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	0.0000	0.0000	0.0000	0.0000
N2	0.0000	0.0000	0.0000	0.0000
NH3	0.0000	0.0000	0.0000	0.0000
NO	0.0000	0.0000	0.0000	0.0000

CASE No.							
PROPELLANT COMPOSITION	WEIGHTS	MOLAN					
H2	20.000	-1.6870					
O2	52.000	-3.0000					
N2	28.000	-2.9000					
INGREDIENT DATA:	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.			
H2	H2		710.0E-4	20.400			
O2	O2		1.142	90.200			
N2	N2		0.0080	77.400			
ATOMIC COMPOSITION(GM AT/100GM)							
H	19.0413						
N	1.9086						
O	3.2503						
PROPELLANT ENTHALPY	-26.624	KCAL/100 GM					
PROPELLANT DENSITY	0.2763	GM/CC					
PRESSURE (PSI)	CHAMBER	EXHAUST	0.0100	LB/CU IN			
SHIFTING EQUILIBRIA	500.0	7.350	0.7350	EXHAUST	735.0E-4		
ISP (SEC)							
IVSP(LB-SEC/CU IN)	320.40						
TEMPERATURE (K)	3.2594						
CP (CAL/GM-DEG.K)	775.25						
MOL. WT.-EFFECTIVE	0.84390						
CP/CV -EFFECTIVE	9.1665						
CF -APPROX.	1.2460						
PEAF/M (SEC)	1.0450						
AE/AT -APPROX.	22.356						
FROZEN EQUILIBRIA	7.2910						
ISP (SEC)	320.31						
TEMPERATURE (K)	771.85						
C* (FT/SEC)							
CF							
PLAF/M (SEC)	1.0450						
AE/AT	22.354						
	7.1937						

WADD TN 60-254

CASF INZ
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0E-4	735.0E-4
TEMPERATURE (KELVIN)	2000.0	775.28	435.18	322.82	322.82
ENTHALPY (KILOCALORIES)	-26.624	-147.11	-175.25	-195.96	-195.96
ENTROPY (CALORIES/DEG.K)	51.02	512.02	512.02	512.02	512.02
HEAT CAPACITY (CAL/K)	105.12	84.39	80.055	74.544	74.544
MOLES OF GAS	10.021	10.917	10.785	10.015	10.015
MOLECULAR COMPOSITION:					
H	0.0030	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000	0.0000
H2	6.6670	6.6650	6.6688	5.3183	5.3183
O2	0.0000	0.0000	0.0000	0.0000	0.0000
OH	0.0002	0.0000	0.0000	0.0000	0.0000
H2O	3.2495	3.2500	3.2500	3.2500	3.2500
N2	0.0090	0.0078	0.00321	0.00487	0.00487
NH3	0.0000	0.0032	0.00346	0.00015	0.00015
NO	0.0000	0.0000	0.0000	0.0000	0.0000

CASE NAME					
PROPELLANT COMPOSITION	WEIGHTS	MOLES			
H2	9.0000				
O2	54.550				
N2	36.760				
INGREDIENT DATA:	FORMULA	HEAT OF FORM.		DENSITY	REF. TEMP.
H2	H2	-1.2370		710.06E-4	20.400
O2	O2	-3.00800		1.142	90.200
N2	N2	-2.9700		0.6080	77.400
ATOMIC COMPOSITION(GRAM/100GRAM)					
H		9.0176			
N		4.0250			
O		3.4094			
PROPELLANT ENTHALPY		-17.522	KCAL/100 GR		
PROPELLANT DENSITY		0.4429	GM/CC		
CHAMBER	EXHAUST				
500.0	7.350				
PRESSURE (PSI)				0.0164	LB/CC IN
SHIFTING EQUILIBRIA				EXHAUST	EXHAUST
ISP (SEC)				0.7350	735.0E-4
IVF(LB-SEC/CU IN)				0.0059	381.07
TEMPERATURE (K)				5.8656	6.2504
CP (CAL/GM-DEG.F)				97.048	561.32
MOLE FRACTION				0.51382	0.46308
CP/CV -EFFECTIVE				17.221	17.222
CF -APPROX.				1.2896	1.3319
PEAF/N (SEC)				1.8432	1.9637
AE/AT -APPROX.				13.589	7.5775
PROGRAM EQUILIBRIA				47.525	250.01
ISP (SEC)				350.62	372.00
TEMPERATURE (K)				779.61	402.00
C* (FT/SEC)					
CF					
PEAF/N (SEC)					
AE/AT					

WADD TN 60-254

WASE N-
CASTS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	7.350	735.0E-4	
TEMPERATURE (KELVIN)	315.0	1573.0	1573.0	561.32	
ENTHALPY (KILOCALORIES)	-17.522	-151.72	-162.25	-162.25	
ENTROPY (CALORIES/DEGREE)	340.10	340.10	340.10	348.10	
HEAT CAPACITY (CAL/K)	65.750	56.350	51.382	46.308	
MOLES OF GAS	5.9760	5.0060	5.0060	5.0060	
MOLECULAR COMPOSITION:					
H	0.1043	0.0000	0.0000	0.0000	
N	0.0000	0.0000	0.0000	0.0000	
O	0.0063	0.0000	0.0000	0.0000	
H2	1.1390	1.0090	1.0090	1.0090	
O2	0.0073	0.0000	0.0000	0.0000	
OH	0.1148	0.0000	0.0000	0.0000	
H2O	3.2600	3.4094	3.4094	3.4094	
N2	1.2911	1.2978	1.2978	1.2978	
NH3	0.0000	0.0000	0.0000	0.0000	
NO	0.0134	0.0000	0.0000	0.0000	

CASE No							
PROPELLANT COMPOSITION	WEIGHTS	MOLAL					
H2	11.500						
O2	53.100						
N2	35.400						
INGREDIENT DATA:	FORMULA	HEAT OF FORM.			DENSITY	REF. TEMP.	
H2	H2	-1.6870			710.0E-4	20.400	
O2	O2	-3.0800			1.142	90.200	
N2	N2	-2.2000			0.6080	77.400	
ATOMIC COMPOSITION(GM AT/100GM)							
H	11.4027						
N	2.5271						
O	3.5187						
PROPELLANT ENTHALPY		-19.539	KCAL/100 GM				
PROPELLANT DENSITY		0.5064	GM/CC				
PRESSURE (PSI)							
SHIFTING EQUILIBRIA							
ISP (SEC)							
IVSP(LB-SEC/CU I)							
TEMPERATURE (K)							
CP (CAL/GM-DEG.K)							
MOL. #1-EFFECTIVE							
CP/CV -EFFECTIVE							
CF -APPROX.							
PEAT/M (SEC)							
AE/AT -APPROX.							
PROGRAM EQUILIBRIA							
ISP (SEC)							
TEMPERATURE (K)							
CF (FT/SEC)							
CF							
PLAF/M (SEC)							
AE/AT							

WADD TN 60-254

CASE NO
 BASIS: 100 GR PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	0.7350	735.0E-4
TEMPERATURE (KELVIN)	2846.0	1209.0	744.38	744.38	416.29
ENTHALPY (KILOCALORIES)	-19.530	-150.20	-107.74	-107.74	-185.76
ENTROPY (CALORIES/DEGREE)	590.78	500.75	380.78	380.78	566.78
HEAT CAPACITY (CAL/GR)	74.493	64.375	55.409	55.409	52.851
MOLES OF GAS	7.0167	6.7575	6.7578	6.7578	6.7570
MOLECULAR COMPOSITION:					
H	0.0667	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000	0.0000
H2	2.5330	2.5350	2.5354	2.5354	2.5393
O2	0.0000	0.0000	0.0000	0.0000	0.0000
OH	0.0281	0.0000	0.0000	0.0000	0.0000
H2O	3.7078	3.5187	3.5187	3.5187	3.5187
N2	1.4420	1.4635	1.4635	1.4635	1.4581
NO	0.0001	0.0000	0.0000	0.0000	0.0109
NO2	0.0013	0.0000	0.0000	0.0000	0.0000

<p>CASE NAME</p> <p>PROPELLANT COMPOSITION</p> <p>H2</p> <p>O2</p> <p>H2</p>	<p>H2</p> <p>O2</p> <p>N2</p>	<p>WEIGHTS</p> <p>13.793</p> <p>51.731</p> <p>34.480</p>	<p>MOLAR</p> <p>-1.8970</p> <p>-3.0900</p> <p>-2.8000</p>	<p>REF. TEMP.</p> <p>20.400</p> <p>90.200</p> <p>77.400</p>
<p>INGREDIENT DATA:</p>				
<p>FORMULA</p> <p>H2</p> <p>O2</p> <p>N2</p>	<p>HEAT OF FORM.</p> <p>-1.8970</p> <p>-3.0900</p> <p>-2.8000</p>			
<p>ATOMIC COMPOSITION(GM T/100GM)</p>				
<p>H</p> <p>N</p> <p>O</p>	<p>13.6800</p> <p>2.4614</p> <p>3.2331</p>			
<p>PROPELLANT ENTHALPY</p>				
<p>PROPELLANT DENSITY</p>	<p>-21.450</p> <p>0.2544</p>	<p>KCAL/100 GM</p> <p>CHAMBER</p>		
<p>PRESSURE (PSI)</p>				
<p>SHIFTING EQUILIBRIA</p>				
<p>ISP (SEC)</p> <p>IV.P(LB-SEC/CU IN)</p> <p>TEMPERATURE (K)</p> <p>CP (CAL/GM-DEG.K)</p> <p>MOL. WT.-EFFECTIVE</p> <p>CP/CV -EFFECTIVE</p> <p>CF -APPROX.</p> <p>PLAF/N (SEC)</p> <p>AE/AT -APPROX.</p>	<p>500.0</p> <p>7.350</p> <p>519.16</p> <p>4.0060</p> <p>10.9.7</p> <p>0.60503</p> <p>12.390</p> <p>1.3097</p> <p>1.3570</p> <p>25.169</p> <p>7.741</p>	<p>EXHAUST</p> <p>EXHAUST</p>	<p>0.0128</p> <p>0.7350</p>	<p>LB/CU IN</p> <p>EXHAUST</p> <p>EXHAUST</p>
<p>PROZEN EQUILIBRIA</p>				
<p>ISP (SEC)</p> <p>TEMPERATURE (K)</p> <p>CF (FT/SEC)</p> <p>CF</p> <p>PLAF/N (SEC)</p> <p>AE/AT</p>	<p>2504.0</p> <p>6500.0</p>	<p>317.80</p> <p>1044.0</p>	<p>350.72</p> <p>581.65</p>	<p>375.45</p> <p>322.83</p>
<p>PLAF/N (SEC)</p> <p>AE/AT</p>	<p>1.3014</p> <p>22.381</p> <p>7.6784</p>	<p>1.7520</p> <p>11.493</p> <p>38.099</p>	<p>1.8440</p> <p>6.0131</p> <p>200.91</p>	

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CASF N2
GASJS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.00E-4
TEMPERATURE (KELVIN)	2554.5	1059.7	600.50	550.31
ENTHALPY (KILOCALORIES)	-21.455	-130.52	-150.51	-185.30
ENTROPY (CALORIES/DEG.K)	421.44	421.44	421.44	421.44
HEAT CAPACITY (CAL/K)	82.631	60.503	62.272	69.050
MOLES OF GAS	8.0085	8.0700	8.0050	7.9742
MOLECULAR COMPOSITION:				
H	0.0092	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	3.5954	3.6069	3.0000	3.0000
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0060	0.0000	0.0000	0.0000
H2O	3.2269	3.2331	3.0000	3.0000
N2	1.2305	1.2306	1.2297	1.2371
NH3	0.0002	0.0002	0.0000	0.0000
NO	0.0002	0.0000	0.0000	0.0000

CASE N2									
PROPELLANT COMPOSITION									
H2	18.670								
O2	50.000								
N2	33.330								
INGREDIENT DATA:	FORMULA	HEAT OF FORI.	MOLAN	DENSITY	REF. TEMP.				
H2		-1.6870		710.0E-4	20.400				
O2		-3.0300		1.142	90.200				
N2		-2.9000		0.0080	77.400				
ATOMIC COMPOSITION(GM AT/100GM)									
H	16.0377								
N	2.0794								
O	3.1250								
PROPELLANT ENTHALPY	-23.866	KCAL/100 GM							
PROPELLANT DENSITY	0.0127	GM/CC							
CHAMBER	EXHAUST								
500.0	7.350								
0.0113	EXHAUST								
0.7350	EXHAUST								
0.7350	EXHAUST								
354.52									
4.0049									
48.087									
0.70524									
10.613									
1.0615									
1.7313									
11.050									
50.709									
354.52									
471.87									
1.7296									
10.895									
50.200									
517.94									
5.0910									
800.82									
0.70272									
10.574									
1.0528									
1.0527									
22.210									
7.0302									
517.94									
860.70									
1.0510									
22.171									
7.0555									
2229.5									
6500.3									
2229.5									
6500.3									
2229.5									
6500.3									

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CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0UE-4
TEMPERATURE (KELVIN)	2225.5	865.82	480.97	332.01
ENTHALPY (KILOCALORIES)	-23.866	-140.04	-155.31	-184.79
ENTROPY (CALORIES/DEG.K)	462.73	462.73	462.73	462.73
HEAT CAPACITY (CAL/K)	91.050	75.272	70.524	66.135
MOLES OF GAS	9.4622	9.4574	9.4224	8.6791
MOLECULAR COMPOSITION:				
H	0.0079	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	5.1794	5.1421	5.0897	4.2747
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0007	0.0000	0.0000	0.0000
H2O	3.1243	3.1250	3.1250	3.1250
N2	1.1694	1.1591	1.1716	0.9000
NH3	0.0000	0.0011	0.0361	0.5794
NO	0.0000	0.0000	0.0000	0.0000

CASE N2							
PROPELLANT COMPOSITION	WEIGHTS	FORMULA	HEAT OF FORM.	DENSITY	REF. TEMP.		
H2	21.57%	H2	-1.5470	710.0E-4	20.400		
O2	47.06%	O2	-3.0800	1.142	90.250		
N2	31.37%	N2	-2.5000	0.0080	77.400		
INGREDIENT DATA:							
H2							
O2							
N2							
ATOMIC COMPOSITION (GM AT/100GM)							
H	21.5080						
N	2.2394						
O	2.9410						
PROPELLANT ENTHALPY							
PROPELLANT DENSITY	-27.060	KCAL/100 GM					
	0.2605	GM/CC					
CHAMBER							
EXHAUST	7.350						
PRESSURE (PSI)							
SHIFTING EQUILIBRIA							
ISP (SEC)	315.01						
IVSP (LB-SEC/CU IN)	2.9460						
TEMPERATURE (K)	1771.6						
CP (CAL/GM-DEG.K)	1.0625						
MOL. WT.-EFFECTIVE	8.4620						
CP/CV -EFFECTIVE	1.2830						
CF -APPROX.							
PEAE/M (SEC)							
AE/AT -APPROX.							
FROZEN EQUILIBRIA							
ISP (SEC)	1771.6						
TEMPERATURE (K)	6527.3						
C* (FT/SEC)							
CF							
PEAE/M (SEC)							
AE/AT							

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CASE N2
BASIS: 100 GM PROPELLANT

	CHAMBER	EXHAUST	EXHAUST	EXHAUST
PRESSURE (PSI)	500.0	7.350	0.7350	735.0614
TEMPERATURE (KELVIN)	1791.8	640.61	399.91	312.75
ENTHALPY (KILOCALORIES)	-27.966	-140.56	-167.10	-184.60
ENTROPY (CALORIES/DEG.K)	527.98	527.98	527.98	527.98
HEAT CAPACITY (CAL/K)	106.28	88.350	83.758	77.461
MOLES OF GAS	11.815	11.797	11.318	10.395
MOLECULAR COMPOSITION:				
H	0.0000	0.0000	0.0000	0.0000
N	0.0000	0.0000	0.0000	0.0000
O	0.0000	0.0000	0.0000	0.0000
H2	7.7551	7.7256	7.0058	5.8219
O2	0.0000	0.0000	0.0000	0.0000
OH	0.0000	0.0000	0.0000	0.0000
H2O	2.7412	2.7412	2.7412	2.7412
N2	1.1184	1.1089	0.6689	0.4076
NH3	0.0016	0.0017	0.0019	1.4242
NO	0.0000	0.0000	0.0000	0.0000

CASE N2
 PROPELLANT COMPOSITION
 H2 25.370
 O2 44.780
 N2 29.850

INGREDIENT DATA: FORMULA HEAT OF FORM. DENSITY REF. TEMP.
 H2 H2 -1.5370 710.0E-4 20.400
 O2 O2 -3.0900 1.142 90.200
 N2 N2 -2.9000 0.0080 77.400

ATOMIC COMPOSITION(GM AT/100GM)
 H 25.1680
 N 2.1309
 O 2.7988

PROPELLANT ENTHALPY -31.145 KCAL/100 GM
 PROPELLANT DENSITY 0.2307 GM/CC

0.008 LB/CC IN

Insufficient iteration of Exhaust 0.0735 psia

PRESSURE (PSI)
 SHIFTING EQUILIBRIA
 ISP (SEC) 500.0
 IVSP(LB-SEC/CU IN) 307.84
 TEMPERATURE (K) 2.5658
 CP (CAL/GM-DEG.K) 537.27
 MOL. WT.-EFFECTIVE 0.95428
 CP/CV -EFFECTIVE 7.4122
 CF -APPROX. 1.0592
 PEAE/M (SEC) 1.0301
 AE/AT -APPROX. 20.357
 FROZEN EQUILIBRIA 6.0831
 ISP (SEC) 307.59
 TEMPERATURE (K) 520.35
 C* (FT/SEC) 1521.3
 CF 6473.5
 PEAE/M (SEC) 1.5288
 AE/AT 19.957
 6.7479

EXHAUST EXHAUST EXHAUST EXHAUST
 7.350 345.32 0.7350 365.79
 2.0615 370.22 300.322
 0.92097 7.7673 295.16
 1.2663 0.86747 8.5442
 1.7064 1.3663 1.8082
 11.899 0.2933 0.2933
 40.233 280.41 280.41

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CASE N2
 BASIS: 100 GM PROPELLANT
 PRESSURE (PSI)
 TEMPERATURE (KELVIN)
 ENTHALPY (KILOCALORIES)
 ENTROPY (CALORIES/DEGREE)
 HEAT CAPACITY (CAL/G)
 MOLES OF GAS
 MOLECULAR COMPOSITION:

CHAMBER	EXHAUST	EXHAUST	EXHAUST	EXHAUST
500.0	7.350	0.7350	735.0E-4	0.0000
151.5	537.27	370.22	298.16	0.0000
-51.147	-140.06	-160.60	-183.25	0.0000
574.75	574.75	574.75	580.66	6.8667
110.20	99.425	93.087	86.747	0.0000
13.645	13.645	12.559	11.704	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
9.7792	9.7475	8.1495	6.8667	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000
2.1037	2.7388	2.7388	2.7388	2.7388
1.0432	0.9562	0.9271	0.925	0.925
0.0044	0.1585	1.0907	1.9459	1.9459
0.0000	0.0000	0.0000	0.0000	0.0000

H
 N
 O
 H2
 O2
 OH
 H2O
 H2
 NH3
 NO