Case name: HyRoE project 2kN

Description: F=8 Mpa=3 calculate sec working

Tue Dec 9 12:56:05 2025

Table 1. Propellant Specification

Component	Temperature, K	Pressure, MPa	Enthalpy, kJ/mol	Enthalpy, kJ/kg	Mass fraction
C32H66(a)	298.1	0.1013	-967.8000	-2146.534	0.1111111
N2O(L),298.15K	298.1	0.1013	65.1000	1479.115	0.8888889
Total			52.6482	1076.259	

Propellant exploded formula:

$C_{0.385766}\ H_{0.795642}\ N_{1.975890}\ O_{0.987945}$ (based on 1 mole)

$C_{9.306232}\ H_{19.194103}\ N_{47.666443}\ O_{23.833222}$ (by mass %)

α: 0.8448571 (oxidizer excess coefficient)

O/F: 8.0000000

O/F_0: 9.4690572 (stoichiometric)

rho: kg/m^3

Table 2. Combustion Properties

Parameter	Injector	Nozzle inlet	Nozzle throat	Nozzle exit	Unit
Pressure	3.0000	2.9878	1.7205	0.1020	MPa
Temperature	3237.8358	3236.9339	3047.7976	2032.7335	K
Enthalpy	28563.7401	28509.7271	14330.7565	-45996.2116	J/mol
	1076.2565	1074.1920	534.0153	-1666.3044	kJ/kg
Entropy	261.7096	261.7337	264.6452	272.2176	J/(mol·K)
	9.8610	9.8616	9.8616	9.8616	kJ/(kg·K)
Internal energy	1642.8446	1596.3311	-11010.0711	-62897.3170	J/mol
	61.9009	60.1467	-410.2747	-2278.5807	kJ/kg
Specific heat (p=const)	3.9132	3.9134	3.6513	1.6085	kJ/(kg·K)
Specific heat (V=const)	3.3481	3.3483	3.1360	1.3039	kJ/(kg·K)
Gamma	1.1688	1.1688	1.1643	1.2336	
Isentropic exponent	1.1486	1.1486	1.1485	1.2333	
Gas constant	0.3133	0.3133	0.3098	0.3012	kJ/(kg·K)
Molecular weight	26.5399	26.5406	26.8359	27.6037	
Density	2.9575	2.9464	1.8220	0.1666	kg/m^3
Sonic velocity	1079.4018	1079.2275	1041.3807	868.9898	m/s
Mach number	0.0000	0.0595	1.0000	2.6951	
Area ratio	10.0000	10.0000	1.0000	4.8632	A/At
Mass flux	189.3307	189.3307	1897.4258	390.1605	kg/(m^2·s)
Viscosity	0.9844	0.9842	0.9448	0.7162 x10^{-4}	kg/(m·s)
Conductivity, frozen	0.2346	0.2346	0.2223	0.1552	W/(m·K)
Specific heat (p=const), frozen	1.6141	1.6141	1.6079	1.5431	kJ/(kg·K)
Prandtl number, frozen	0.6772	0.6772	0.6835	0.7120	
Conductivity, effective	0.7519	0.7518	0.6458	0.1704	W/(m·K)
Specific heat (p=const), effective	3.9133	3.9134	3.6513	1.6082	kJ/(kg·K)
Prandtl number, effective	0.5123	0.5123	0.5342	0.6760	

Table 3. Combustion Products

Product	Injector mass fraction	Injector mole fraction	Nozzle inlet mass fraction	Nozzle inlet mole fraction	Nozzle throat mass fraction	Nozzle throat mole fraction	Nozzle exit mass fraction	Nozzle exit mole fraction
CO	0.1237349	0.1172395	0.1237049	0.1172144	0.1127621	0.1080342	0.0795940	0.0784388
CO2	0.1526405	0.0920492	0.1526876	0.0920801	0.1698852	0.1035910	0.2220029	0.1392443
COOH	0.0000038	0.0000022	0.0000038	0.0000022	0.0000020	0.0000012		
H	0.0003595	0.0094661	0.0003593	0.0094618	0.0002620	0.0069769	0.0000114	0.0003112
H2	0.0021060	0.0277260	0.0021055	0.0277200	0.0018839	0.0250794	0.0017523	0.0239946
H2O	0.1160689	0.1709903	0.1160810	0.1710128	0.1210499	0.1803169	0.1306463	0.2001803
H2O2	0.0000031	0.0000024	0.0000031	0.0000024	0.0000016	0.0000013		
HCN	0.0000001	0.0000001	0.0000001	0.0000001				
HCO	0.0000022	0.0000020	0.0000022	0.0000020	0.0000010	0.0000009		
HCOOH	0.0000004	0.0000002	0.0000004	0.0000002	0.0000002	0.0000001		
HNCO	0.0000004	0.0000002	0.0000004	0.0000002	0.0000002	0.0000001		
HNO	0.0000062	0.0000053	0.0000062	0.0000053	0.0000030	0.0000026		
HNO2	0.0000015	0.0000009	0.0000015	0.0000009	0.0000007	0.0000004		
HO2	0.0000274	0.0000220	0.0000273	0.0000219	0.0000141	0.0000114		
N	0.0000040	0.0000077	0.0000040	0.0000076	0.0000017	0.0000033		
N2	0.5595110	0.5300776	0.5595183	0.5300991	0.5614318	0.5378287	0.5657390	0.5574621
N2O	0.0000051	0.0000031	0.0000051	0.0000031	0.0000027	0.0000016		
NCO	0.0000001	0.0000001	0.0000001	0.0000001				
NH	0.0000013	0.0000024	0.0000013	0.0000024	0.0000006	0.0000010		
NH2	0.0000005	0.0000009	0.0000005	0.0000009	0.0000002	0.0000004		
NH3	0.0000004	0.0000006	0.0000004	0.0000006	0.0000002	0.0000003		
NO	0.0133569	0.0118139	0.0133413	0.0118004	0.0092608	0.0082823	0.0000507	0.0000466
NO2	0.0000130	0.0000075	0.0000129	0.0000074	0.0000066	0.0000038		
O	0.0028073	0.0046568	0.0028049	0.0046529	0.0017369	0.0029133	0.0000015	0.0000026
O2	0.0135006	0.0111973	0.0134941	0.0111923	0.0098473	0.0082584	0.0000107	0.0000092
OH	0.0158448	0.0247256	0.0158336	0.0247089	0.0118452	0.0186903	0.0001911	0.0003102
Gaseous fraction:	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000	1.0000000
Condensed fraction:	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000

Table 4. Ideal Performance

Parameter	Sea level	Optimum expansion	Vacuum	Units
Characteristic velocity		1577.8739		m/s
Effective exhaust velocity	2343.7638	2342.0337	2603.4646	m/s
Specific impulse (by mass)	2343.7638	2342.0337	2603.4646	N·s/kg
Specific impulse (by weight)	238.9974	238.8210	265.4795	s
Thrust coefficient	1.4854	1.4843	1.6500	
Thrust	2.0861	2.0846	2.3173	kN
Altitude	0.0000	0.0000		km
Ambient pressure	1.0000	1.0067	0.0000	atm

Table 5. Estimated Delivered Performance

Parameter	Sea level	Optimum expansion	Vacuum	Units
Characteristic velocity		1537.4889		m/s
Effective exhaust velocity	2246.9882	2245.3025	2500.0421	m/s
Specific impulse (by mass)	2246.9882	2245.3025	2500.0421	N·s/kg

Parameter	Sea level	Optimum expansion	Vacuum	Units
Specific impulse (by weight)	229.1290	228.9571	254.9333	s
Thrust coefficient	1.4615	1.4604	1.6261	
Thrust	2.0000	1.9985	2.2252	kN
Altitude	0.0000	0.0000		km
Ambient pressure	1.0000	1.0067	0.0000	atm

Table 6. Altitude Performance

Altitude, km	Pressure, atm	Specific impulse, N·s/kg	Specific impulse, s	Thrust coefficient	Thrust, kN
0.0000	1.0000	2246.9882	229.1290	1.4615	2.0000

Table 7. Throttled Performance

Table 8. Chamber Size

Combustion chamber size			Nozzle size		
Dc	76.29	mm	Type	TIC nozzle	
Dt	24.12	mm	Rn	9.65	mm
Lcyl	545.10	mm	Tn	18.58	deg
Lc	600.00	mm	Te	6.63	deg
L*	5753.06	mm	De	53.20	mm
R1	24.12	mm	Le	61.61	mm
R2	45.45	mm	Le/Dt	2.55	
b	45.00	deg	Le/Lc15	113.52	%
Ac/At	10.00		Ae/At	4.86	

Parameter		Engine	Chamber	
Thrust	sea level	2.0000	2.0000	kN
	opt exp	1.9985	1.9985	kN
	vacuum	2.2252	2.2252	kN
Specific Impulse	sea level	2246.9882	2246.9882	N·s/kg
	opt exp	2245.3025	2245.3025	N·s/kg
	vacuun	2500.0421	2500.0421	N·s/kg
Mass flow rate	total	0.8901	0.8901	kg/s
	oxidizer	0.7912	0.7912	kg/s
	fuel	0.0989	0.0989	kg/s
Number of chambers		1		

Table 10. Thermal Analysis