

Case name: HyRoE project F

Description: F=8

Thu Nov 27 15:34:42 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/F₀: 9.4690572 (stoichiometric)
 ρ : kg/m³

Table 2. Combustion Properties

Parameter	Injector	Nozzle inlet	Nozzle throat	Nozzle exit Unit
Pressure	10.0000	9.8366	5.6794	0.1197 MPa
Temperature	3345.2346	3341.2857	3131.0755	1648.2493 K
Enthalpy	28813.2821	28585.3936	14017.7967	-62507.8159 J/mol
	1076.2565	1067.6384	518.4709	-2263.7086 kJ/kg
Entropy	253.9425	254.0357	256.5252	261.9923 J/(mol·K)
	9.4855	9.4880	9.4880	9.4880 kJ/(kg·K)
Internal energy	999.4226	804.3673	-12015.4427	-76212.1387 J/mol
	37.3312	30.0424	-444.4106	-2760.0080 kJ/kg
Specific heat (p=const)	3.4010	3.4011	3.1365	1.5207 kJ/(kg·K)
Specific heat (V=const)	2.8982	2.8985	2.6788	1.2195 kJ/(kg·K)
Gamma	1.1735	1.1734	1.1708	1.2470
Isentropic exponent	1.1571	1.1571	1.1586	1.2470
Gas constant	0.3106	0.3105	0.3075	0.3011 kJ/(kg·K)
Molecular weight	26.7718	26.7744	27.0368	27.6130
Density	9.6253	9.4801	5.8983	0.2412 kg/m ³
Sonic velocity	1096.4315	1095.6992	1056.2058	786.6869 m/s
Mach number	0.0000	0.1198	1.0000	3.2854
Area ratio	5.0000	5.0000	1.0000	10.0000 A/At
Mass flux	1244.6161	1244.6161	6229.8106	623.2702 kg/(m ² ·s)
Viscosity	1.0085	1.0076	0.9640	0.6200 x 10 ⁻⁴ kg/(m·s)
Conductivity, frozen	0.2403	0.2401	0.2268	0.1287 W/(m·K)
Specific heat (p=const), frozen	1.6195	1.6193	1.6127	1.4960 kJ/(kg·K)
Prandtl number, frozen	0.6796	0.6797	0.6853	0.7206
Conductivity, effective	0.6262	0.6256	0.5310	0.1293 W/(m·K)
Specific heat (p=const), effective	3.4010	3.4011	3.1365	1.4979 kJ/(kg·K)
Prandtl number, effective	0.5478	0.5478	0.5694	0.7184

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	0.1171557	0.1119755	0.1170398	0.1118759	0.1066610	0.1029541	0.0733033	0.0722637
CO2	0.1629673	0.0991353	0.1631497	0.0992561	0.1794663	0.1102527	0.2318869	0.1454926
COOH	0.0000087	0.0000052	0.0000086	0.0000051	0.0000044	0.0000027		
H	0.0002446	0.0064975	0.0002441	0.0064846	0.0001738	0.0046627	0.0000005	0.0000142
H2	0.0018925	0.0251333	0.0018907	0.0251121	0.0017012	0.0228159	0.0021998	0.0301324
H2O	0.1203517	0.1788486	0.1203943	0.1789297	0.1247086	0.1871578	0.1268436	0.1944190
H2O2	0.0000057	0.0000045	0.0000056	0.0000044	0.0000028	0.0000022		
HCHO,form aldehy	0.0000001	0.0000001	0.0000001	0.0000001				
HCN	0.0000004	0.0000004	0.0000003	0.0000003	0.0000002	0.0000002		
HCO	0.0000044	0.0000040	0.0000043	0.0000040	0.0000020	0.0000018		
HCOOH	0.0000013	0.0000008	0.0000013	0.0000008	0.0000007	0.0000004		
HNCO	0.0000011	0.0000007	0.0000011	0.0000007	0.0000006	0.0000004		
HNO	0.0000105	0.0000091	0.0000104	0.0000090	0.0000047	0.0000041		
HNO2	0.0000032	0.0000018	0.0000032	0.0000018	0.0000014	0.0000008		
HO2	0.0000348	0.0000282	0.0000344	0.0000279	0.0000163	0.0000134		
N	0.0000039	0.0000075	0.0000039	0.0000074	0.0000016	0.0000031		
N2	0.5598325	0.5350158	0.5598625	0.5350975	0.5618743	0.5422830	0.5657624	0.5576728
N2O	0.0000089	0.0000054	0.0000088	0.0000053	0.0000044	0.0000027		
NCO	0.0000003	0.0000002	0.0000002	0.0000002				
NH	0.0000019	0.0000035	0.0000019	0.0000034	0.0000008	0.0000014		
NH2	0.0000011	0.0000019	0.0000011	0.0000019	0.0000005	0.0000008		
NH3	0.0000010	0.0000016	0.0000010	0.0000016	0.0000006	0.0000009	0.0000001	0.0000002
NO	0.0126503	0.0112866	0.0125867	0.0112310	0.0083058	0.0074838	0.0000003	0.0000003
NO2	0.0000180	0.0000105	0.0000178	0.0000103	0.0000083	0.0000049		
O	0.0017676	0.0029578	0.0017607	0.0029464	0.0010164	0.0017175		
O2	0.0097513	0.0081583	0.0097275	0.0081392	0.0065412	0.0055268		
OH	0.0132810	0.0209059	0.0132399	0.0208432	0.0095023	0.0151059	0.0000029	0.0000048
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		1592.1150	m/s
Effective exhaust velocity	2614.0123	2584.5561	2776.5823 m/s
Specific impulse (by mass)	2614.0123	2584.5561	2776.5823 N-s/kg
Specific impulse (by weight)	266.5551	263.5514	283.1326 s
Thrust coefficient	1.6418	1.6233	1.7440
Thrust	5.1869	5.1284	5.5095 kN
Altitude	0.0000	0.0000	km
Ambient pressure	1.0000	1.1812	0.0000 atm

Table 5. Estimated Delivered Performance

Parameter	Sea level	Optimum expansion	Vacuum Units
Characteristic velocity		1570.3655	m/s

Parameter	Sea level	Optimum expansion	Vacuum Units
Effective exhaust velocity	2562.3208	2533.2669	2722.6699 m/s
Specific impulse (by mass)	2562.3208	2533.2669	2722.6699 N-s/kg
Specific impulse (by weight)	261.2840	258.3213	277.6351 s
Thrust coefficient	1.6317	1.6132	1.7338
Thrust	5.0843	5.0267	5.4025 kN
Altitude	0.0000	0.0000	km
Ambient pressure	1.0000	1.1812	0.0000 atm

[illegible]

Throttle value	Mass flow rate, kg/s	Pressure, MPa	Specific impulse, N·s/kg Sea level	Specific impulse, s Sea level	Thrust, kN Sea level	Specific impulse, N·s/kg Optimum expansion	Specific impulse, s Optimum expansion	Thrust, kN Optimum expansion	Specific impulse, N·s/kg Vacuum	Specific impulse, s Vacuum	Thrust, kN Vacuum
0.1000	0.1984	0.9814	1471.7196	150.0736	0.2920	2503.5786	255.2940	0.4968	2701.1118	275.4367	0.5360
0.1819	0.3609	1.7946	1826.1502	186.2155	0.6591	2512.6362	256.2176	0.9068	2707.6847	276.1070	0.9772
0.1900	0.3770	1.8754	1864.1935	190.0948	0.7028	2513.2587	256.2811	0.9475	2708.1366	276.1531	1.0210
0.2800	0.5556	2.7729	2139.3145	218.1494	1.1886	2518.5629	256.8219	1.3993	2711.9871	276.5457	1.5068
0.3700	0.7342	3.6725	2281.2048	232.6182	1.6748	2522.1306	257.1857	1.8517	2714.5779	276.8099	1.9930
0.4600	0.9128	4.5737	2367.9233	241.4610	2.1613	2524.7712	257.4550	2.3045	2716.4958	277.0055	2.4795
0.5500	1.0913	5.4761	2426.4764	247.4317	2.6481	2526.8553	257.6675	2.7577	2718.0099	277.1599	2.9663
0.6400	1.2699	6.3795	2468.7122	251.7386	3.1351	2528.5607	257.8414	3.2111	2719.2491	277.2862	3.4532
0.7300	1.4485	7.2837	2500.6430	254.9946	3.6222	2529.9958	257.9878	3.6647	2720.2921	277.3926	3.9404
0.8200	1.6271	8.1885	2525.6468	257.5443	4.1095	2531.2291	258.1135	4.1185	2721.1884	277.4840	4.4276
0.9100	1.8057	9.0940	2545.7692	259.5962	4.5968	2532.3136	258.2241	4.5725	2721.9768	277.5644	4.9150
1.0000	1.9843	10.0000	2562.3208	261.2840	5.0843	2533.2669	258.3213	5.0267	2722.6699	277.6351	5.4025

Table 8. Chamber Size

Combustion chamber size			Nozzle size		
Dc	44.72	mm	Type	TIC nozzle	
Dt	20.00	mm	Rn	3.98	mm
Lcyl	446.65	mm	Tn	24.09	deg
Lc	500.00	mm	Te	9.77	deg
L*	2403.40	mm	De	63.25	mm
R1	15.00	mm	Le	70.00	mm
R2	94.98	mm	Le/Dt	3.50	
b	20.00	deg	Le/Lc15	86.74	%
Ac/At	5.00		Ae/At	10.00	

Parameter		Engine	Chamber
Thrust	sea level	5.0843	5.0843 kN
	opt exp	5.0267	5.0267 kN
	vacuum	5.4025	5.4025 kN
Specific Impulse	sea level	2562.3208	2562.3208 N·s/kg

Mass flow rate	opt exp	2533.2669	2533.2669	N·s/kg
	vacuun	2722.6699	2722.6699	N·s/kg
	total	1.9843	1.9843	kg/s
	oxidizer	1.7638	1.7638	kg/s
	fuel	0.2205	0.2205	kg/s
Number of chambers		1		

Table 10. Thermal Analysis