

## Case name: Nescius Block 0

### Description:

Sun Nov 17 20:37:10 2024

**Table 1. Propellant Specification**

Component	Temperature, K	Pressure, MPa	Enthalpy, kJ/mol	Enthalpy, kJ/kg	Mass fraction
C <sub>2</sub> H <sub>5</sub> OH(L), 95%	298.1	0.1013	-278.1390	-6507.593	0.3921569
O <sub>2</sub> (L)	90.2	0.1013	-12.9790	-405.608	0.6078431
Total			-99.3410	-2798.528	

Propellant exploded formula:

C<sub>0.574140</sub> H<sub>1.799644</sub> O<sub>1.674302</sub> (based on 1 mole)

C<sub>14.183006</sub> H<sub>44.456661</sub> O<sub>41.360333</sub> (by mass %)

$\alpha$ : 0.7829879 (oxidizer excess coefficient)

O/F: 1.5500000

O/F<sub>0</sub>: 1.9795964 (stoichiometric)

rho: kg/m<sup>3</sup>

**Table 2. Combustion Properties**

Parameter	Injector	Nozzle inlet	Nozzle throat	Nozzle exit Unit
Pressure	2.8958	2.8877	1.6737	0.1014 MPa
Temperature	3252.5423	3251.9781	3091.0957	2250.5644 K
Enthalpy	-64156.4670	-64195.2657	-79394.6502	-145715.7638 J/mol
	-2798.5073	-2800.1541	-3423.8762	-6064.7964 kJ/kg
Entropy	269.8106	269.8266	272.9209	282.7834 J/(mol·K)
	11.7691	11.7697	11.7697	11.7697 kJ/(kg·K)
Internal energy	-91199.6393	-91233.7464	-105095.4787	-164428.0182 J/mol
	-3978.1314	-3979.5543	-4532.2185	-6843.6141 kJ/kg
Specific heat (p=const)	5.9657	5.9660	5.5064	2.4680 kJ/(kg·K)
Specific heat (V=const)	5.1473	5.1476	4.7778	2.0980 kJ/(kg·K)
Gamma	1.1590	1.1590	1.1525	1.1764
Isentropic exponent	1.1290	1.1290	1.1285	1.1749
Gas constant	0.3627	0.3627	0.3586	0.3461 kJ/(kg·K)
Molecular weight	22.9252	22.9256	23.1885	24.0265
Density	2.4548	2.4485	1.5101	0.1301 kg/m <sup>3</sup>
Sonic velocity	1154.0172	1153.9018	1118.3624	956.5758 m/s
Mach number	0.0000	0.0497	1.0000	2.6719
Area ratio	12.0000	12.0000	1.0000	5.0773 A/At
Mass flux	140.5172	140.5172	1688.7861	332.6157 kg/(m <sup>2</sup> ·s)
Viscosity	1.0623	1.0622	1.0277	0.8263 x 10 <sup>-4</sup> kg/(m·s)
Conductivity, frozen	0.3477	0.3476	0.3322	0.2474 W/(m·K)
Specific heat (p=const), frozen	2.2127	2.2127	2.2009	2.1033 kJ/(kg·K)
Prandtl number, frozen	0.6761	0.6761	0.6808	0.7025
Conductivity, effective	1.1619	1.1618	1.0243	0.3315 W/(m·K)
Specific heat (p=const), effective	5.9657	5.9660	5.5064	2.4679 kJ/(kg·K)
Prandtl number, effective	0.5454	0.5454	0.5525	0.6151

**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	0.2545065	0.2083042	0.2544863	0.2082911	0.2436553	0.2017132	0.2033326	0.1744145
CO2	0.3119049	0.1624762	0.3119367	0.1624954	0.3289663	0.1733317	0.3923358	0.2141912
COOH	0.0000130	0.0000066	0.0000130	0.0000066	0.0000073	0.0000038	0.0000002	0.0000001
H	0.0007341	0.0166973	0.0007340	0.0166958	0.0006037	0.0138876	0.0000874	0.0020829
H2	0.0067770	0.0770697	0.0067767	0.0770686	0.0065169	0.0749633	0.0066254	0.0789661
H2O	0.3722761	0.4737379	0.3722857	0.4737577	0.3795106	0.4884904	0.3958016	0.5278698
H2O2	0.0000105	0.0000071	0.0000105	0.0000071	0.0000056	0.0000038		
HCHO,form aldehy	0.0000003	0.0000002	0.0000003	0.0000002	0.0000001	0.0000001		
HCO	0.0000076	0.0000060	0.0000076	0.0000060	0.0000041	0.0000033		
HCOOH	0.0000022	0.0000011	0.0000022	0.0000011	0.0000012	0.0000006		
HO2	0.0000582	0.0000404	0.0000581	0.0000404	0.0000311	0.0000219		
O	0.0036553	0.0052376	0.0036537	0.0052354	0.0024810	0.0035958	0.0000252	0.0000379
O2	0.0175062	0.0125422	0.0175002	0.0125381	0.0127147	0.0092139	0.0001414	0.0001062
OH	0.0325480	0.0438734	0.0325349	0.0438565	0.0255020	0.0347706	0.0016501	0.0023312
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		1712.3290	m/s
Effective exhaust velocity	2555.9749	2555.8909	2860.6057 m/s
Specific impulse (by mass)	2555.9749	2555.8909	2860.6057 N·s/kg
Specific impulse (by weight)	260.6369	260.6283	291.7006 s
Thrust coefficient	1.4927	1.4926	1.6706
Thrust	0.3229	0.3229	0.3614 kN
Altitude	0.0000	0.0000	km
Ambient pressure	1.0000	1.0003	0.0000 atm

**Table 5. Estimated Delivered Performance**

Parameter	Sea level	Optimum expansion	Vacuum Units
Characteristic velocity		1670.4682	m/s
Effective exhaust velocity	2422.3855	2422.3015	2727.0163 m/s
Specific impulse (by mass)	2422.3855	2422.3015	2727.0163 N·s/kg
Specific impulse (by weight)	247.0146	247.0060	278.0783 s
Thrust coefficient	1.4501	1.4501	1.6325
Thrust	0.3060	0.3060	0.3445 kN
Altitude	0.0000	0.0000	km
Ambient pressure	1.0000	1.0003	0.0000 atm

**Table 6. Altitude Performance**

**Table 7. Throttled Performance****Table 8. Chamber Size**

Combustion chamber size			Nozzle size		
Dc	33.39	mm	Type	Parabolic nozzle	
Dt	9.64	mm	Rn	1.84	mm
Lcyl	64.32	mm	Tn	19.83	deg
Lc	97.73	mm	Te	8.00	deg
L*	1000.00	mm	De	21.72	mm
R1	7.23	mm	Le	24.75	mm
R2	40.71	mm	Le/Dt	2.57	
b	30.00	deg	Le/Lc15	108.65	%
Ac/At	12.00		Ae/At	5.08	

Parameter		Engine	Chamber
Thrust	sea level	0.3060	0.3060 kN
	opt exp	0.3060	0.3060 kN
	vacuum	0.3445	0.3445 kN
Specific Impulse	sea level	2422.3855	2422.3855 N·s/kg
	opt exp	2422.3015	2422.3015 N·s/kg
	vacuun	2727.0163	2727.0163 N·s/kg
Mass flow rate	total	0.1263	0.1263 kg/s
	oxidizer	0.0768	0.0768 kg/s
	fuel	0.0495	0.0495 kg/s
Number of chambers		1	

**Table 10. Thermal Analysis**