

## Case name: polylox

Description: space vacuum mode

Tue Dec 2 22:49:10 2025

**Table 1. Propellant Specification**

Component	Temperature, K	Pressure, MPa	Enthalpy, kJ/mol	Enthalpy, kJ/kg	Mass fraction
Polyethylene	298.1	0.1013	-53.1706	-1895.352	0.2500000
O2(L)	100.0	0.1013	-12.6816	-396.314	0.7500000
Total			-23.8353	-771.074	

Propellant exploded formula:

$C_{0.550952} H_{1.101903} O_{1.449048}$  (based on 1 mole)

$C_{17.761729} H_{35.523459} O_{46.714812}$  (by mass %)

$\alpha$ : 0.8766923 (oxidizer excess coefficient)

O/F: 3.0000000

O/F<sub>0</sub>: 3.4219534 (stoichiometric)

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

**Table 2. Combustion Properties**

Parameter	Injector	Nozzle inlet	Nozzle throat	Nozzle exit Unit
Pressure	4.0000	3.9554	2.3059	0.0023 MPa
Temperature	3611.7633	3609.1601	3447.4011	1816.5388 K
Enthalpy	-18804.3728	-18974.8115	-35201.6551	-199765.8236 J/mol
	-771.0764	-778.0054	-1422.1152	-7124.8107 kJ/kg
Entropy	271.7669	271.8342	275.8909	312.5050 J/(mol·K)
	11.1438	11.1457	11.1457	11.1457 kJ/(kg·K)
Internal energy	-48834.2775	-48983.0718	-63864.9755	-214869.3844 J/mol
	-2002.4577	-2008.4043	-2580.0876	-7663.4915 kJ/kg
Specific heat (p=const)	7.6768	7.6832	7.7422	1.9413 kJ/(kg·K)
Specific heat (V=const)	6.4503	6.4562	6.5551	1.6392 kJ/(kg·K)
Gamma	1.1901	1.1900	1.1811	1.1843
Isentropic exponent	1.1290	1.1290	1.1245	1.1839
Gas constant	0.3409	0.3409	0.3359	0.2965 kJ/(kg·K)
Molecular weight	24.3872	24.3891	24.7530	28.0381
Density	3.2484	3.2148	1.9913	0.0043 kg/m <sup>3</sup>
Sonic velocity	1179.0966	1178.5869	1141.0933	798.5998 m/s
Mach number	0.0000	0.0999	1.0000	4.4638
Area ratio	6.0000	6.0000	1.0000	150.0000 A/At
Mass flux	378.4407	378.4407	2272.2887	15.1552 kg/(m <sup>2</sup> ·s)
Viscosity	1.1311	1.1305	1.0972	0.7163 x10 <sup>-4</sup> kg/(m·s)
Conductivity, frozen	0.3377	0.3375	0.3244	0.1818 W/(m·K)
Specific heat (p=const), frozen	1.9750	1.9749	1.9682	1.8163 kJ/(kg·K)
Prandtl number, frozen	0.6616	0.6616	0.6658	0.7159
Conductivity, effective	1.7071	1.7078	1.6522	0.2054 W/(m·K)
Specific heat (p=const), effective	7.6768	7.6832	7.7422	1.9079 kJ/(kg·K)
Prandtl number, effective	0.5087	0.5086	0.5142	0.6655

**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	0.2967242	0.2583449	0.2966313	0.2582840	0.2824114	0.2495721	0.1394118	0.1395510
CO2	0.3181297	0.1762867	0.3182761	0.1763814	0.3406399	0.1915921	0.5653507	0.3601800
COOH	0.0000256	0.0000139	0.0000254	0.0000138	0.0000154	0.0000085		
H	0.0011682	0.0282641	0.0011681	0.0282641	0.0010279	0.0252437	0.0000208	0.0005786
H2	0.0046223	0.0559190	0.0046215	0.0559134	0.0043585	0.0535176	0.0032559	0.0452849
H2O	0.2378680	0.3220005	0.2379086	0.3220804	0.2451890	0.3368902	0.2916629	0.4539293
H2O2	0.0000241	0.0000173	0.0000239	0.0000172	0.0000152	0.0000111		
HCHO,form aldehy	0.0000003	0.0000002	0.0000003	0.0000002	0.0000002	0.0000001		
HCO	0.0000157	0.0000132	0.0000155	0.0000131	0.0000087	0.0000074		
HCOOH	0.0000024	0.0000013	0.0000024	0.0000013	0.0000014	0.0000007		
HO2	0.0002306	0.0001704	0.0002292	0.0001693	0.0001546	0.0001159		
O	0.0151557	0.0231011	0.0151441	0.0230853	0.0126161	0.0195186	0.0000022	0.0000039
O2	0.0667671	0.0508850	0.0667477	0.0508742	0.0612427	0.0473750	0.0000197	0.0000172
O3	0.0000007	0.0000003	0.0000006	0.0000003	0.0000003	0.0000002		
OH	0.0592654	0.0849820	0.0592051	0.0849020	0.0523189	0.0761466	0.0002760	0.0004551
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		1750.5602	m/s
Effective exhaust velocity	-2969.9398	3564.7536	3715.8666 m/s
Specific impulse (by mass)	-2969.9398	3564.7536	3715.8666 N-s/kg
Specific impulse (by weight)	-302.8496	363.5037	378.9129 s
Thrust coefficient	-1.6966	2.0364	2.1227
Thrust	-4.2775	5.1342	5.3518 kN
Altitude	0.0000	25.7012	km
Ambient pressure	1.0000	0.0226	0.0000 atm

**Table 5. Estimated Delivered Performance**

Parameter	Sea level	Optimum expansion	Vacuum Units
Characteristic velocity		1708.2445	m/s
Effective exhaust velocity	-2988.1962	3388.5365	3535.9967 m/s
Specific impulse (by mass)	-2988.1962	3388.5365	3535.9967 N-s/kg
Specific impulse (by weight)	-304.7112	345.5346	360.5713 s
Thrust coefficient	-1.7493	1.9836	2.0700
Thrust	-4.3038	4.8804	5.0928 kN
Altitude	0.0000	25.7012	km
Ambient pressure	1.0000	0.0226	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	-2988.1962	-304.7112	-1.7493	-4.3038

**Table 7. Throttled Performance (delivered)**

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
1.0000	1.4403	4.0000	-2988.1962	-304.7112	-4.3038	3388.5365	345.5346	4.8804	3535.9967	360.5713	5.0928

**Table 8. Chamber Size**

Combustion chamber size				Nozzle size	
Dc	68.74	mm	Type	TIC nozzle	
Dt	28.06	mm	Rn	5.36	mm
Lcyl	413.15	mm	Tn	42.19	deg
Lc	500.00	mm	Te	24.46	deg
L*	2812.98	mm	De	343.70	mm
R1	14.03	mm	Le	250.09	mm
R2	161.61	mm	Le/Dt	8.91	
b	20.00	deg	Le/Lc15	42.46	%
Ac/At	6.00		Ae/At	150.00	

Parameter		Engine	Chamber
Thrust	sea level	-4.3038	-4.3038 kN
	opt exp	4.8804	4.8804 kN
	vacuum	5.0928	5.0928 kN
Specific Impulse	sea level	-2988.1962	-2988.1962 N-s/kg
	opt exp	3388.5365	3388.5365 N-s/kg
	vacuum	3535.9967	3535.9967 N-s/kg
Mass flow rate	total	1.4403	1.4403 kg/s
	oxidizer	1.0802	1.0802 kg/s
	fuel	0.3601	0.3601 kg/s
Number of chambers		1	

**Table 10. Thermal Analysis**