

Case name: project 5mPa

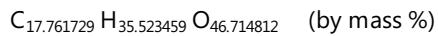
Description:

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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)	90.2	0.1013	-12.9790	-405.608	0.7500000
Total			-24.0508	-778.044	

Propellant exploded formula:



α : 0.8766923 (oxidizer excess coefficient)

O/F: 3.0000000

O/F₀: 3.4219534 (stoichiometric)

rho: kg/m³

Table 2. Combustion Properties

Parameter	Injector	Nozzle inlet	Nozzle throat	Nozzle exit Unit
Pressure	5.0000	4.8749	2.8614	0.1228 MPa
Temperature	3644.8550	3638.8593	3475.9769	2705.6890 K
Enthalpy	-19039.6325	-19431.1803	-35583.8486	-121928.2420 J/mol
	-778.0457	-793.9086	-1432.9402	-4547.9602 kJ/kg
Entropy	270.7966	270.9477	274.9043	296.7867 J/(mol·K)
	11.0660	11.0702	11.0702	11.0702 kJ/(kg·K)
Internal energy	-49344.6773	-49686.3743	-64484.7615	-144424.6176 J/mol
	-2016.4472	-2030.0589	-2596.7626	-5387.0818 kJ/kg
Specific heat (p=const)	7.4537	7.4677	7.5230	6.3155 kJ/(kg·K)
Specific heat (V=const)	6.2639	6.2769	6.3706	5.5519 kJ/(kg·K)
Gamma	1.1899	1.1897	1.1809	1.1375
Isentropic exponent	1.1300	1.1299	1.1254	1.1101
Gas constant	0.3398	0.3397	0.3348	0.3101 kJ/(kg·K)
Molecular weight	24.4711	24.4753	24.8328	26.8094
Density	4.0375	3.9436	2.4586	0.1463 kg/m ³
Sonic velocity	1182.9834	1181.8183	1144.4603	965.1682 m/s
Mach number	0.0000	0.1507	1.0000	2.8450
Area ratio	4.0000	4.0000	1.0000	7.0000 A/At
Mass flux	702.4248	702.4248	2813.8220	401.8388 kg/(m ² ·s)
Viscosity	1.1390	1.1378	1.1043	0.9418 x 10 ⁻⁴ kg/(m·s)
Conductivity, frozen	0.3400	0.3396	0.3265	0.2639 W/(m·K)
Specific heat (p=const), frozen	1.9772	1.9769	1.9702	1.9287 kJ/(kg·K)
Prandtl number, frozen	0.6623	0.6624	0.6664	0.6883
Conductivity, effective	1.6555	1.6571	1.6028	1.0599 W/(m·K)
Specific heat (p=const), effective	7.4537	7.4677	7.5230	6.3154 kJ/(kg·K)
Prandtl number, effective	0.5128	0.5127	0.5183	0.5612

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	0.2943009	0.2571169	0.2940917	0.2569786	0.2800306	0.2482652	0.1976238	0.1891526
CO2	0.3219281	0.1790054	0.3222582	0.1792200	0.3443756	0.1943171	0.4738868	0.2886796
COOH	0.0000304	0.0000165	0.0000297	0.0000162	0.0000181	0.0000100	0.0000008	0.0000005
H	0.0011082	0.0269047	0.0011080	0.0269046	0.0009752	0.0240274	0.0003972	0.0105649
H2	0.0045374	0.0550805	0.0045356	0.0550678	0.0042787	0.0527069	0.0030479	0.0405347
H2O	0.2394997	0.3253251	0.2395910	0.3255056	0.2467080	0.3400692	0.2800318	0.4167295
H2O2	0.0000278	0.0000200	0.0000273	0.0000197	0.0000174	0.0000127	0.0000009	0.0000007
HCHO,form aldehy	0.0000004	0.0000003	0.0000004	0.0000003	0.0000002	0.0000002		
HCO	0.0000181	0.0000152	0.0000177	0.0000149	0.0000100	0.0000085	0.0000003	0.0000003
HCOOH	0.0000031	0.0000016	0.0000030	0.0000016	0.0000017	0.0000009		
HO2	0.0002507	0.0001859	0.0002472	0.0001833	0.0001671	0.0001257	0.0000106	0.0000086
O	0.0144566	0.0221114	0.0144315	0.0220768	0.0120202	0.0186566	0.0027550	0.0046165
O2	0.0652256	0.0498813	0.0651812	0.0498560	0.0597213	0.0463469	0.0228571	0.0191503
O3	0.0000007	0.0000004	0.0000007	0.0000004	0.0000004	0.0000002		
OH	0.0586122	0.0843345	0.0584767	0.0841541	0.0516754	0.0754524	0.0193878	0.0305619
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		1754.8366	m/s
Effective exhaust velocity	2799.3150	2745.8749	3051.4683 m/s
Specific impulse (by mass)	2799.3150	2745.8749	3051.4683 N·s/kg
Specific impulse (by weight)	285.4507	280.0013	311.1632 s
Thrust coefficient	1.5952	1.5647	1.7389
Thrust	5.3196	5.2181	5.7988 kN
Altitude	0.0000	0.0000	km
Ambient pressure	1.0000	1.2119	0.0000 atm

Table 5. Estimated Delivered Performance

Parameter	Sea level	Optimum expansion	Vacuum Units
Characteristic velocity		1716.2932	m/s
Effective exhaust velocity	2668.1083	2615.8420	2914.7233 m/s
Specific impulse (by mass)	2668.1083	2615.8420	2914.7233 N·s/kg
Specific impulse (by weight)	272.0713	266.7416	297.2191 s
Thrust coefficient	1.5546	1.5241	1.6983
Thrust	5.0703	4.9709	5.5389 kN
Altitude	0.0000	0.0000	km
Ambient pressure	1.0000	1.2119	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	2668.1083	272.0713	1.5546	5.0703

Table 7. Throttled Performance (delivered)

Throttle value	Mass flow rate, kg/ s	Pressure Sea level N·s/kg Sea level	Specific impulse, Sea level s	Specific impulse, Sea level kN	Thrust, Optimum level N·s/kg Optimum m	Specific impulse, Optimum level kN	Specific impulse, Optimum expansio n s	Thrust, Optimum expansio n kN	Specific impulse, Optimum expansio n N·s/kg Optimum m	Specific impulse, Optimum expansio n s	Thrust, Optimum expansio n kN
1.0000	1.9003	5.0000	2668.108	272.0713	5.0703	2615.842	266.7416	4.9709	2914.723	297.2191	5.5389

Table 8. Chamber Size

Combustion chamber size			Nozzle size	
Dc	58.00	mm	Type	TIC nozzle
Dt	29.00	mm	Rn	5.54 mm
Lcyl	437.05	mm	Tn	21.22 deg
Lc	500.00	mm	Te	4.02 deg
L*	1914.05	mm	De	76.73 mm
R1	21.75	mm	Le	116.00 mm
R2	109.34	mm	Le/Dt	4.00
b	20.00	deg	Le/Lc15	130.23 %
Ac/At	4.00		Ae/At	7.00

Parameter		Engine	Chamber	
Thrust	sea level	5.0703	5.0703	kN
	opt exp	4.9709	4.9709	kN
	vacuum	5.5389	5.5389	kN
Specific Impulse	sea level	2668.1083	2668.1083	N·s/kg
	opt exp	2615.8420	2615.8420	N·s/kg
	vacuum	2914.7233	2914.7233	N·s/kg
Mass flow rate	total	1.9003	1.9003	kg/s
	oxidizer	1.4252	1.4252	kg/s
	fuel	0.4751	0.4751	kg/s
Number of chambers		1		

Table 10. Thermal Analysis