Engine name: Converse

Mon Nov 29 20:46:48 2021

Propellant Specification

Component	Temperature (K)	Mass fraction	Mole fraction
C3H8(L)	231.08	0.19	0.18
N2O(L),298.15K	298.15	0.81	0.82
	Total	1.00	1.00

Exploded propellant formula: $N_{1.630}\ O_{0.815}\ C_{0.555}\ H_{1.479}$

O/F = 4.400

O/F^0 = 9.981 (stoichiometric) α_{ox} = 0.441
(oxidizer excess coefficient)

Table 1. Thermodynamic properties

Parameter	Injector	Nozzle inlet	Nozzle throat	Nozzle exit	Unit
Pressure	3.4474	3.4474	1.8973	0.0117	MPa
Temperature	2400.6726	2400.6726	2116.4505	823.2841	K
Enthalpy	666.6951	666.6951	129.7272	-2476.5175	kJ/kg
Entropy	10.9970	10.9970	10.9970	10.9970	kJ/(kg·K)
Internal energy	-290.2740	-290.2740	-713.5100	-2790.7130	kJ/kg
Specific heat (p=const)	1.9405	1.9405	1.8640	10.3246	kJ/(kg·K)
Specific heat (V=const)	1.5351	1.5351	1.4634	8.7935	kJ/(kg·K)
Gamma	1.2641	1.2641	1.2738	1.1741	
Isentropic exponent	1.2636	1.2636	1.2736	1.1169	
Gas constant	0.3986	0.3986	0.3984	0.3816	kJ/(kg·K)
Molecular weight (M)	20.8579	20.8579	20.8686	21.7864	
Molecular weight (MW)	0.02086	0.02086	0.02087	0.02124	
Density	3.6024	3.6024	2.2500	0.0372	kg/m³
Sonic velocity	1099.6349	1099.6349	1036.3089	592.3949	m/s
Velocity	0.0000	0.0000	1036.3089	2507.2745	m/s
Mach number	0.0000	0.0000	1.0000	4.2324	
Area ratio	infinity	infinity	1.0000	25.0000	
Mass flux	0.0000	0.0000	2331.7360	93.2322	kg/(m²·s)
Mass flux (relative)	0.000e-04	0.000e-04			kg/(N·s)
Viscosity	7.56e-05	7.56e-05	6.929e-05	3.673e-05	kg/(m·s)
Conductivity, frozen	0.2451	0.2451	0.2198	0.1049	W/(m·K)
Specific heat (p=const), frozen	1.852	1.852	1.822	1.581	kJ/(kg·K)
Prandtl number, frozen	0.5711	0.5711	0.5744	0.5533	
Conductivity, effective	0.2826	0.2826	0.2332	nan	W/(m·K)
Specific heat (p=const), effective	1.941	1.941	1.864	1.581	kJ/(kg·K)
Prandtl number, effective	0.5191	0.5191	0.5539	nan	

Table 2. Fractions of the combustion products

Species	Injector mass fractions	Injector mole fractions	Nozzle inlet mass fractions	Nozzle inlet mole fractions	Nozzle throat mass fractions	Nozzle throat mole fractions	Nozzle exit mass fractions	Nozzle exit mole fractions
C(gr)							0.0141885	0.0250908
CH4	0.0000002	0.0000002	0.0000002	0.0000002	0.0000002	0.0000003	0.0066388	0.0087896
CO	0.3288592	0.2448866	0.3288592	0.2448866	0.3256783	0.2426427	0.1754557	0.1330459
CO2	0.0377299	0.0178817	0.0377299	0.0178817	0.0427448	0.0202689	0.2085925	0.1006702

Species	Injector mass fractions	Injector mole fractions	Nozzle inlet mass fractions	Nozzle inlet mole fractions	Nozzle throat mass fractions	Nozzle throat mole fractions	Nozzle exit mass fractions	Nozzle exit mole fractions
COOH	0.0000003	0.0000001	0.0000003	0.0000001				
H	0.0000650	0.0013455	0.0000650	0.0013455	0.0000190	0.0003941		
H2	0.0236045	0.2442308	0.0236045	0.2442308	0.0238767	0.2471740	0.0266082	0.2803491
H2O	0.0910036	0.1053628	0.0910036	0.1053628	0.0890350	0.1031366	0.0498966	0.0588273
HCHO,formaldehy	0.0000012	0.0000008	0.0000012	0.0000008	0.0000007	0.0000005		
HCN	0.0000148	0.0000114	0.0000148	0.0000114	0.0000085	0.0000066		
HCO	0.0000026	0.0000019	0.0000026	0.0000019	0.0000007	0.0000005		
HCOOH	0.0000007	0.0000003	0.0000007	0.0000003	0.0000004	0.0000002		
HNC	0.0000014	0.0000011	0.0000014	0.0000011	0.0000005	0.0000004		
HNCO	0.0000029	0.0000014	0.0000029	0.0000014	0.0000016	0.0000008		
N2	0.5185805	0.3861180	0.5185805	0.3861180	0.5185934	0.3863262	0.5185982	0.3932003
NH2	0.0000005	0.0000007	0.0000005	0.0000007	0.0000001	0.0000001		
NH3	0.0000246	0.0000302	0.0000246	0.0000302	0.0000199	0.0000244	0.0000213	0.0000266
NO	0.0000111	0.0000077	0.0000111	0.0000077	0.0000014	0.0000010		
O	0.0000003	0.0000004	0.0000003	0.0000004				
OH	0.0000963	0.0001181	0.0000963	0.0001181	0.0000184	0.0000226		

Table 3. Theoretical (ideal) performance

Parameter	Sea level	Sea level (flow sep.)	Optimum expansion	Vacuum	Unit
Characteristic velocity			1478.46		m/s
Effective exhaust velocity	1545.78	1768.87	2507.27	2632.59	m/s
Specific impulse (by mass)	1545.78	1768.87	2507.27	2632.59	N·s/kg
Specific impulse (by weight)	157.63	180.37	255.67	268.45	s
Thrust coefficient	1.0455	1.1964	1.6959	1.7806	

Table 4. Estimated delivered performance

Parameter	Sea level	Sea level (flow sep.)	Optimum expansion	Vacuum	Unit
Characteristic velocity			1438.85		m/s
Effective exhaust velocity	1417.46	1643.14	2378.95	2504.26	m/s
Specific impulse (by mass)	1417.46	1643.14	2378.95	2504.26	N·s/kg

Specific impulse (by weight)	144.54	167.55	242.59	255.36	s
Thrust coefficient	0.9851	1.1420	1.6534	1.7405	

Ambient condition for optimum expansion: H=15.23 km, p=0.115 atm