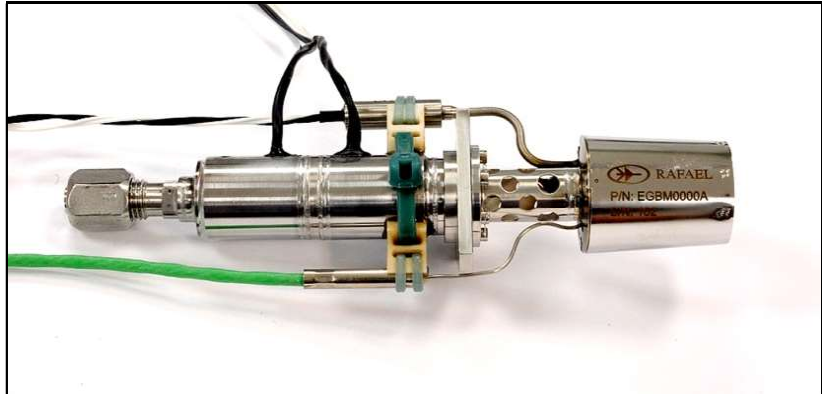


1N Thruster

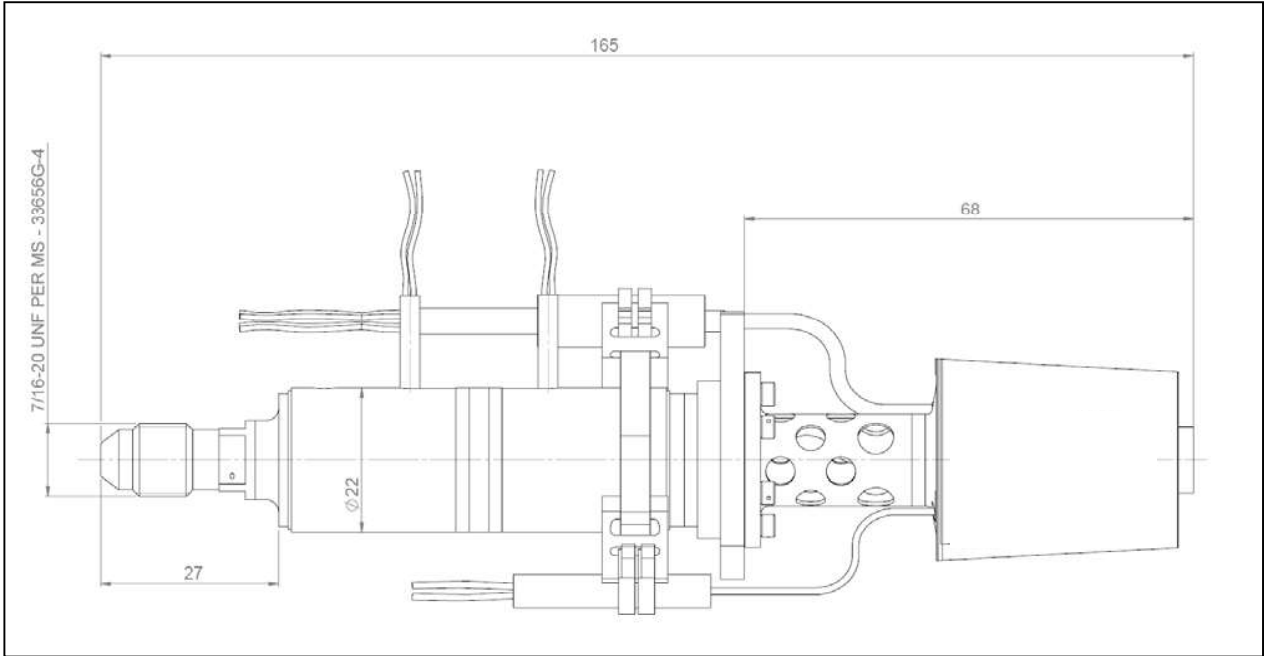


General Description

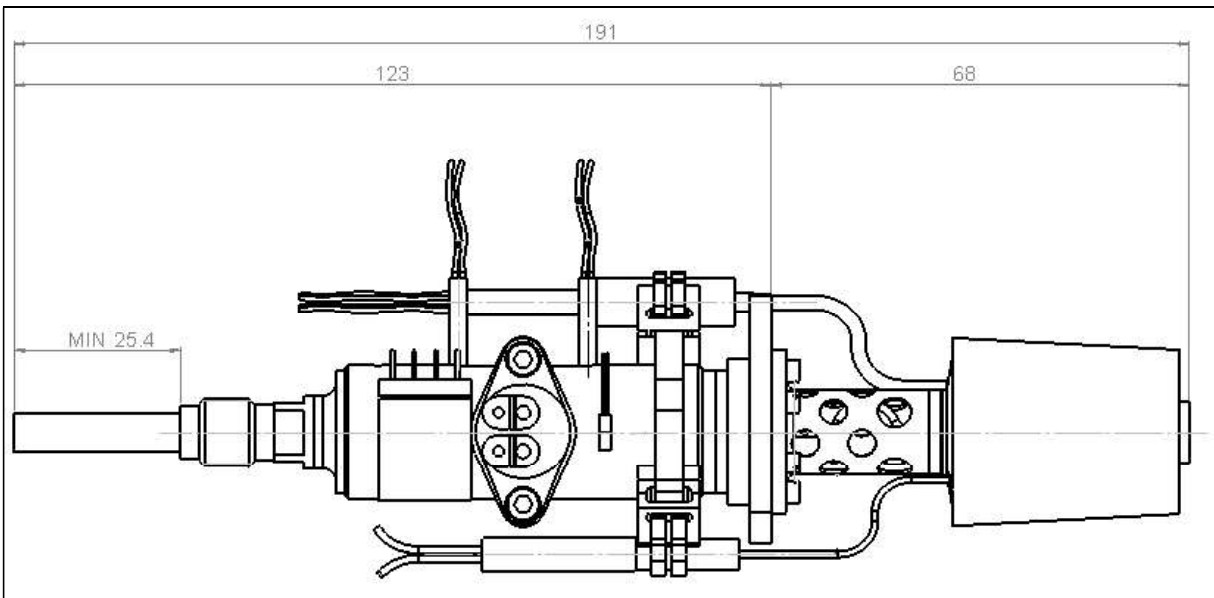
The 1N hydrazine thruster generates the required thrust for maneuvering the satellite by means of a hot gas jet created by hydrazine decomposition and expansion through the exit nozzle. The thruster was designed and qualified for the OFEQ program.

The Rafael 1N thruster was chosen for the following programs: Globalstar-2 (by TAS-F), O3B constellation (by TAS-F), NEOSAT Space bus (by TAS-UK), Cosmo SG (by TAS-I), Prisma (OHB-I) and for ESA programs: Galileo IOV (by EADS-ST), Sentinel-1 A, B, C & D (by TAS-I), Koreasat (by TAS-I) and Sabia-Mar (by CONAE).

The 1N thruster is governed by a solenoid-operated, dual-coil, dual-seat normally-closed Flow Control Valve (FCV). The Normally-closed position is maintained by springs for both seats. The FCV is equipped with an integral, 15-micron absolute filter, installed at the valve inlet.



1N Thruster (threaded connector inlet)



1N Thruster (tube inlet FCV with thermal components)



The normally-closed FCV is operated by its solenoid, opened when energized and shut-off by electric switch-off. The valve is an all-welded construction.

The FCV consists of the following main parts: inlet port (filter included), valve body; coils (2); springs (2); seats (2); plungers (2) and a mounting flange.

The all-welded FCV and the Thrust Chamber Assembly (TCA) are assembled together through a perforated, Hayness-alloy tubular element, which serves as a thermal barrier between the TCA and the FCV. The thermal barrier controls heat conduction from the TCA to the FCV, throughout thruster operation and the heat soak-back period. A metallic seal provides the leak tightness between the FCV and the TCA.

The TCA incorporates a bell-shaped nozzle, with an expansion ratio of $\epsilon=130$. It is welded to the decomposition chamber and provides the required thrust.

The FCV has been developed and qualified by Rafael, as an integral part of its policy to develop an in-house capacity for components and processes.

Rafael's thrusters are free of any ITAR restrictions.

The thruster is equipped with an electric catalyst bed heater (CBH), with two resistance coils, providing the initial thermal condition required for long duration and repeatable operation. The pre-heating time is required for reliable start of the thruster. The recommended pre-heating temperature is 180°C. The elapsed time to reach this temperature depends on the thruster's initial temperature. A typical time for pre-heating from +25°C is about 20 minutes.

Thruster inlet connection to the system tubing is through an MS 33656-4 threaded connector, complying with the requirement for a screwed connection.

Alternatively, the thruster may be supplied with 1/4" or 3/8" welded inlet tube, according to customer preference.

There is no limitation on FCV heaters and thermistors bonding on free areas on the external envelope of the FCV.

1N Thruster Main Characteristics

Parameter	Characteristics	
Propellant	Hydrazine (N2H4)	
Feed Pressure (bar abs)	Type 1	Type 2
	24.5 to 9	24.5 to 5.5
Thrust (BOL), Steady State (N)	1.3 ÷ 1.4	1.0 ÷ 1.1
Thrust (EOL), Steady State (N)	> 0.2	
SSF Specific Impulse (sec)	>214 @ 22 bar	
	>205 @ 5.5 bar	
Minimum Impulse Bit (N-s)	0.008 @ 5.5 bar and D/C 0.02 sec/1 sec	
Nominal Duty Cycle	0.1 sec / 1 sec	
Response Time (Hot Pulse)		
Rise Time (ms.)	< 200 @ nominal duty cycle	
Decay Time (ms.)	< 300 @ nominal duty cycle	
Total Delivered Impulse (N-s)	Type 1	Type 2
	100,000	60,000
Total Number of Pulses	Type 1	Type 2
	100,000	58,000
Leakage		
Internal Leakage (Scc/s GHe):	< 1.0x10 ⁻⁵ @ 5.5 bar and 24.5	
External Leakage (Scc/s GHe):	< 1.0x10 ⁻⁶ @ 24.5	
Temperature	Operating: +5°C to 90°C Non-Operating: -10°C to 95°C	
Flow Control	FCV – dual-coil, dual seat, NC solenoid valve	
FCV Operating Voltage (Vdc)	23 to 36	
FCV Power (W)	9.2 @ 28 Vdc	
Heater – Dual Element		
Heater Operating Voltage (Vdc)	23 to 36	
Heater Resistance (ohms)	257 for each element	
Nozzle Expansion Ratio	130	
Total Life (Storage and Flight)	15 years	
Inlet Filtration	15 microns absolute	
Inlet Interface	MS 33656-4 or welded tube (1/4" or 3/8")	
Weight (gr.)	≤ 310 (1000 mm lead wire length)	
Heritage	Qualified for OFEK, Globalstar-2, O3B, Neosat and GALILEO IOV. Flight heritage with Globalstar-2, O3B, Venus, GALILEO-IOV, Sentinel-1, Gokturk PS2, COSMO SG, Neosat SB and PRISMA.	