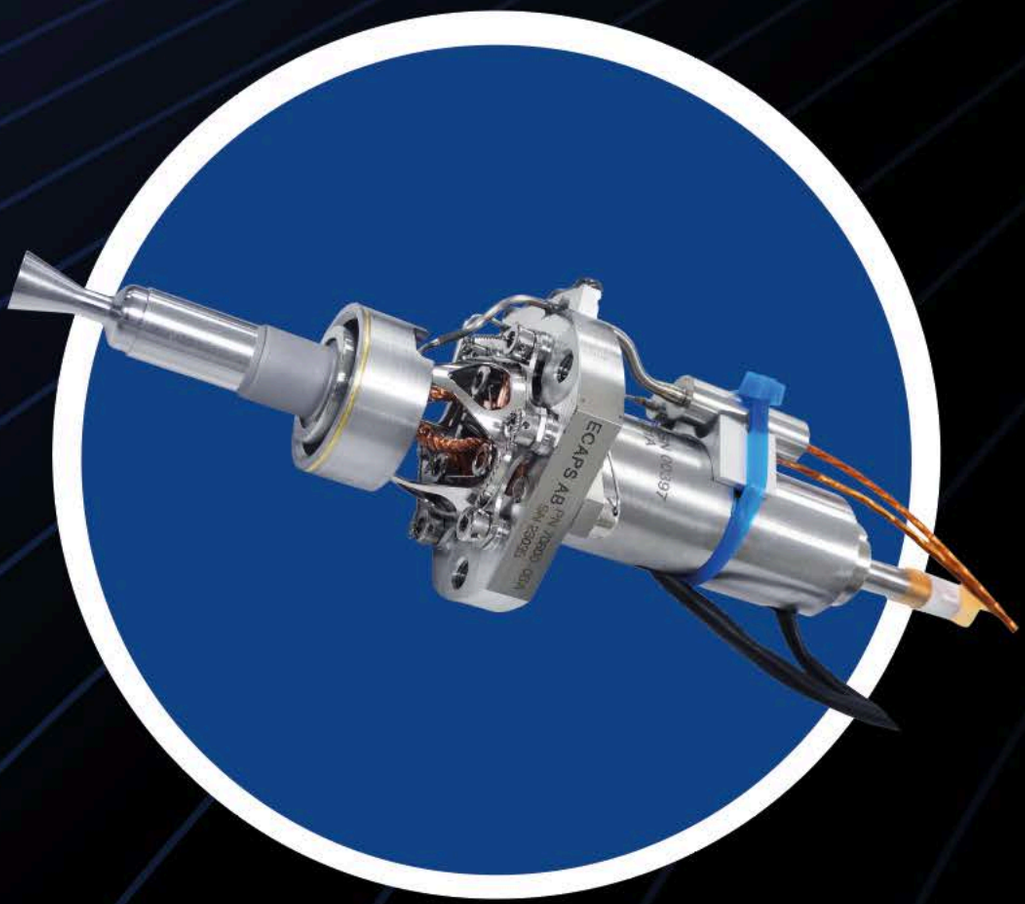
1 N HPGP THRUSTER

High Performance Green Propulsion (HPGP).



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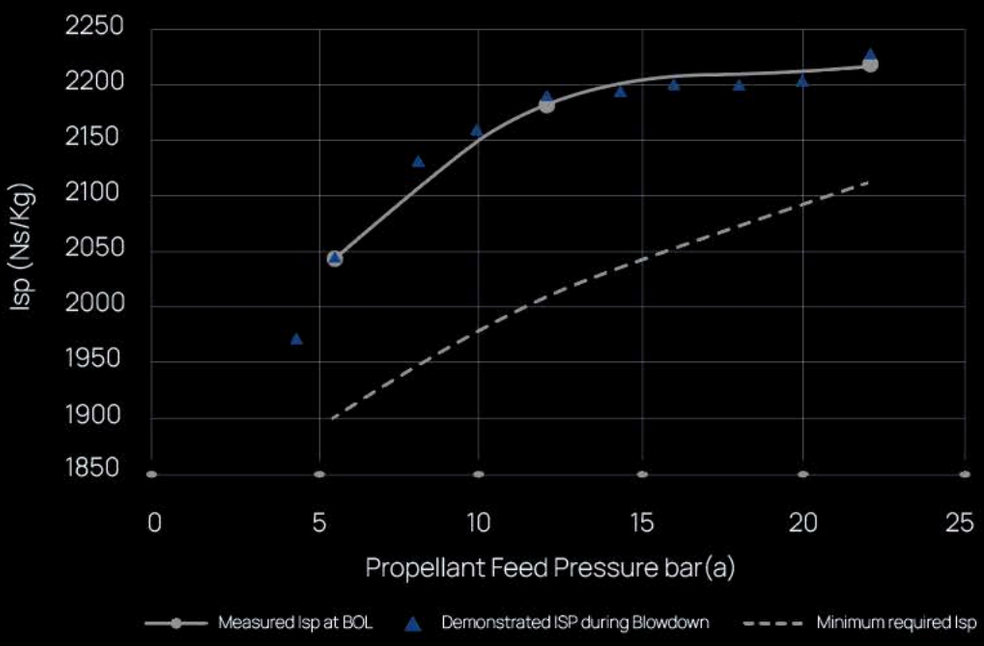
DESCRIPTION ↗

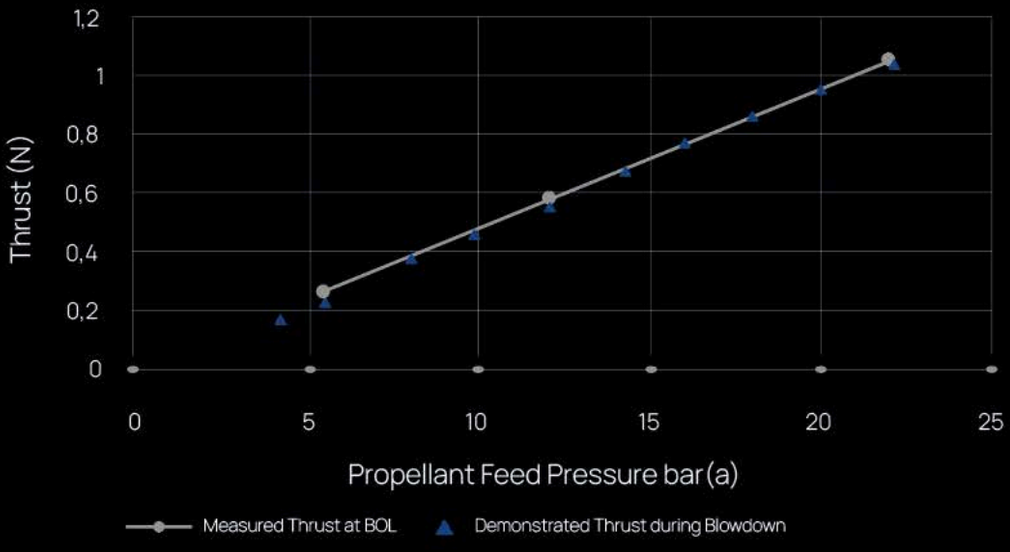
The 1 N High Performance Green Propellant (HPGP) thruster enables high thrust apogee, reaction control, and proximity operations maneuvering for satellites.

The thruster operates on LMP-103S low-toxicity monopropellant with 1.3X the density-Isp of hydrazine.Additionally, LMP-103S offers up to 72%(1) cheaper spacecraft loading as compared to hydrazine, reducing the total life-cycle cost of the mission.

The propellant is long term storable (>15 years) and enables "fuel at the factory" for rapid response satellites. Over 25 satellites are presently flying the 1 N HPGP thruster (+100 units in space, and +160 additional delivered to customers).

PERFORMANCE CHARACTERISTICS



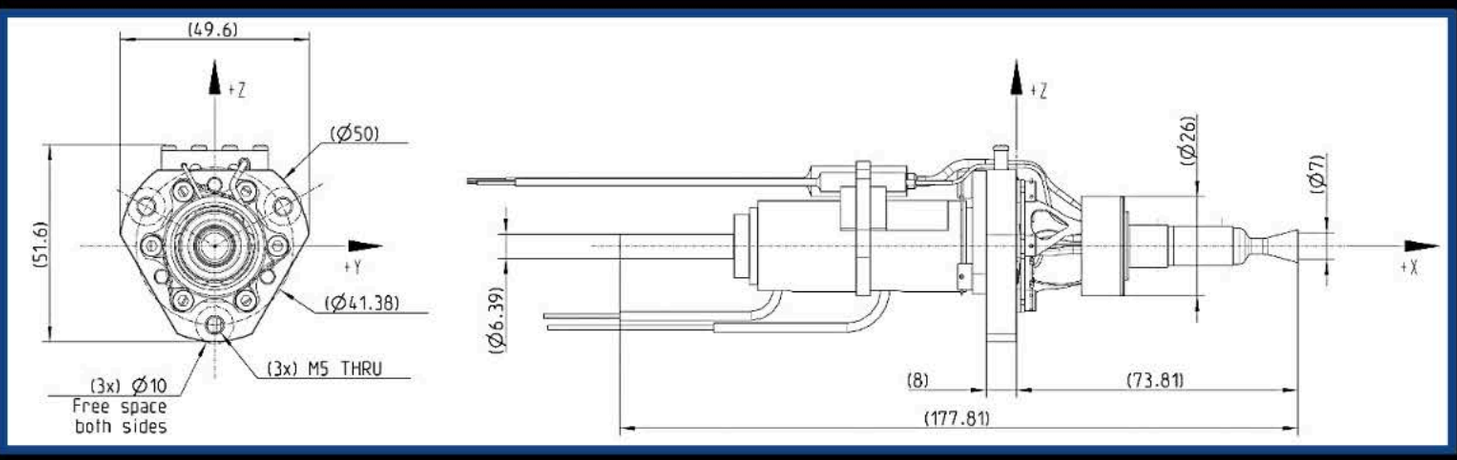


(1) Henry Mulkey, et al. "Green Propellant Loading Demonstration at U.S. Range," AIAA 2016-4576. 52nd AIAA/SAE/ASEE Joint Propulsion Conference. July 2016.

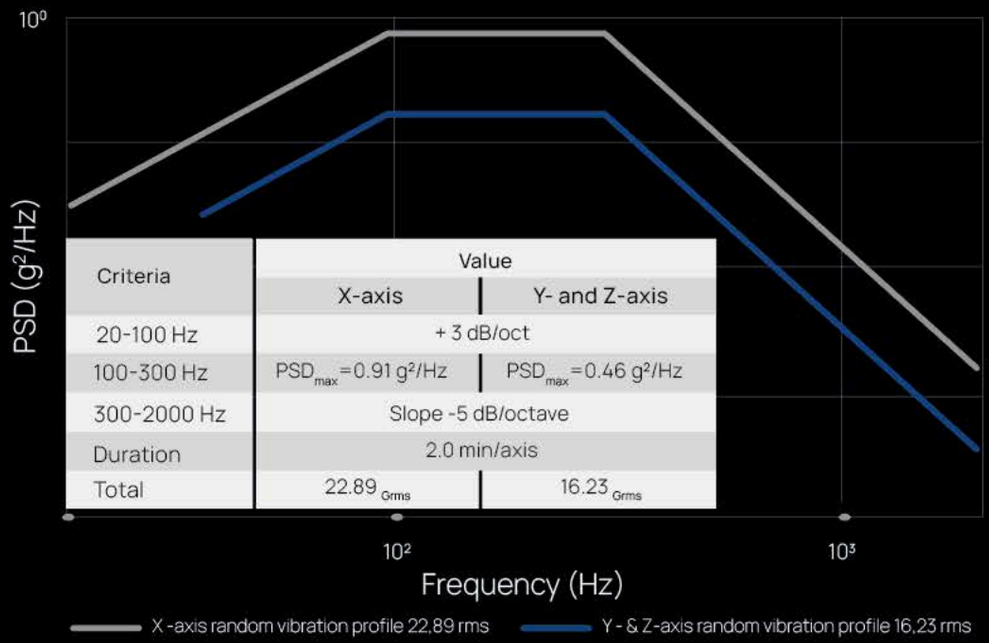
OPERATING PARAMETERS

Propellant	LMP-103S
Propellant Density	1242 kg/m3
Propellant Temperature	10 to 50°C 5 to 60°C (qual)
Burst Pressure	>86 bar (1247 psi)
Proof Pressure	34 bar (478 psi)
Operating Pressure	5.5 to 22 bar (32 to 319 psi)
Thrust (Steady State)	>0.25 N 1N ± 0.1N
Specific Impulse (Steady State)	>193 to 215s (min. spec) >208 to 224s (typical)
Propellant Throughput	24 kg (qual)
Total Impulse, Ns	50000 Ns
No. pulses	>60000
Min. Impulse Bit	< 0.1 Ns
Thermal Cycle Life	300 (flight)
Pulse Length	10 ms to 60 minutes
Preheat Time (nominal)	30 min
Operating Voltage	24-32 VDC
Preheat Power	8.3 to 16 W
Opening Response Time	10 ms
Closing Response Time	10 ms
Valve Seats	Dual
Valve Power(Hold open)	0.5 W per coil
Valve Hold Open Voltage	10 ±1 VDC
Valve Pull-in Voltage	≤ 19 VDC
Valve Drop-Out Voltage	≥1 VDC
Internal Leakage	≤ $1x10^{-5}$ scc/s at 24 bar GHe
External Leakage	≤ $1x10^{-6}$ scc/s at 24 bar GHe
Thruster Mass (incl. harness)	0.39 kg

MECHANICAL INTERFACE

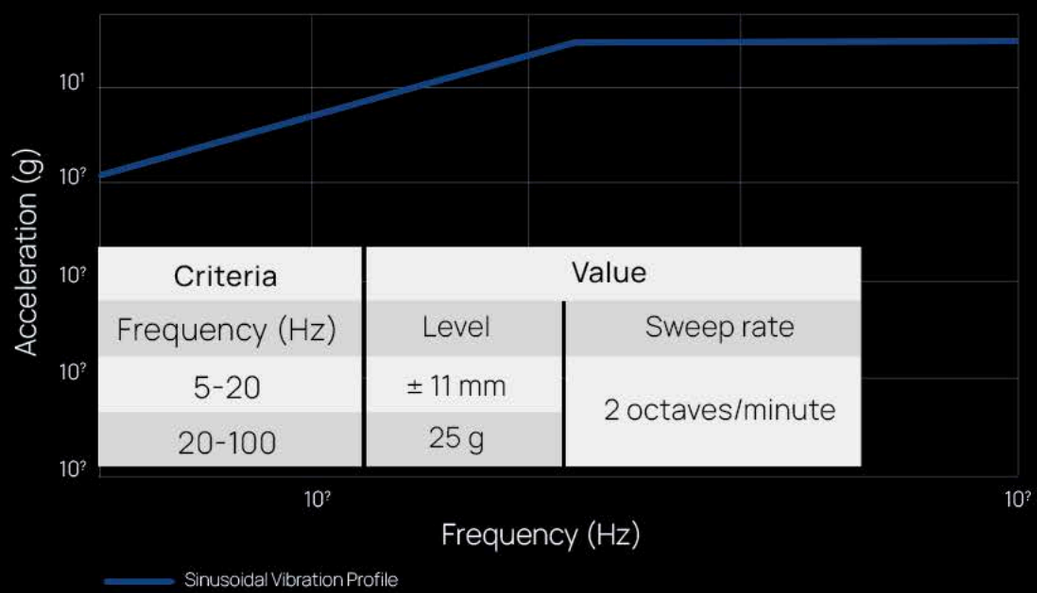


Lead	AWG	Wire Color	Description
1	24	Red	Valve 1+
2	24	Black	Valve 1-
3	24	Red	Valve 2+
4	24	Black	Valve 2-
5	26	Amber	Thermocouple 1+
6	26	Amber	Thermocouple 1-
7	26	Amber	Thermocouple 2+
8	26	Amber	Thermocouple 2-
9	26	Amber	Heater 1+
10	26	Amber	Heater 1-
11	26	Amber	Heater 2+
12	26	Amber	Heater 2-



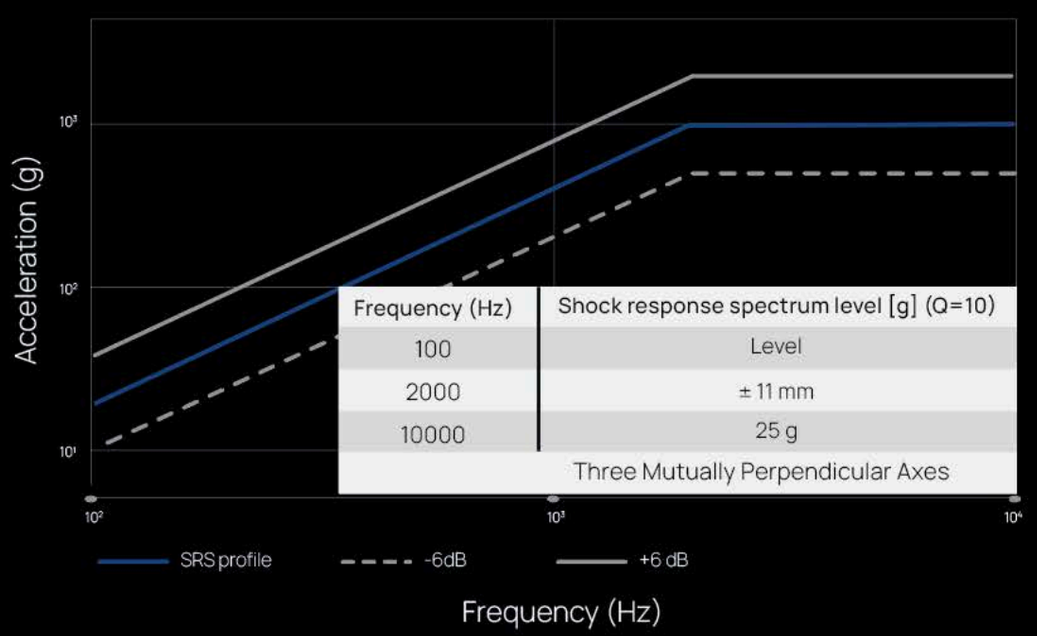
Criteria	Value	
	X-axis	Y- and Z-axis
20-100 Hz	+ 3 dB/oct	
100-300 Hz	PSD_{max} = 0.91 g²/Hz	PSD_{max} = 0.46 g²/Hz
300-2000 Hz	Slope -5 dB/octave	
Duration	2.0 min/axis	
Total	22.89 $_{Grms}$	16.23 $_{Grms}$

X -axis random vibration profile 22,89 rms Y - & Z-axis random vibration profile 16,23 rms



Criteria	Value	
Frequency (Hz)	Level	Sweep rate
5-20	± 11 mm	2 octaves/minute
20-100	25 g	

Sinusoidal Vibration Profile



Frequency (Hz)	Shock response spectrum level [g] (Q=10)
100	Level
2000	± 11 mm
10000	25 g
	Three Mutually Perpendicular Axes

SRS profile -6dB +6 dB

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