The 1 N HPGP thruster is designed for attitude and orbit control of small-sized satellites.

FLIGHT-PROVEN.

High Performance Green Propulsion.

bradford
ecaps

Increased performance and reduced mission costs.

Compared to traditional propulsion, High Performance Green Propulsion (HPGP) provides higher specific impulse and higher propellant density, which results in increased performance. The propellant is based on ADN (Ammonium DiNitrimide) and is considerably less toxic, non-carcinogenic and simpler to handle than hydrazine. The architecture of HPGP propulsion systems consists of COTS (Commercial Off The Shelf) components with extensive flight heritage. This enables a simplified transition away from hydrazine, and allows the overall mission cost to be reduced.

The people behind this innovation are found at Bradford ECAPS, a company in the AIAC Group. On the following pages you will find more information about our HPGP technology and the many benefits it provides.

HPGP provides numerous advantages over hydrazine

INCREASED PERFORMANCE
Allows for an extended mission, or use of a smaller propellant tank

INCREASED RESPONSIVENESS
Non-hazardous fueling operations allow for a shorter launch campaign

INCREASED RIDESHARE OPPORTUNITIES
Non-interference of secondary satellites with a primary

HYDRAZINE-FREE LAUNCH VEHICLES
Through the replacement of current hydrazine systems

REDUCED COSTS
On the Prisma mission, a 2/3 cost savings was realized for HPGP propellant, transportation and fueling operations over the hydrazine system also flown on the same satellite

NEW OPPORTUNITIES
Improved safety, simplified handling and reduced costs allow for the inclusion of liquid monopropellant propulsion systems on university-designed satellites

HPGP CHARACTERISTICS, AS COMPARED TO HYDRAZINE

Comparison Parameter	Hydrazine	HPGP (LMP-103S)
Specific Impulse	Reference	≥ 6% higher than hydrazine
Density	Reference	24% higher than hydrazine
Stability	Unstable (reactivity)	Stable > 20 yrs (STANAG 4582)
Toxicity	Highly Toxic	Low Toxicity (due to methanol)
Carcinogenic	Yes	No
Corrosive	Yes	No
Flammable Vapors	Yes	No
Environmental Hazard	Yes	No
Sensitive to Air & Humidity	Yes	No
SCAPE Required for Handling	Yes	No
Storable	Yes	Yes (> 8.5 yrs, end-to-end test is ongoing)
Freezing Point	1° C	-90°C (-7°C saturation)
Boiling Point	114° C	120°C
Qualified Operating Temp Range	10°C to 50°C	10°C to 50°C (allows use of COTS hydrazine components)
Operating Temp Range Capability	10°C to 50°C	-5°C to 60°C
Typical Blow-Down Ratio	4:1	4:1
Exhaust Gases	Ammonia, nitrogen, hydrogen	H_2O, N_2, H_2, CO, CO_2
Shipping	Class 8 / UN2029 (Forbidden on commercial aircraft)	UN 1.4S (Permitted on commercial passanger aircraft)

The facts behind the benefits.

Increased Performance

The novel HPGP monopropellant, called LMP-103S, provides increased performance compared to hydrazine. The specific impulse is ≥ 6% higher and the propellant density is 24% higher. As a result, the satellite can either be fitted with a smaller tank, or the mission duration can be extended while retaining the same tank size.

LMP-103S is based on ADN, has a very high energy content and can be stored for more than 20 years. It is also insensitive to space radiation. The thruster, including the catalyst and propellant, have been patented by ECAPS.

Simplified Handling During Fueling

Fueling with hydrazine requires a rigorous regime of safety procedures; including the use of SCAPE suits by fueling personnel. With LMP-103S, the procedures are much simpler, with only normal protective clothing for chemical handling required. This makes pre-launch fueling both faster and less expensive. Unlike hydrazine, LMP-103S is also insensitive to air and humidity, making it much easier to handle and de-fuel, if necessary.

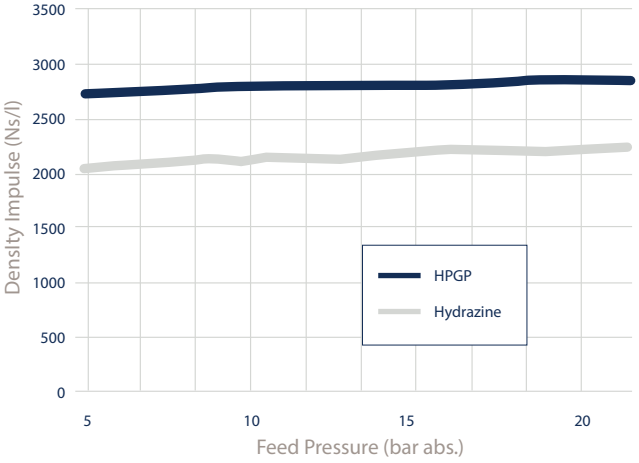
Simplified Propellant Transportation

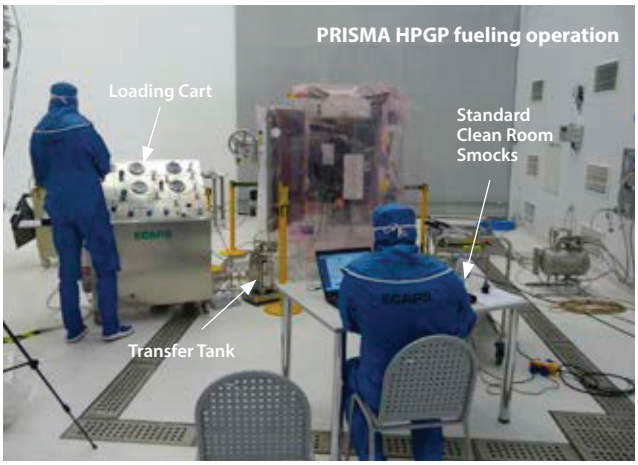
LMP-103S is transport classified as both UN and US DOT 1.4S. This means that it can be transported to the launch site by air together with the satellite, rather than requiring a separate shipment by land or sea. Consequently, both transport costs and time can be saved. Transport by commercial passenger aircraft has been demonstrated numerous times to delivery destinations in Europe, the United States and Japan.

Reduced Environmental Impact

LMP-103S is environmentally benign compared with hydrazine, which is a highly toxic substance. So if your company has a clearly expressed environmental policy, HPGP will be an important component in its pro-environment profile.

DENSITY IMPULSE COMPARISON BETWEEN HPGP AND HYDRAZINE





And Ultimately: More Profitable Business

Lower costs or higher performance – irrespective of the specific needs of your specific satellite or launch vehicle project, HPGP adds value while also reducing environmental impact. We go so far as to claim that no other propulsion system technology can offer the same benefits.

Different thrust levels to suit your application.

Thrusters

Our range of products encompasses multiple models with different thrust levels. All are designed to replace hydrazine thrusters in monopropellant propulsion systems and support operations in both steady-state and pulse mode.

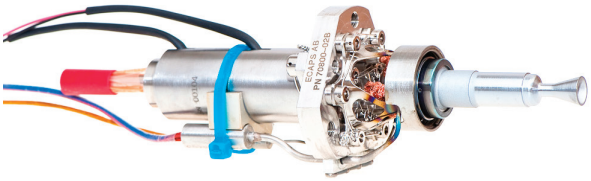
We offer both separate thrusters and complete propulsion systems to satisfy the widest range of customer requirements. Furthermore, we are also able to provide worldwide launch site fueling services.

100 mN HPGP THRUSTER

Designed for CubeSat propulsion systems and modules.

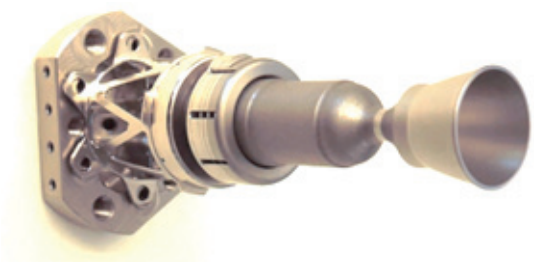
1 N HPGP THRUSTER

Designed for attitude and orbit control of small-sized satellites.



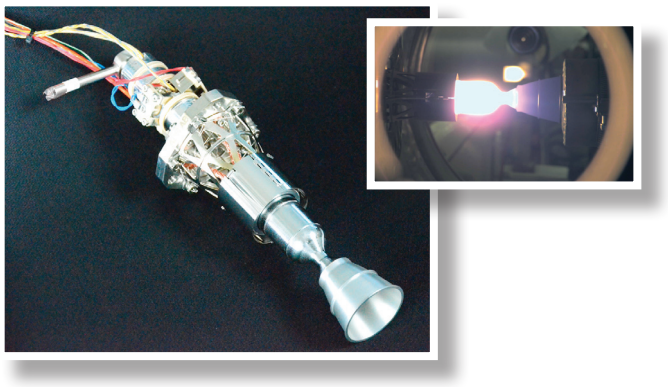
5N HPGP THRUSTER

Designed for attitude, trajectory and orbit control of small and medium satellites.



22N HPGP THRUSTER

Designed for attitude, trajectory and orbit control of larger satellites.



50N HPGP THRUSTER

Designed for attitude, trajectory and orbit control of medium and larger satellites, or launch vehicle applications.

200N HPGP THRUSTER

Designed for launch vehicle upper-stage reaction control.

220N HPGP THRUSTER

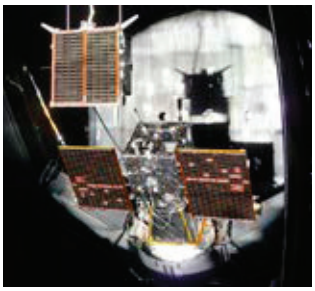
Designed for attitude, trajectory and orbit control of larger satellites, and launch vehicle upper-stage applications.

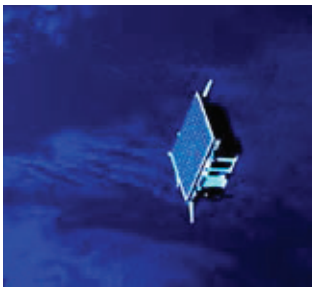
HPGP in space.

Prisma

A complete 1 N HPGP propulsion system was delivered to SSC for flight on the Prisma satellite project.

Based on COTS components with extensive flight heritage, the HPGP flight system on Prisma successfully demonstrated a mission-average 8% higher performance than the hydrazine system flown on the same satellite. The two Prisma formation flying satellites were launched in 2010 and decommissioned in 2015.





Credit: OHB Sweden

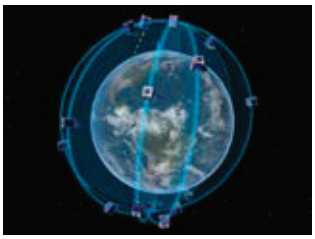
Planet

ECAPS was selected to provide nineteen complete 1N HPGP propulsion system modules for Planet's constellation of SkySat Earth observation satellites.

SkySat-3 was the first of the SkySat satellites to be equipped with orbit maneuvering capability provided by HPGP. A total of five SkySat satellites with HPGP systems have been operational in orbit since 2016, and six additional SkySat satellites with HPGP systems will be launched from Vandenberg AFB in 2017.

Planet's SkySat satellites empower global businesses to make better decisions with timely, sub-meter color imagery and high definition video of the Earth. The HPGP systems provide the SkySat satellites with more than double the on-orbit delta-v compared to the other monopropellant systems considered during Planet's procurement. In addition, the handling and safety advantages of HPGP provide the lowest life-cycle cost of all the liquid propulsion technologies that were evaluated.

The on-going serial production of HPGP systems for the SkySat satellites allows ECAPS to offer the existing system design, or derivatives thereof, as an off-the-shelf solution for other small satellites with similar needs.



Credit: Skybox Imaging

This is ECAPS.

ECAPS is owned by Bradford Engineering (a company in the AIAC Group). Our facilities for R&D, manufacturing and testing are located in Stockholm, Sweden. The ECAPS team consists of highly skilled researchers and engineers with a proven track record in the areas of design, manufacturing, testing and integration of both HPGP thrusters and complete liquid propulsion systems.

If you are interested in increased performance and reduced total mission costs, please visit our website, where you will find the latest information and contact details.

Propulsion Systems

We provide complete propulsion systems tailored and tested to meet customer-specific requirements. We take care of the entire design, provide all the necessary components for the system (propellant tank, piping, valves, etc.) and assemble the complete unit together with the HPGP thrusters.

Launch Site Fueling Services

We can provide worldwide launch site fueling services. This also includes propellant transport and interface to Range Safety.

Compared with hydrazine fueling, our fueling services are highly economical. We take overall responsibility from planning and propellant transport to fueling and Flight Readiness Review. This results in greater flexibility for satellite and launch vehicle projects, and shorter launch campaigns.

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