

Iodine Hall Thruster

For space exploration

Iodine enables dramatic mass and cost savings for lunar and Mars cargo missions, including Earth escape and near-Earth space maneuvers. The demonstrated throttling ability of iodine is important for a singular thruster that might be called upon to propel a spacecraft from Earth to Mars or Venus. The ability to throttle efficiently is even more important for missions beyond Mars.

In the Phase I project, Busek Company, Inc., tested an existing Hall thruster, the BHT-8000, on iodine propellant. The thruster was fed by a high-flow iodine feed system and supported by an existing Busek hollow cathode flowing xenon gas. The Phase I propellant feed system was evolved from a previously demonstrated laboratory feed system. Throttling of the thruster between 2 and 11 kW at 200 to 600 V was demonstrated. Testing showed that the efficiency of iodine fueled BHT-8000 is the same as with xenon, with iodine delivering a slightly higher thrust-to-power (T/P) ratio.

In Phase II, a complete iodine-fueled system was developed, including the thruster, hollow cathode, and iodine propellant feed system. The nominal power of the Phase II system is 8 kW; however, it can be deeply throttled as well as clustered to much higher power levels. The technology also can be scaled to greater than 100 kW per thruster to support megawatt-class missions. The target thruster efficiency for the full-scale system is 65 percent at high specific impulse (Isp) (~3,000 s) and 60 percent at high thrust (Isp ~2,000 s).

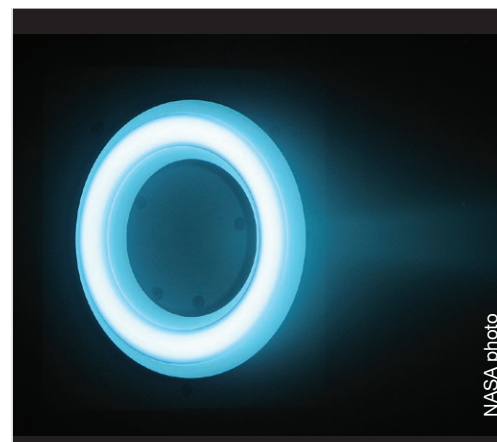
Applications

NASA

- ▶ Orbit raising and interplanetary transfers:
 - Exploration and science missions to near-Earth objects, asteroids, comets, and planets
- ▶ Reboosting the International Space Station (ISS), which is currently accomplished by chemical propulsion

Commercial

- ▶ Orbiting spacecraft:
 - Orbit raising
 - Orbit circularization
 - Inclination changes
 - Station keeping
 - Repositioning
- ▶ High-power electric upper stage for a commercial launch vehicle



NASA photo

Phase II Objectives

- ▶ Design and build fully integrated high-power iodine thruster system consisting of a thruster, cathode, and propellant feed system
- ▶ Measure performance of integrated system
- ▶ Assess materials compatibility requirements and system issues
- ▶ Collect data to assess spacecraft interactions

Benefits

- ▶ High-purity iodine is available commercially in large quantities and at much lower cost than xenon.
- ▶ Iodine stores at two to three times greater density than xenon and at approximately one-thousandth of the pressure and may be stored in low-mass, low-cost propellant tanks.
- ▶ Passive, long-term storage of a fully fueled system is feasible, including storage in conformal tanks that may be used to shield internal components against some types of space radiation.

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