Development of a Low Cost, Modular, IVA/EVA Compatible Cold-Gas Propulsion System at NASA-JSC

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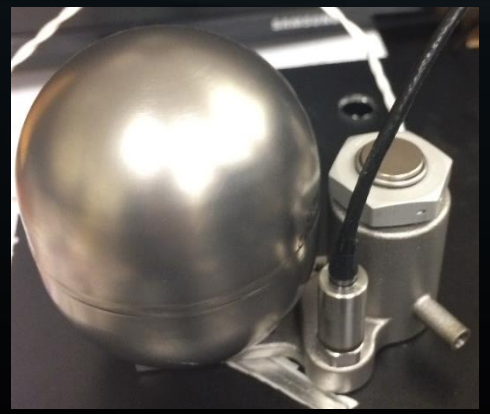
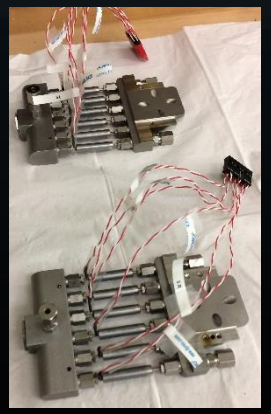




(L) Tank, iso valve and transducer mounted on 3-D printed tank boss and (R) Thruster valves assembled with 3-D Printed thruster clusters

Problem statement and goals

Meet the demand for miniature propulsion systems which

- Are capable of IVA operation in the vicinity of crew
- Enable EVA proximity operations near human spacecraft
- Emphasize modularity and low cost over performance

In response, JSC has developed a 1U propulsion system using state of the art additive manufacturing with an emphasis on COTS components. The system provides:

- 6 DOF maneuverability
- A path to on-orbit recharge
- An integrated vehicle demonstration within 3U CubeSat (Dec '16) with roadmap to expanded 6U vehicle
- Lineage to JSC SAFER and AERCam development experience and hardware, enhanced for performance, manufacturability, cost, and modularity.

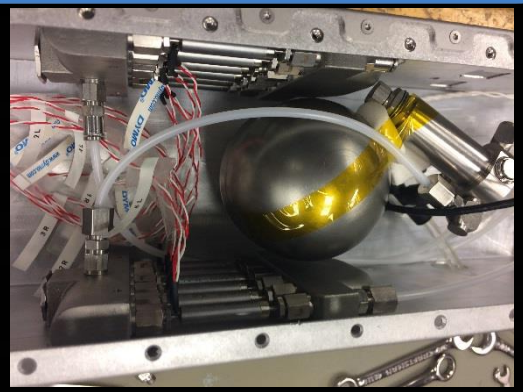
Capability and Innovation

Current and future capabilities of the system include

- 5-10 m/s ΔV using GN_2 with roadmap to Tridyne and warm gas technologies for increased performance
- ~40-60 mN maneuvering thrust
- MAWP of up to 42 MPa (6,000 psi)
- Modular for application specific thrust impulse, layout, tank capacity, and number of thrusters
- Unit cost under 100k

Use of additive manufacturing and COTS components streamlined development

- Significant reduction in mass and complexity due to integrated components
- COTS component use has reduced development time to less than 1 year from concept to test



Propulsion system shown, integrated into 1U of 3U CubeSat

Assembled Seeker 3U- EVA inspection CubeSat

Future work and growth path

Initial flight demonstration test of the Seeker EVA inspection CubeSat will further increase the fidelity of the propulsion subsystem and vehicle design though

- Additional component testing (burst, vibe, thermal)
- Integrated system testing (Vibe, thermal/vacuum)

Clear growth path

- Forward compatibility with Tridyne warm gas propulsion technology to increase ISP
- Further mass reduction with design iterations
- Continued evolution and utilization through partnerships with academia and industry