

# Manifold Integrated Pyrovalve

PM / PI Info EP3 | Jacob French | [jacob.m.french@nasa.gov](mailto:jacob.m.french@nasa.gov)

## EXECUTIVE SUMMARY

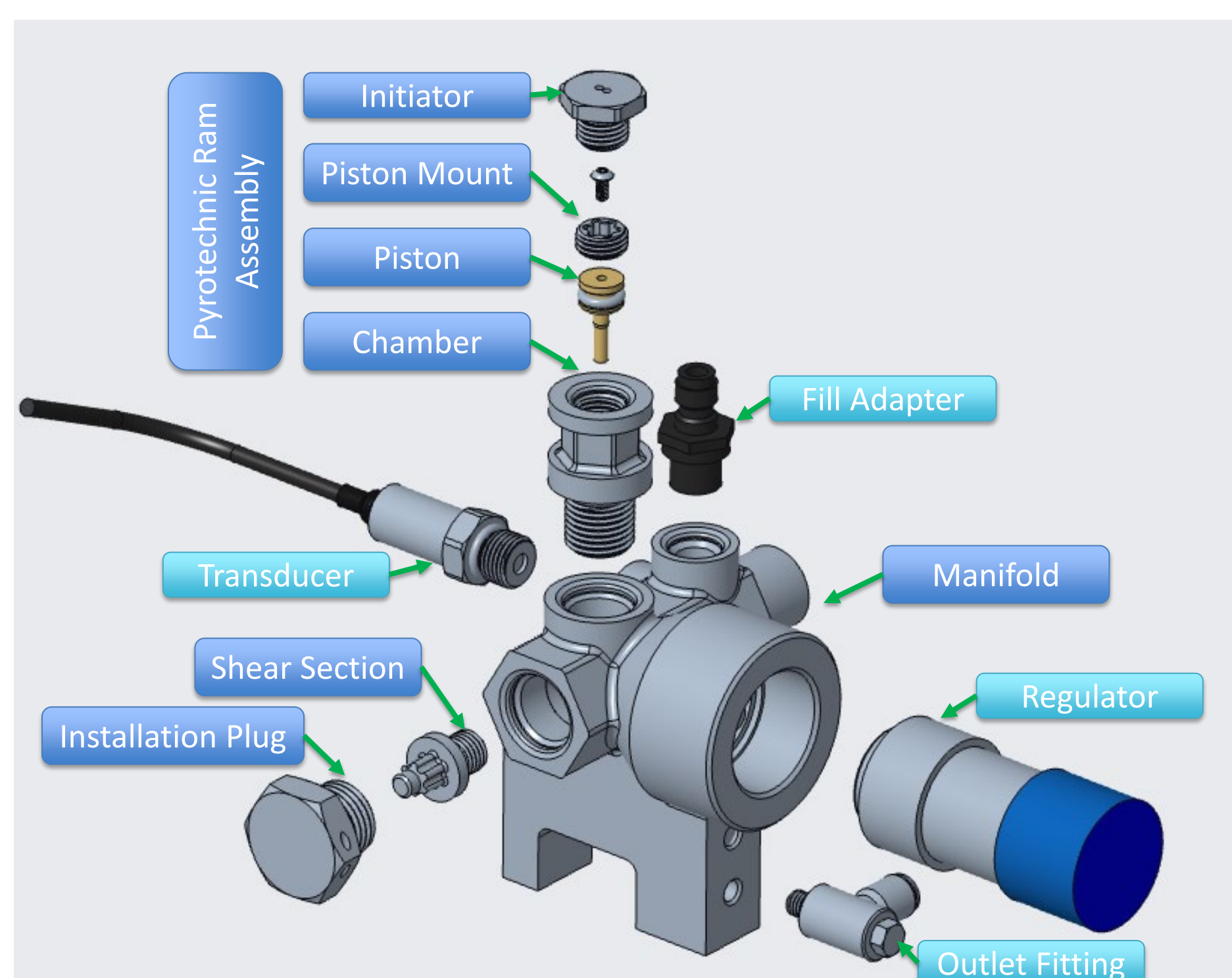
The Manifold Integrated Pyrovalve (MI-PV) provides a state-of-the-art, low mass, low volume, normally-closed (NC) pyrotechnic isolation valve configuration which is optimized for small free-flier applications. Small scale free-flier (e.g. CubeSat) applications require high pressure fluid isolation valves with leak rates low enough to endure long pad stays, and often have severe mass and volume limitations. The MI-PV utilizes a unique configuration where the shear section and the pyrotechnic ram assembly (PRA) are installed directly into a ported gas manifold, allowing elimination of heavy fluid fittings and connections. This configuration can be readily scaled and adapted to the needs of other long duration missions.

## INNOVATION & BENEFITS

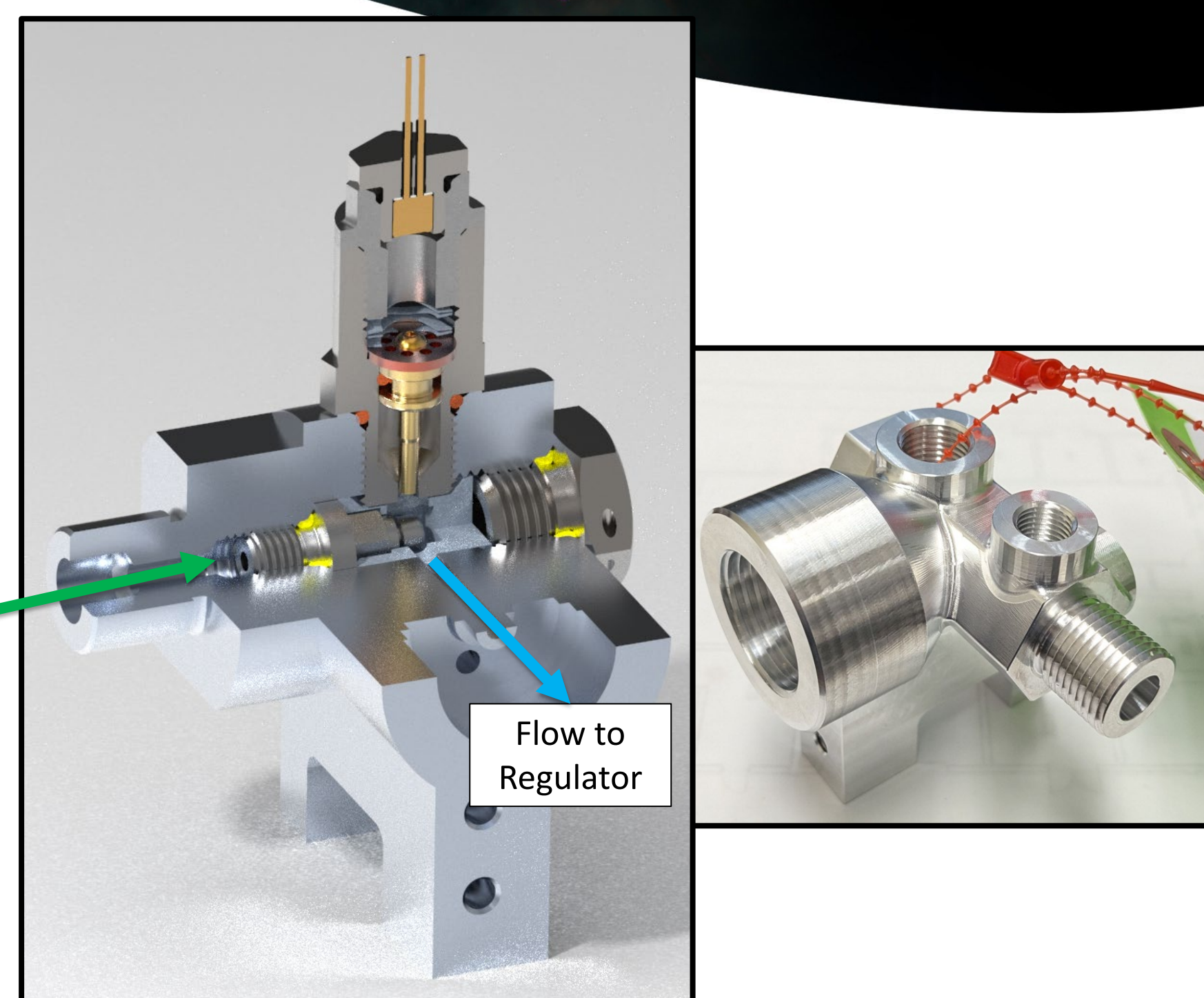
Propulsion systems for free-fliers must effectively isolate propellant supply before deployment, then allow sufficient flow during operation. Solenoid valves may be used in to isolate propulsion systems, but these valves are not leak-proof, therefore their use inherently limits allowable pad stays/deployment delays. This is a particular issue for small scale free fliers which have small volumes of propellant and must often endure long pad stays before deployment. Pyrovalves with their zero-leak hermetic parent metal seal offer an attractive solution to this problem, but existing designs require external gas fittings which are unsuited to the mass/volume needs of small free-fliers. A suitable pyrovalve design must allow for easy installation, removal, and replacement of consumable components (i.e. the PRA and shear section) to facilitate end-to-end testing of the manifold assembly. The MI-PV utilizes a self-contained pyrotechnic ram assembly (a pin pusher) and a replaceable shear section. These components interface with standard ports on the manifold. The ram assembly can be driven by a single initiator, and can be removed after use and replaced with a new assembly. The configuration pictured here depicts an MI-PV in a Realizing Rapid, Reduced cost high Risk Research (R5) free-flier manifold. In this application it replaces a solenoid valve without significantly increasing mass or volume of the assembly.

## COLLABORATION

1. Bill Studak / Jacob Nunez-Kearney R5/SEEKER providing requirements, and supporting end-to-end testing of the manifold design for the Realizing Rapid, Reduced cost high Risk Research free-flier project.



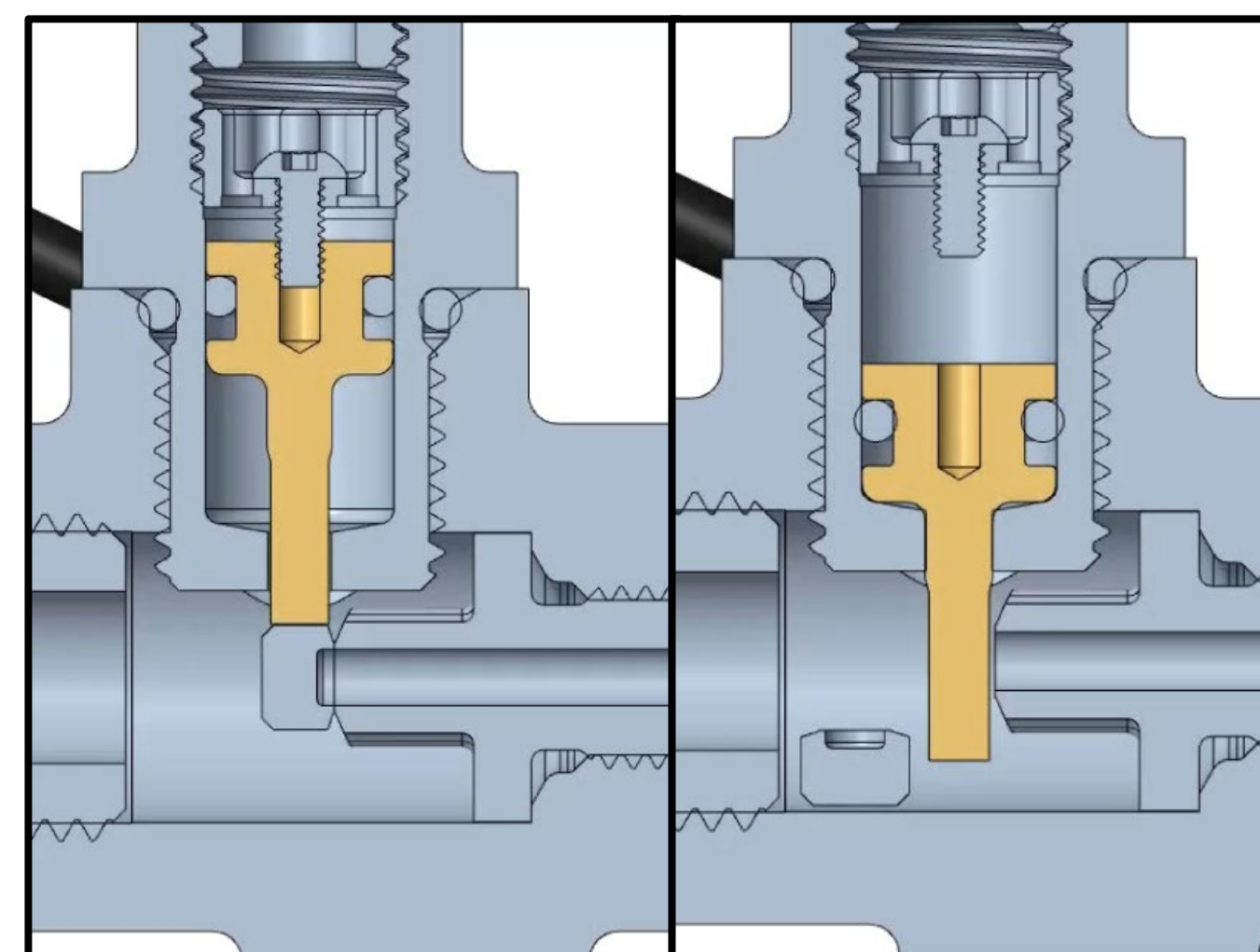
R5 Manifold Assembly Showing Pyrovalve



Rendered Section of Manifold with Pyrovalve and Prototype Manifold

## OUTCOMES & INFUSION

- Demonstrated a new initiator prototype which utilizes a COTS primer encased in a body with an NSI-style output interface, and direct access to primer leads. This reduces mass and length of the PRA by eliminating the MIL-DTL-38999 electrical connector interface. The prototype initiator provides approximately 70% of the output of an NSI at ullage volumes <1CC in ambient conditions.
- Gathered performance data on NSI's and Prototype initiators at low (<1CC) ullage volumes allowing a redesigned chamber with approximately 0.2CC ullage.
- Designed and procured prototype gas manifolds compatible with the R5 flier for future testing.
- Redesigned pyrotechnic ram assembly to reduce length and mass by ~40% each.



Shear Section Functional Diagram

## NEXT STEPS

1. Apply for funding to continue development
2. FY25 – Demonstrate flight capable prototype through all applicable qual conditions and environments
3. Present design to small sat community
4. FY26 – Deliver flight qualified manifold as option for R5 integration - First possible flight opportunity
5. FY27 – First Likely Flight opportunity

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