Rapid Fluidics

Shaping the Future of Microfluidics

FROM PROTOTYPE TO ORBIT: HOW RAPID FLUIDICS AND 3D-PRINTED MICROFLUIDICS ARE ENABLING NEXT-GENERATION SPACE RESEARCH

Rapid Fluidics Ltd was established in 2020 to provide a design and manufacturing consultancy service to customers with a need for microfluidic systems.

3D printing is reshaping space technology by making hardware lighter, faster to develop, and easier to manufacture both on Earth and in orbit—and Rapid Fluidics is positioned to extend those benefits into the fluid-handling research systems that missions rely on.

Why 3D Printing Matters in Space

Space programs live under brutal constraints: every gram, every cubic millimeter, and every launch slot matters. Additive manufacturing helps by:

- Reducing part weight with lattice structures and internal voids, cutting launch costs that scale directly with mass.
- Consolidating assemblies into single printed parts, reducing fasteners, leaks, and failure points.
- Enabling complex internal geometries for thermal management, fluid routing, and structural optimization that unlock designs that were previously too complex or expensive to consider.
- Allow rapid iteration and manufacturing to meet strict launch timelines, compressed timelines and evolving requirements mid-program

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On-Demand and In-Orbit Manufacturing Validation

3D printing has already flown on the International Space Station (ISS), where astronauts can fabricate tools and components instead of waiting weeks or months for a resupply launch. In-orbit manufacturing facilities now routinely print mission-critical parts in thermoplastics like ABS and PEI/PC, demonstrating that additively manufactured hardware can meet stringent space standards.

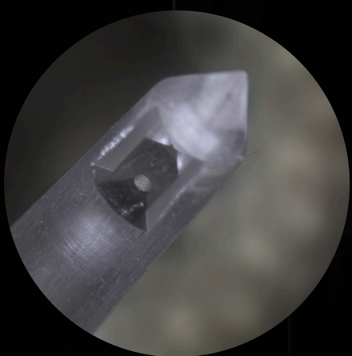
Cutting Launch Costs Through Lightweight Design

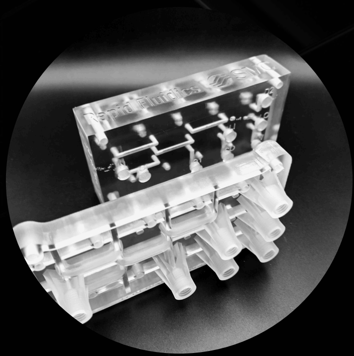
Reducing part weight is one of the most powerful levers space engineers have to cut mission costs. By strategically removing non-critical material components can maintain stiffness and strength while shedding significant mass. Lighter parts also free up mass for additional instruments, redundancy, or propellant, giving mission designers more flexibility without changing the launch vehicle. Because these structures are typically enabled by 3D printing, they also unlock geometries and internal features that are impossible with traditional machining, combining cost efficiency with higher-performing, more optimized hardware.

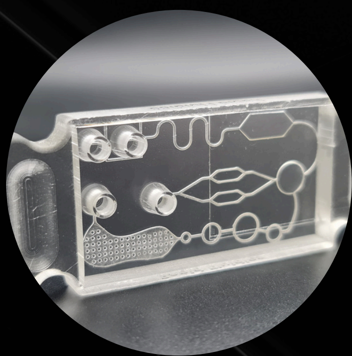
Fluid Handling: A Hidden Bottleneck for Space Systems

Many space technologies depend on precise control of liquids and gases: life-support systems, environmental monitoring, fuel and oxidizer management, thermal control loops, and biological experiments all depend on reliable fluidics. Traditional manufacturing makes it hard to create intricate internal channels, manifolds, and valves in compact, integrated packages, especially when volumes are modest and designs are evolving.

3D-printed microfluidics and pneumatic manifolds can integrate channels, junctions, check valves, and sensor ports into a single compact body. This reduces assembly steps, potential leak paths, and overall mass—exactly the levers space engineers need to pull when optimizing a spacecraft or payload.







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Moving Faster in a Shifting Launch Schedule

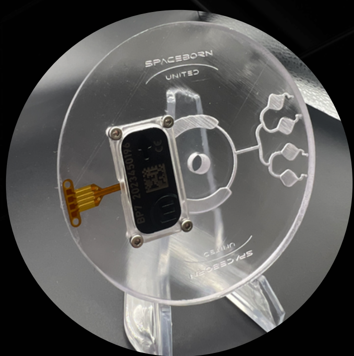
Rapid iteration and agile manufacturing are critical when launch dates move up, rideshare slots open unexpectedly, or mission requirements change mid-program. Being able to update a design in CAD, print a new iteration, and test it within days—not months—means hardware can keep pace with shifting timelines. This agility also reduces the risk of late-breaking design changes, allowing teams to refine performance and fix issues without blowing the schedule. In an environment where launch windows are unforgiving and commercial opportunities can appear at short notice, fast iteration and production become core strategic advantages, not just engineering conveniences.

Rapid Fluidics and Space Technology

Rapid Fluidics specializes in designing and manufacturing microfluidic devices, complex pneumatic manifolds, and other configurations using proprietary 3D printing approaches and other advanced fabrication techniques. The company combines high-precision 3D printing with expert CAD manipulation to generate organic, highly complex internal features that conventional manufacturing struggles to deliver. Rapid Fluidics has been working with partners to create solutions for various space research applications.

Rapid Fluidics has added value to space technology programs in several ways:

- Designed and manufactured a microfluidic system to support IVF investigation under altered gravity conditions with **SpaceBorn United** – launching their ARTIS "disc" into orbit on 21 April 2025, aboard SpaceX's Bandwagon-3 mission



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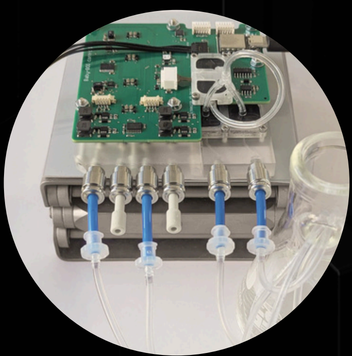
- Supported the development of a complete microfluidic biological experimentation system intended for launch on a future SpaceX mission with **MassBalance** with consultancy on system specification, mechanical design, microfluidic architecture, electronics integration, and control software development. Project included ensuring the system operated within strict mass, volume, and spacecraft interface constraints.
  The system includes sample storage, control mechanisms, and analytics to monitor biological sample reproduction and survival rates.

- For a space manufacturing company, Rapid Fluidics produced bespoke microfluidic adapters to create a more compact, lightweight and space-efficient fluidic assembly for a space pharmaceutical system. By designing adapters compatible with the components already available to the team, we simplified their system integration and expanded compatibility between existing hardware elements, allowing their fluidic system to be assembled with significantly reduced volume and mass.



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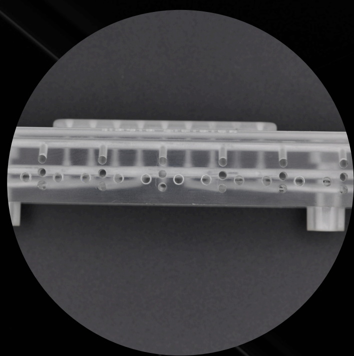

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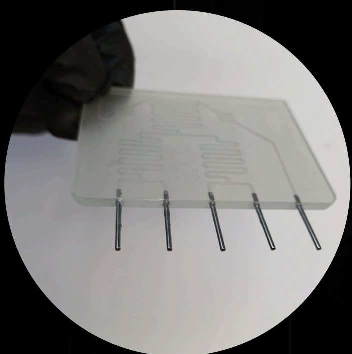
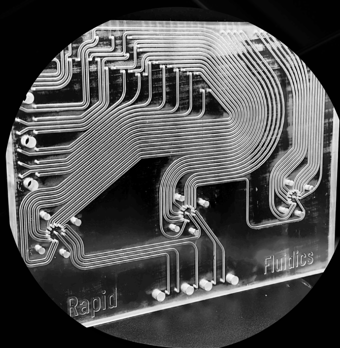
- For an international company focused on conducting scientific experiments in microgravity, Rapid Fluidics redesigned their multilayer lab-on-a-chip architecture for additive manufacturing (DfAM), replacing traditional laminate fabrication methods which were time-consuming, costly, and restrictive in geometry. Our 3D-printed microfluidic design significantly reduced lead times by over 80%, while also lowering unit production cost and enabling greater design flexibility for biochemical formulation experiments.

- Other projects in development include developing custom hardware solutions that streamlined the assembly within a microgravity experimental setup to meet the strict flight envelope constraints without requiring major redesign, and collaborating on development of a microfluidic manifold platform featuring metal reinforcement inserts required to integrate functional components directly onto a cartridge while maintaining structural reliability for space-based experimentation.





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Designing IVF for Orbit: The SpaceBorn United–Rapid Fluidics Partnership

SpaceBorn United's ARTIS tech improves Earth-based IVF mainly by miniaturizing and automating the lab, optimizing embryo culture/cryopreservation, and generating new biological insights from partial-gravity research. Studying embryos at different gravity levels helps identify biological pathways and proteins that, when added to culture media, could boost implantation chances and Better understanding of embryo development and more targeted protocols should allow shorter IVF cycles with less aggressive ovarian stimulation, reducing side effects and overall medication burden for patients. To function in orbit, SpaceBorn had to redesign IVF incubators and cryogenic vitrification hardware, making them more robust, compact, and tightly controlled.

In early 2022 first discussions started with design support and the need for microfluidic experience that Rapid Fluidics could provide. In 2023 the strategy evolved to first prove ground-based IVF workflow using discs with external fluid control, then move toward fully centrifugal systems, with Rapid Fluidics driving design and IVF workflow optimization. 2024 saw focus turn to defining requirements for first SpaceX flight disc: constraints on thickness, mass, thermal and electrical interfaces, fluid storage, pumps, valves, imaging, layout, and manufacture.

This collaboration culminated in a viable prototype launched on 21 April 2025, aboard SpaceX's Bandwagon-3 mission.

- Experiments verified that the ARTIS mini-lab and all its subsystems (pumps, sensors, imaging, control electronics) survived launch loads, vibration, and operated as intended in microgravity.

- The device carried live yeast cells to validate basic life-support and biological handling inside the disc during real flight conditions.

- Returned data and imagery confirming internal components stayed secured and functional, marking the first in-orbit test of hardware specifically engineered for early stages of human reproduction research.

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Rapid Fluidics at the Core of Next-Generation Space Research Payloads

Together, these projects show how 3D-printed microfluidics are moving from promising concept to proven flight hardware, with Rapid Fluidics helping partners de-risk complex fluid handling in some of the harshest environments imaginable. By combining lightweight, highly integrated designs with fast iteration and deep application expertise, the team is enabling payloads that are not only smaller and more reliable, but scientifically more ambitious—from IVF in orbit to autonomous biological experiments and space-pharma platforms. As demand for in-orbit research and manufacturing grows, this blend of additive manufacturing and fluidic design experience will be a key enabler for missions that need to do more science in less space, on tighter schedules, and at lower cost.

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