SBIR/STTR
Small Business Innovation Research / Small Business Technology Transfer

NASA SBIR 2014 Phase I Solicitation

H10.01 Recycling/Reclamation of 3-D Printer Plastic for Reuse

Lead Center: MSFC

Participating Center(s): ARC, JSC, KSC

The subtopic seeks to develop innovative concepts to support the development of recycling/reclaiming technologies for Acrylonitrile Butadiene Styrene (ABS) plastic parts in space, thus providing viable solutions for self-sustained additive manufacturing capability with plastic materials.

As the National Aeronautics and Space Administration (NASA) destinations push farther beyond the limits of low Earth orbit, the convenience of fabricating components and equipment on the ground to quickly resupply missions will no longer be a reasonable option. Resupply is difficult during deep space missions; it requires a paradigm shift in the way the Agency currently relies on an Earth-based supply chain for spares, maintenance, repair, and hardware design models, including those currently on the International Space Station (ISS). With the ISS program extension, there is a high likelihood of necessary replacement parts. This is a unique opportunity to begin changing the current model for resupply and repair to prepare and mature technology for deep space exploration missions.

3-D printing, formally known as “Additive Manufacturing”, is the method of building parts layer-by-layer from data files such as Computer Aided Design models. Data files with tool and part schematics can be pre-loaded onto the device before a launch, or up-linked to the device while on-orbit. 3-D printers currently scheduled for on-board ISS use will employ extrusion-based additive manufacturing, which involves building an object out of plastic deposited by the melting of feedstock by an extruder head. The plastic extrusion additive manufacturing process is a low-energy, low-mass solution to many common needs on board the ISS.

The 3-D Printing in Zero-G “3-D Print” Technology Demonstration and the Additive Manufacturing Facility (AMF) plan to utilize the commercial 3-D printing standard 1.75mm ABS filament as feedstock on ISS. To truly develop a self-sustaining, closed-loop on-orbit manufacturing process that will result in less mass to launch and increased on-demand capability in space, a means of recycling and reclaiming the feedstock is required. This SBIR seeks technologies that can take ABS parts analogous to those which could be printed on ISS (maximum size of 6cm x 12 cm x 6 cm) and demonstrate recycling/reclamation capability of the part back into 1.75mm filament feedstock.

This subtopic seeks innovative technologies in the following areas:

- ABS part reclamation - decomposing a plastic part (maximum size of 6 cm x 12 cm x 6 cm) and reconstitution into 1.75mm (±0.1mm) diameter wire spools, pellets, or other forms that can be fed into an extrusion device.
- Production of recycled plastic filament while maintaining repeatable, consistent filament diameter of 1.75mm with ±0.1mm tolerance.
- Methods to avoid bulging of feedstock as the filament is created.
- Gravity-independent filament spooling capability: drawing the filament onto a feedstock spool as it is being created without relying on gravity to guide the filament. Goal for spool dimension should be 156mm OD,

48mm ID, 43mm wide.
- Environmental containment for Foreign Object Debris (FOD) and material off-gassing.

For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path towards Phase II hardware/software demonstration with delivery of a demonstration unit for NASA testing at the completion of the Phase II contract. Demonstration of the Engineering Unit at the end of Phase II may lead to an opportunity for a Phase III contract for a Flight Unit.

Phase I Deliverables - Feasibility study with proposed path forward to develop Engineering Unit in Phase II; study should address how the design will meet flight certification, safety requirements, and operational constraints for spaceflight; and bench top proof-of-concept, including samples and test data, proving the proposed approach to develop a given product (TRL 3-5).

Phase II Deliverables - Functioning Engineering Unit of proposed product, along with full report of development and test data (TRL 5-6).