National Aeronautics and Space Administration

Space Tools On Demand:

3D Printing in Zero G

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NASAfacts

The Made In Space 3-D Printer will launch on the fourth installment of the SpaceX Cargo Resupply Service mission.

Today, human spaceflight missions are completely dependent on Earth for the resupply of necessary equipment using launch vehicles that transport cargo to space. Astronauts can't go to the corner hardware store when a tool breaks—they have to wait on the next cargo resupply mission to bring them a replacement, which could take months. The greater the distance from Earth, and the longer the mission duration, the more difficult and costly it is to resupply materials.

The 3D Print experiment will demonstrate the capability of utilizing additive manufacturing technology in space. Additive manufacturing is a way of printing three-dimensional (3D) components from a digital model. If you think of a common office printer, it takes a 2D file and prints it on a sheet of paper. A 3D printer will take a 3D file and by depositing thin layers of material on top of each other creates a 3D model giving us the ability to print tools on demand.

This technology demonstration is the first step towards realizing an additive manufacturing, print-on-demand "machine shop" for long-duration space missions and sustaining human exploration of other planets, where there is extremely limited ability and availability of Earth-based logistics support.

To prepare for a future when parts can be printed on demand in space, NASA's Marshall Space Flight Center in Huntsville, Ala., and Made in Space of Mountain View, Calif., have partnered to develop and launch the first 3D printing experiment to the International Space Station. The 3D printing experiment aboard the space station will implement the first device used to manufacture parts in space. The printer uses extrusion additive manufacturing, which builds objects layer by layer out of Acrylonitrile Butadiene Styrene (ABS) plastic, the same material that is used to manufacture

a Lego® brick) and other materials. More than 20 parts will be printed from computer-aided design files loaded on the printer with the ability to uplinked additional files from Earth.

For this mission, NASA awarded Made in Space a Phase III Small Business Innovation and Research Contract. The Small Business Innovation Research (SBIR) program is a highly competitive program that encourages domestic small businesses to engage in Federal Research/ Research and Development that has the potential for commercialization. Through a competitive awards-based program, SBIR enables small businesses to explore their technological potential and provides the incentive to profit from its commercialization. By including qualified small businesses in the nation's R&D arena, high-tech innovation is stimulated and the United States gains entrepreneurial spirit as it meets its specific research and development needs.

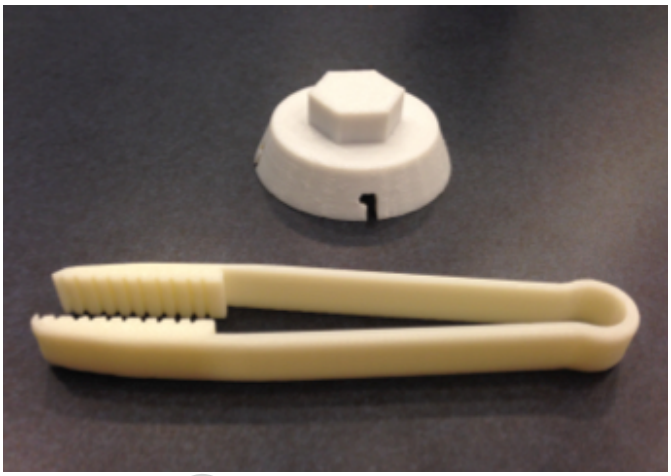
The ability to 3D print parts and tools on demand will dramatically reduce the time it takes to get parts to orbit and increase the reliability and safety of space missions, while dropping costs. Current space missions take months to years to get parts to orbit. With 3D printing, parts can be built within minutes to hours. The 3D print hardware is targeted to launch to the space station in the summer of 2014.

The 3D printer effort is a shared investment between NASA's Human Exploration and Operations and the Space Technology Mission Directorates, which together seek to innovate, develop, test and fly hardware for use in NASA's future missions.

For more information about the 3D printer, visit:
http://go.nasa.gov/QFDI60

For more information about Made in Space, visit:
http://www.madeinspace.us

For more information on the SBI Program, visit:
sbir.nasa.gov



The plastic tools above were printed with the Made In Space 3-D printer and are representative of tools used by the space station crew.

Astronauts who pioneer the solar system and Mars will use additive manufacturing to print 3-D supplies such as tools and equipment.

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