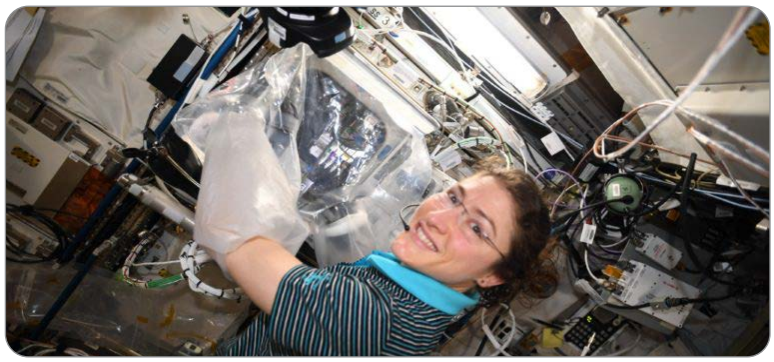
REDWIRE

AEROSPACE TECHNOLOGY

3D BIOFABRICATION FACILITY

PRODUCT DESCRIPTION

The Redwire 3D BioFabrication Facility (BFF) is the first American system capable of manufacturing human tissue in the microgravity condition of space. Utilizing adult human cells (such as pluripotent or stem cells), the system can create viable tissue in space through technology that enables it to precisely place and build ultra-fine layers of bioink.



APPLICATIONS

+ Low Earth Orbit (LEO) Missions.
+ Gateway Missions.
+ Deep Space Missions.

PARAMETERS

The long-term success of BFF as a manufacturing system brings an array of prospective medical breakthroughs, including:

+ Reducing the organ donor shortage (there are about 113,000 people on transplant waiting lists).
+ The possibility of transplant recipients receiving organs manufactured from their own stem cells, thus reducing likelihood of rejection, and reducing long-term costs associated with a lifetime of anti-rejection drugs, and perhaps additional transplants.
+ Creating patient-specific replacement tissues or patches.
+ Eliminating the requirement that someone must first die in order for another person to receive a new heart or other organ.
+ Testing drug efficacy using Redwire-manufactured tissue.
+ Cultured meat production as a deep space food source.

MARKETS SERVED

+ Bioscience Research.
+ Regenerative Medicine.
+ Cultured Meat Research and Production.

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MODULAR DESIGN

Modularity of the BFF design enables reconfiguration of the facility, with Orbital Replaceable Units (ORUs), such that multiple and varying tissue types can be printed and cultured. In addition, modularity increases the service life of the facility with easier routine maintenance and repair. Examples of BFF ORUs include the following:

+ Print heads.
+ Bio-ink reservoirs (syringes).
+ Print Tips (nozzles).
+ Bioreactor.
+ Print Cassette.
+ Hard Drives.
+ Consumable Cartridges (for environmental control).
+ Media bags.
+ Glove bag.

OTHER FEATURES

Why Bioprint in Space?

While researchers have seen some success with the 3D printing of bones on Earth, the manufacture of soft human tissue, such as blood vessels and muscle, has proven more difficult. On Earth, when attempting to print with soft, easily flowing biomaterials that better mimic the body's natural environment, tissues collapse under their own weight – resulting in little more than a puddle. But if these same materials are used in space in a microgravity environment, 3D-printed soft tissues will maintain their shape.

Without proper conditioning, space-printed tissues also would collapse if immediately returned to Earth. Operating in space along with BFF is a Redwire-developed cell-culturing system that strengthens the tissue over time, to the point where it becomes viable and self-supporting once back in the Earth's gravity. Whereas the tissue printing process may take less than a day, the strengthening process can take 12 to 45 days, depending on the tissue.

MISSION HERITAGE

BFF operations have taken place on the following flights:

+ **SpaceX-18**
  - Cardiac Tissue test print.
  - Returned first tissue samples.
+ **NG12**
  - Sent BFF bio-inks to support tissue printing.
+ **SpaceX-19**
  - Returned tissue samples.
+ **NG13**
  - Sent hardware in support of BFF Tissue prints.
+ **SpaceX-20**
  - Bio-inks for Meniscus print.
  - Returned Meniscus prints.

3D BioFabrication Facility (BFF) is export controlled through an ECCN (Export Control Classification Number) issued by the United States Department of Commerce, ECCN 7A104. Export shipment requires successful application for an export license.

FOR MORE INFORMATION ABOUT OUR SPACE CAPABILITIES, CONTACT REDWIRE SPACE SALES AT
DISCOVER@REDWIRESPACE.COM

HERITAGE

Redwire is a new leader in mission critical space solutions and high reliability components for the next generation space economy. With decades of flight heritage combined with the agile and innovative culture of commercial space platform, Redwire is uniquely positioned to assist its customers in solving the complex challenges of the future space missions. For more information, please visit **www.redwirespace.com**

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