National Aeronautics and Space Administration

NASAfacts

# Space Technology
## Game Changing Development
## Key Technologies for Humans in Space: Next Generation Life Support

To extend human presence beyond low-Earth orbit and into the solar system, current life support systems will need to be upgraded.

Today's systems are only partially closed, require resupply, and they cannot recycle all potential waste streams. Current space suits are based on a design that is more than 30 years old.

The Next Generation Life Support (NGLS) project develops new life support technologies for future human space vehicles and for the next generation space suit.

**Rapid cycling amine (RCA)** technology provides carbon dioxide removal, humidity control, and regenerates in real time during space walks using cyclic exposure to space vacuum.

This unique RCA regenerative design approach reduces space suit complexity by eliminating several onboard components associated with humidity control and fluid handling. The RCA was fabricated as the first full-sized assembly and integrated into a prototype of an advanced space suit Portable Life Support System (PLSS). Further maturation of the design will include certification for use with 100% oxygen and compatibility with spacelike environments.

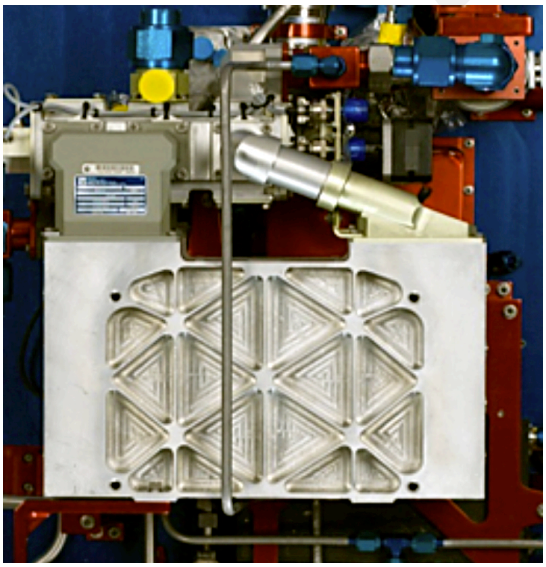
NGLS will also advance space suit oxygen regulator technology. These devices keep the space suit pressurized and provide breathing oxygen.

The **variable oxygen regulator (VOR)** development increases the number of space suit pressure set points from 2 to as many as 4,000, improves the ability to interface with different vehicles, and simplifies space suit operations.

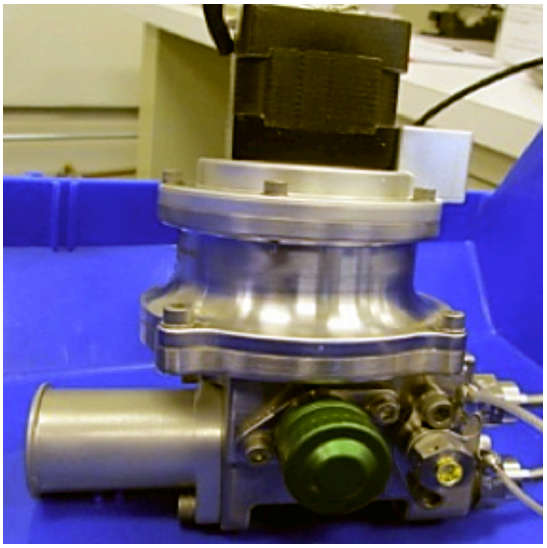
Performance of the regulator will be assessed as part of vacuum chamber tests when integrated into an advanced space suit PLSS and a human metabolic simulator.

The unit will be assessed for oxygen safety and performance under different simulated environments. Lessons learned will be incorporated into the next design. New units will be fabricated and included in human-in-the-loop vacuum chamber tests using 100% oxygen.

A third technology being pursued for extra-vehicular activity (EVA) is **high performance EVA gloves**. The objective is to develop advanced EVA gloves



*Rapid cycling amine.*



*Variable oxygen regulator.*

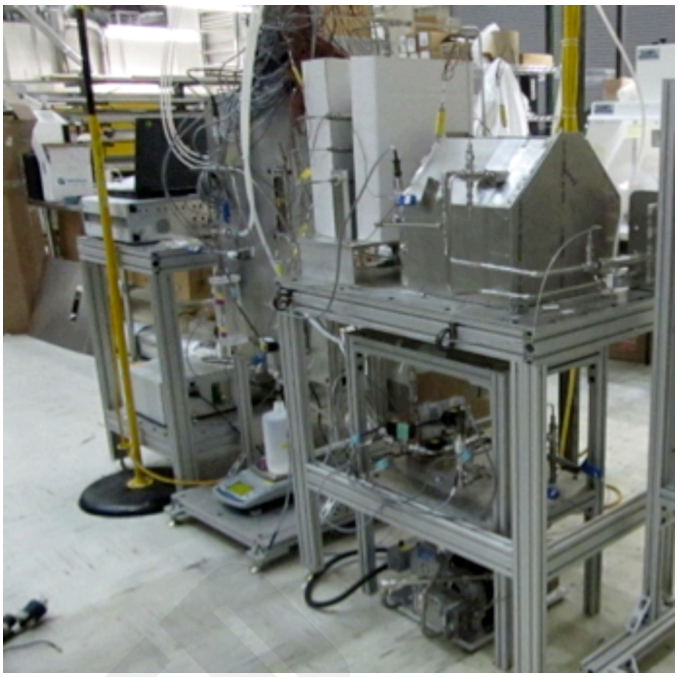
*Prototype glove finger layups.*

for future human space exploration missions. Finger and hand mobility, fit, durability, and injury reduction will be addressed. The approach will be to target technologies for implementation into next generation gloves and their success will be measured against NASA performance standards.

Water recovery systems (WRS) on the ISS are limited to treating cabin humidity condensate and urine, require use of toxic chemicals to prevent biological and chemical fouling, and use nonregenerable multifiltration beds that requiring regular replacement. The **alternative water processor (AWP)** under development by NGLS can recover water from a more complex wastewater stream that includes wastewater from laundry, shower and other hygiene functions.

In collaboration with Texas Tech University, membrane aerated biological reactors (MABR) were designed and fabricated for use as primary water processors. No harsh chemicals are required to stabilize the wastewater because growth of bacteria are encouraged. These naturally occurring organisms efficiently mineralize organic forms of carbon and nitrogen within the wastewater.

*AWP includes four membrane-aerated biological reactors (left) and the Forward Osmosis Secondary Treatment (right).*



*Series Bosch test stand for AOR.*

The second part of the AWP uses a combination of Forward and Reverse Osmosis processes to remove salts, mineralized organics and other suspended solids. Improvements in commercial forward osmosis membranes have enabled the use of systems with greater resistance to fouling and improved contaminant rejection. Unlike the ISS WRS, large multifiltration beds will not be required.

As part of technology development in the area of atmosphere revitalization, NGLS is investigating methods for recovering oxygen from carbon dioxide, as part of an **advanced oxygen recovery (AOR)** system. One focus of this will be in maturing Bosch technology. Bosch is based on a chemical reaction between carbon dioxide and hydrogen that produces two products: elemental carbon (similar to graphite) and water. The water can be used by a space vehicle's oxygen generation system to produce oxygen for the crew to breath. A test stand has been developed to enable evaluation of candidate carbon formation technologies, a key missing piece to development of an efficient Bosch system.

The Game Changing Development (GCD) Program investigates ideas and approaches that could solve significant technological problems and revolutionize future space endeavors. GCD projects develop technologies through component and subsystem testing on Earth to prepare them for future use in space. GCD is part of NASA's Space Technology Mission Directorate.

For more information about GCD, please visit
http://gameon.nasa.gov/

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