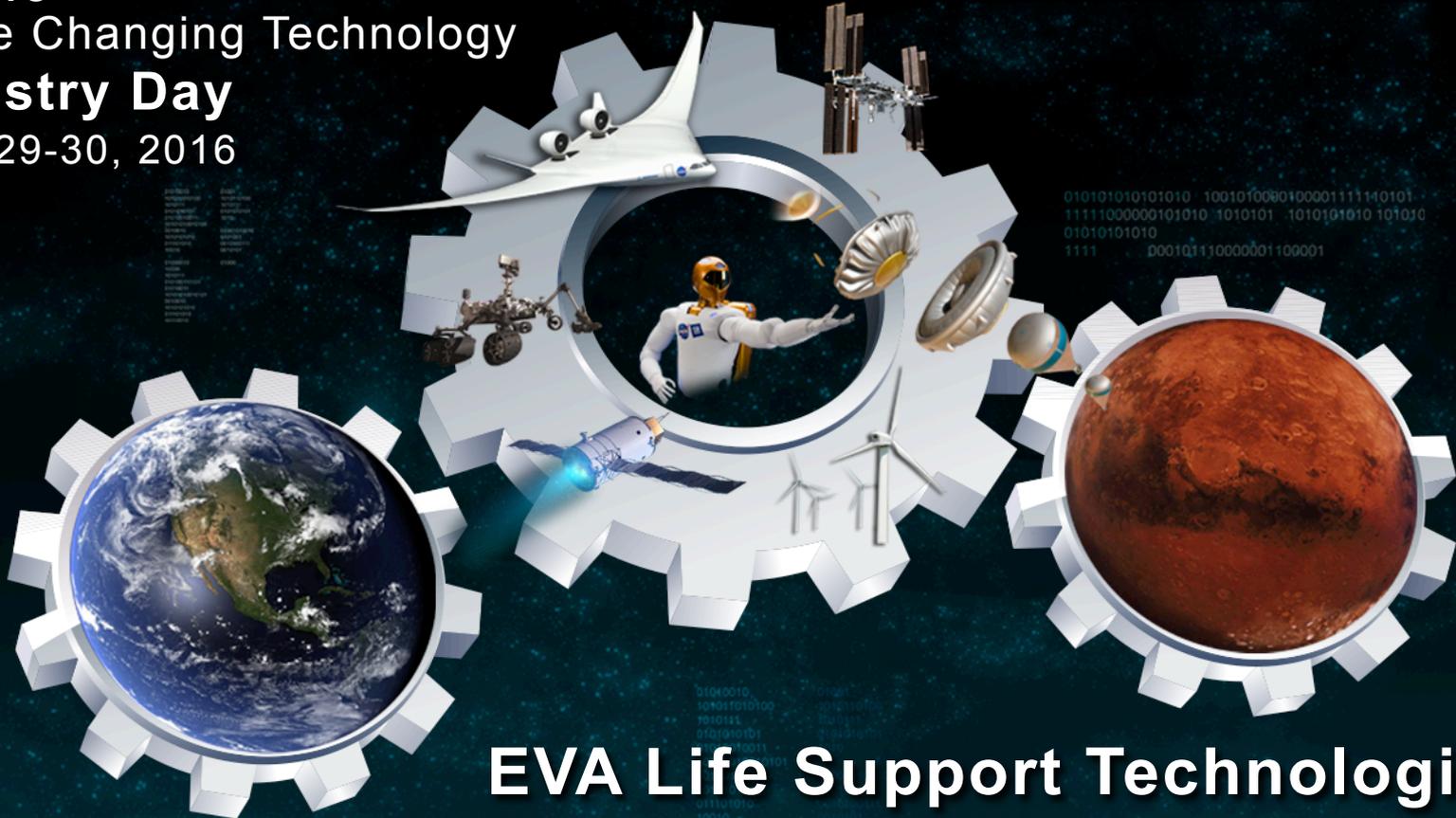




NASA's
Game Changing Technology
Industry Day
June 29-30, 2016



EVA Life Support Technologies

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NASA Johnson Space Center

TECHNOLOGY DRIVES EXPLORATION



EVA Life Support Technologies



The Next Generation Life Support Project developed two technologies for EVA Portable Life Support Systems (PLSS):

Variable Oxygen Regulator (VOR)

- An oxygen-rated, contaminant-tolerant oxygen regulator to control space suit pressure with an increased number of pressure setpoints as compared to the SOA.

Rapid Cycle Amine (RCA) Swingbed

- Continuously removes CO₂ and H₂O from a flowing ventilation stream through the use of a two-bed amine based, vacuum-swing adsorption system.

Second Generation prototypes (2.0) were integrated into the Portable Life Support Systems (PLSS) 2.0 Test Article and evaluated during a series of integrated tests.



PLSS 2.0 Test Article

Courtesy AES Advanced Space Suit Project



Variable Oxygen Regulator (VOR)

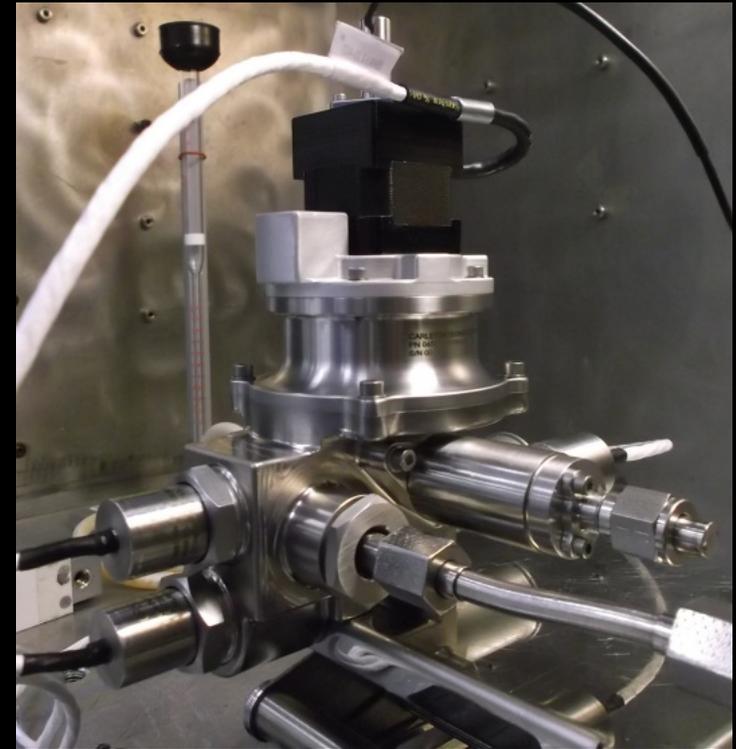


Key Features

- Oxygen-rated
- Nominal pressure source 3000 psi
- Contaminant tolerant (100 mg/ft²)
- Combustion tolerant
- Pressure regulation range: 0 – 8.4 psi
- Pressure set points: 8,000

Status

- Developed over the period October 2011 to April 2015
- Current TRL : 6
- Transitioned to NASA Customer Advanced Space Suit Project, Advanced Exploration Systems



VOR Test Article at White Sands Test Facility (WSTF) for Oxygen Compatibility and Contaminant Testing

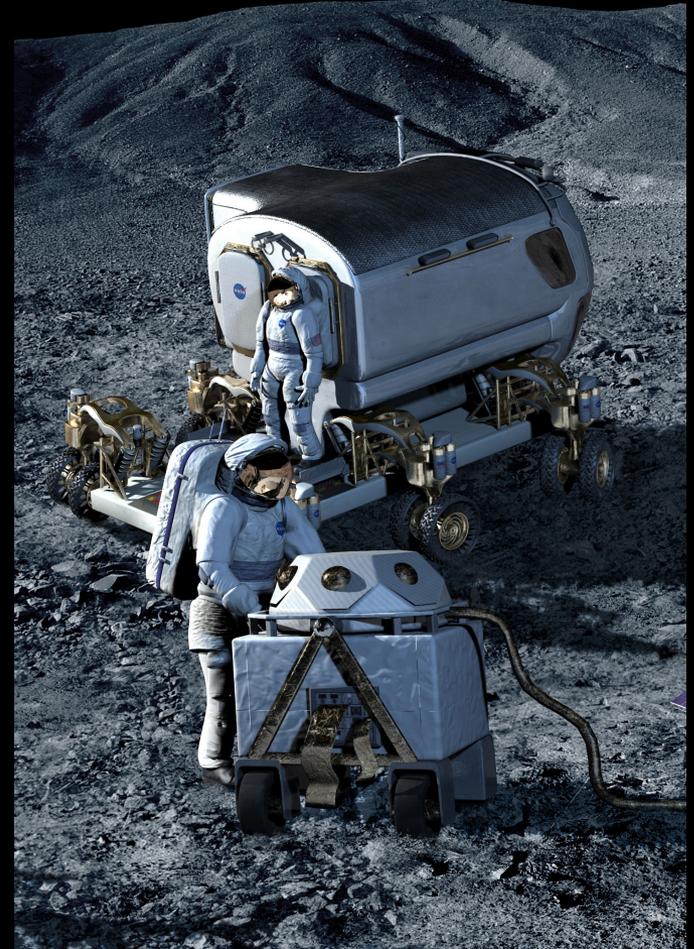


Variable Oxygen Regulator (VOR)



Benefits

- Provides continuous control of suit pressure, resulting in higher levels of flexibility & safety for EVA.
- Allows suits to have flexibility to integrate across various future spacecraft & missions, regardless of cabin pressure, including designs with “suit ports”.
- Pre-breathe protocols to prevent “the bends” could partly be performed within the suit, decreasing preparation time and allowing for more rapid deployment.
- Potential for higher operating pressure reduces decompression sickness (DCS) risk with ability to begin treatment during the EVA due to the adjustability.
- It is robust and tolerant of contamination. It can withstand internal combustion events and retain enough capability to return an astronaut back to the spacecraft safely.





Variable Oxygen Regulator (VOR)



Potential uses beyond NASA

- Commercial crew space suits
- Commercial human spacecraft
- Medical and industrial applications that require precision and varied oxygen pressure settings.

Partnerships

- Current partnerships
 - Cobham Life Support, Orchard Park, NY
 - NASA AES Advanced Life Support Project
- Future/potential partnerships
 - Other space suit or space vehicle companies (Boeing, Lockheed Martin, SpaceX, Blue Origin, David Clark Co., ILC Dover, etc.)
- Industry/NASA collaborations could benefit in reduced development costs to bring this technology to commercial markets earlier.
- Next steps: Testing of the VOR in the relevant space environment of suited thermal vacuum conditions.





Rapid Cycle Amine (RCA) Swingbed

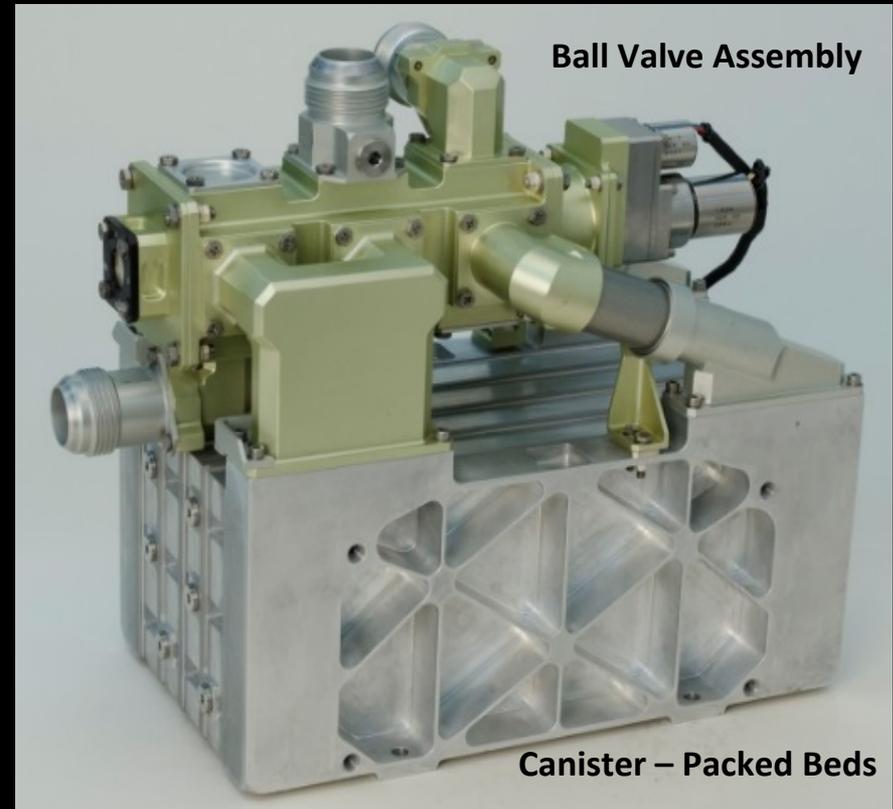


Key Features

- Carbon dioxide removal
- Humidity removal
- Continuous regeneration into space vacuum
- Sizing: 1 crew-member EVA
- Oxygen-Rated

Status

- Developed over the period October 2011 to July 2015
- Current TRL : 5
- Transitioned to NASA Customer Advanced Space Suit Project, Advanced Exploration Systems



Rapid Cycle Amine (RCA) Swingbed
without integrated controller



Rapid Cycle Amine (RCA) Swingbed

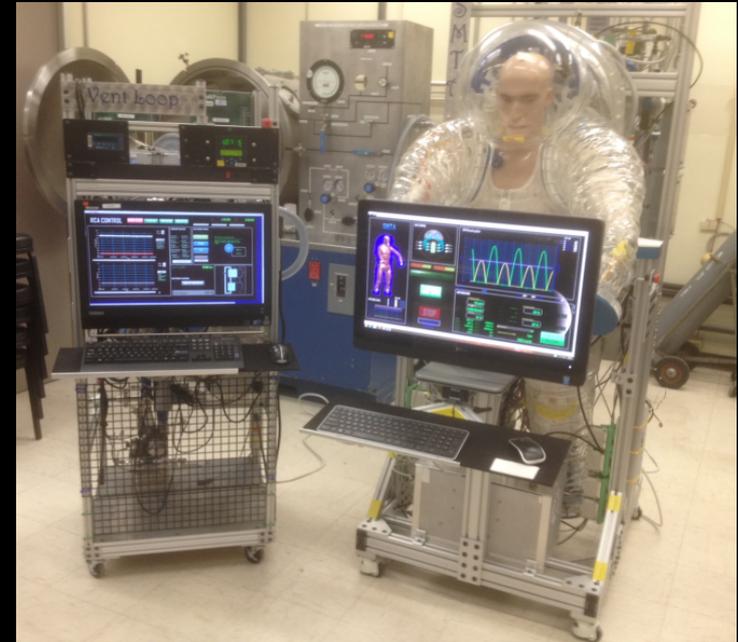


Current Space Suit State-of-the-Art

- One time use lithium hydroxide canisters and regenerable Metal Oxide (METOX) consume significant mass, volume, power and limit the duration of the EVA.
- The thermal loop humidity condenser and spin separator complicate suit design, add mass and are prone to failure.

Benefits

- The RCA Swingbed is a dual function component for the space suit ventilation system, removing both carbon dioxide and humidity
- The system is regenerative. The dual amine beds do not require change out and thus do not limit the duration of EVAs
- Allows the suit's thermal system to be greatly simplified, reducing mass and complexity of the suit, and eliminating high maintenance hardware associated with moisture removal.



Suited Manikin Test Apparatus (SMTA) for evaluation of advanced space suit ventilation loop components



Rapid Cycle Amine (RCA) Swingbed



Potential uses beyond NASA

- Commercial crew space suits
- Commercial human spacecraft

Partnerships

- Current partnerships
 - United Technologies Aerospace Systems, Windsor Locks, CT
 - NASA AES Advanced Life Support Project
- Future/potential partnerships
 - Other space suit or space vehicle companies (Boeing, Lockheed Martin, SpaceX, Blue Origin, David Clark Co., ILC Dover, etc.)
- Industry/NASA collaborations could benefit in reduced development costs to bring this technology to commercial markets earlier.
- Next steps: Testing of the RCA Swingbed in the relevant space environment of suited thermal vacuum conditions.



Z-Series Next Generation Space Suit



Next Generation Life Support Project





Contact Information



For more information about the technologies or to discuss potential collaboration efforts:



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