



**PARAGON**  
SPACE DEVELOPMENT CORPORATION

**25<sup>th</sup>**  
Anniversary

**Life Support & Thermal Control  
for Extreme Environments**

Paragon is at the forefront of innovation for its customers with extreme-environment solutions for mission-critical operations. Our continued advancements in thermal control, life support and human performance are chosen to solve a myriad of challenges across an array of space, subsea, subearth, and defense applications.

### **LIFE SUPPORT SYSTEMS**

Paragon designs and delivers integrated life support systems for government and commercial customers, from the Air Management System (AMS) for the Genesis Single Person Spacecraft, which maintains a safe and comfortable shirt sleeve atmosphere for a single occupant for up to 7 hours of operation, to support on multiple NASA NS2 BAA programs in the development and integration of regenerative life support systems needed for deep space exploration.

### **AIR REVITALIZATION SYSTEMS**

Paragon designs & delivers fully modular life support systems which meet or exceed NASA human flight safety standards and can be used for government or commercial applications. Paragon is providing the patented Humidity Control Subassembly for cabin atmospheric humidity control for the Boeing CST-100 spacecraft which flies to orbit in 2019.

### **WATER RECOVERY SYSTEMS**

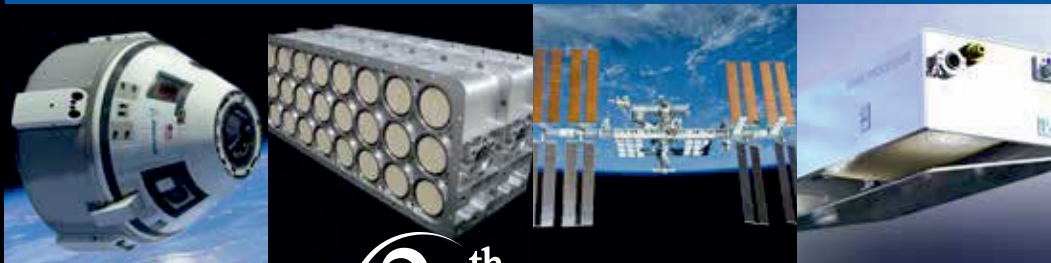
Paragon's Ionomer-membrane Processing (IWP) technology is integrated into our Brine Processor Assembly. BPA utilizes the forced convection of dry spacecraft cabin air coupled with membrane distillation to purify and recover water while increasing loop closure to >98%. BPA flies to the International Space Station (ISS) in 2019. Our Integrated Water Recovery Assembly (IRA) is another NASA program for complete recycling of habitation wastewater.

### **EXTREME ENVIRONMENTAL SUITS**

Paragon's expertise in advanced life support technologies has translated into developing robust and technically-advanced suits for extreme environments. Recent projects include the spacesuit developed for Paragon's record breaking StratEx Program and the Oceaneering Space Systems-led NASA Constellation Space Suit.

### **IN SITU RESOURCE UTILIZATION**

Paragon was recently selected by NASA to develop the ISRU-derived Water Purification and Hydrogen Oxygen Production (IHOP) subsystem. IHOP closely couples water purification and water electrolysis – two critical steps in the production of hydrogen and oxygen propellant from lunar and eventually Martian resources.





# Environmental Control & Life Support

## CHEMICAL AND BIOLOGICAL HAZARD PROTECTION

Paragon's Environmental Control and Life Support Systems (ECLSS) technologies include solutions for Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) threats and other operating environmental hazards.

### PARAGON DIVE SYSTEM™ (PDS)

A surface-fed, fully encapsulated protection system that isolates divers from the hazards found in grossly contaminated (Category 1) water. PDS allows divers to operate in these highly contaminated conditions with reduced risk of illness, injury and potential immediate and latent health risks.

### MINE AIR REVITALIZATION SYSTEM (MARS)

MARS technology for use in emergency shelters such as those used in mines during a disaster. Provides a safe breathable habitat isolated from the potentially toxic external environment for up to 96 hours.

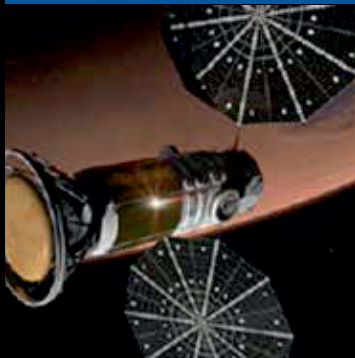
### RANCOR

Paragon's Regenerable, heat-Abating, humidity-Neutralizing, Carbon diOxide Removal system (RANCOR) reduces system weight & operational logistics, increases user comfort, prolongs entry, and expands the operational environment of current Self-Contained Breathing Apparatus (SCBA). RANCOR achieves both the elimination of the ice pack, and logistical burden for potential use in prolonged entry into IDLH or CBRN environments.



# Systems Engineering & Integration

Paragon's success in all core competencies for life support and thermal controls within extreme environments reflects a top down Systems Engineering approach from human requirements analyses, customer hardware/software/ technical/design requirements, systems integration, test and deployment. Past and current programs include: StratEx, Genesis Single-Person Spacecraft, Inspiration Mars, Mars One, and Orion Span.







Paragon's expertise in life support extends to space dives. Paragon was the prime systems integrator for the StratEx mission for manned exploration of the stratosphere above 135,000 feet. We designed and manufactured the system and led operations (launch, tracking, landing, recovery, and support) while managing > 20 subcontractors. The world records set still stand today.

The StratEx Mission spacesuit is now on display at the Smithsonian National Air & Space Museum's Steven F. Unver-Hazy Center in Virginia. Our StratEx Program was a finalist for the 2014 Collier Trophy awarded "for the greatest achievement in aeronautics or astronautics in America".

# Space Dives

# Thermal Control

## THERMAL CONTROL SYSTEMS

Paragon delivered thermal control analysis and flight hardware (precision tubing and the flow measurement subassembly) for the NASA Orion MPCV. We designed and manufactured the thermal control system (TCS) for the StratEx program. The StratEx TCS integrated active and passive cooling technologies maintained a comfortable thermal environment for the pilot despite the external temperature varying from a low of -60 C to a high of 20 C throughout the mission.

## THERMAL CONTROL RADIATORS

Paragon designs and manufactures radiators for a wide variety of customers and applications. Our patented Extruded Radiator (xRAD™) technology is a state-of-the-art, cost effective radiator solution which eliminates the structural and thermal inefficiencies associated with traditional bonded radiator structures.

## NEXT-GEN COOLING SYSTEMS

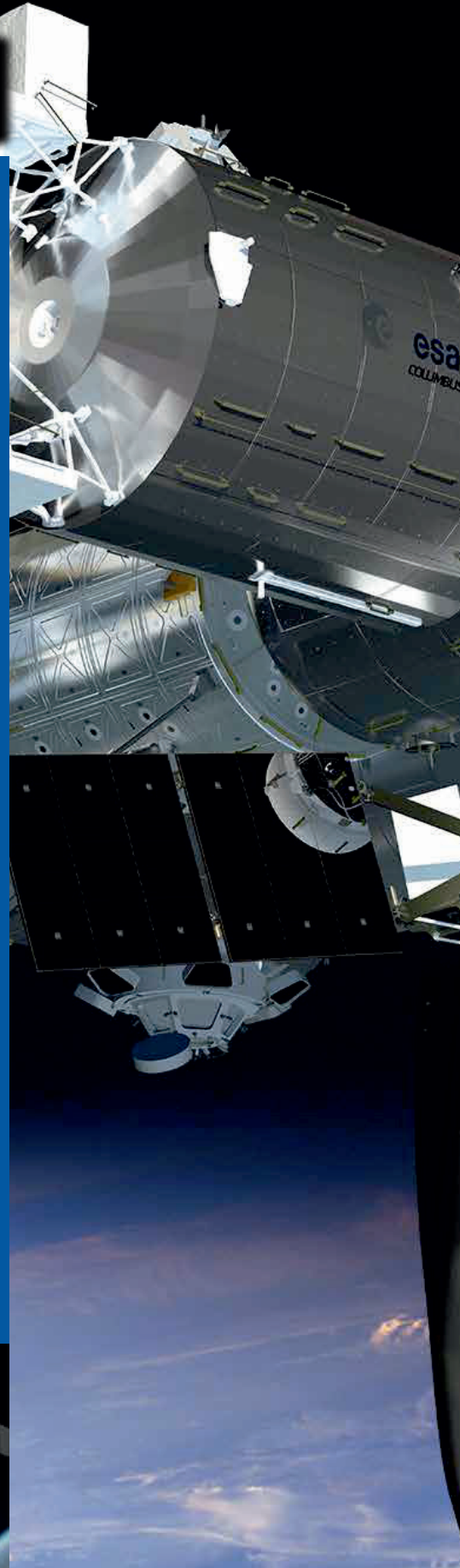
Paragon designs and manufactures cooling technologies for a wide variety of power system applications. Paragon's Buswork Integrated Cooling System (BICS) is a single phase or two phase active cooling solution for energy storage and power conditioning modules developed for the Navy. Other technologies include a low profile hybrid manufactured (LPHM) cold plate for cost-effective integration into a wide-range of thermal solutions.

## INTEGRATED THERMAL SOLUTIONS

Paragon develops active cooling and storage systems with battery powered and phase change cooling technology. SOCOM recently contracted Paragon's team to develop a multifunctional and transportable blood and pharmaceutical storage system. We are developing a cooling solution for high-voltage and high-thermal flux systems that are packaged into complex assemblies and geometries for a defense client.

## SOFT GOOD APPLICATIONS

Paragon, with its teammates, has developed Multi-Layer Insulation (MLI) and MicroMeteoroid and Orbital Debris (MMOD) protection for cryogenic systems.





Rendering of SNC's *Dream Chaser*® Unmanned Cargo Module at ISS  
with Paragon's xRAD™ radiators mounted on the vehicle



Paragon's precision manufacturing, assembly & test capabilities, certified to ISO 9001:2015 and AS9100D, are core to our ability to provide space qualified or military grade products to our customers.

#### **STANDARD AND SPECIALTY MANUFACTURING**

Precision tube manufacturing and bending  
Linear & orbital welding  
Traditional/CNC Machining & Protomax

#### **INSPECTION**

Romer Infinite 2.0: 6' Portable CMM  
Mitutoyo PH-3515F Profile Projector with  
QM-Data200 Series 264-2-D Processing Unit

#### **ASSEMBLY**

Dedicated Labs, High Bay, ISO Class 7 Clean Room

#### **TEST**

ECLSS Human Rating Facility  
Human Breathing Simulator  
Cold Testing  
Fluid and Air fully instrumented flow benches

# Manufacturing, Assembly & Test

Image courtesy of Sierra Nevada Corporation



# CELEBRATING 25 YEARS OF PIONEERING INNOVATION

We stand at a historic time where the exploration and settlement of space by humans will bring forth scientific and technological discoveries and tremendous advances for the good of all humankind. Paragon's 25 years of award-winning technical expertise in engineering, design, analysis, and manufacturing position us as a leader in developing innovative technology to support these endeavors. Paragon has worked on every major human space flight program since 1993 and its hardware has flown on NASA spacecraft (Orion, Space Shuttle, & ISS), foreign spacecraft (Soyuz & Mir) as well as commercial spacecraft. Our commitment to excellence has resulted in groundbreaking achievements, numerous patents, & exceptional value for our customers.

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Corporation



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