National Aeronautics and Space Administration

NASAfacts

Space Exploration Vehicle Concept

Background

NASA is testing concepts for a new generation of roving space exploration vehicles. These new ideas will help future robots and astronauts explore more than ever before, build a long-term space presence and conduct a wealth of science experiments.

Roving vehicles proved invaluable during the Apollo missions, enabling astronauts to complete almost 20 trips across the surface of the moon. With each successive mission, NASA improved the rovers’ capacities, increasing the number and duration of exploration missions.

NASA is still building on the lessons learned during the Apollo missions, and also incorporating the experience gained operating unmanned rovers on Mars. Using them, NASA has developed the multi-mission Space Exploration Vehicle, or SEV. The SEV cabin concept could be coupled with a flying platform for use near the International Space Station, satellite servicing and near-Earth asteroid missions. A wheeled chassis concept, unveiled in 2007 with an upgraded version completed in 2009, could be used for exploring planetary surfaces.

The Space Exploration Vehicle:

NASA plans to conduct human space exploration missions to a variety of destinations. To maximize the number of destinations NASA explores, space exploration systems must be flexible, and NASA must minimize the number of systems developed. One system concept NASA is analyzing is the SEV. The SEV would use the same cabin for in-space missions (i.e., satellite servicing, telescope assembly and exploration of near-Earth asteroids) as well as surface exploration on planetary bodies (i.e., the moon and Mars).

On planetary surfaces, astronauts will need surface mobility to explore multiple sites across the lunar and Martian surfaces. The SEV surface concept has the small, pressurized cabin mounted on a wheeled chassis that would enable a mobile form of exploration. These two components could be delivered to the planetary surface together, or as separate elements. The SEV can provide the astronauts' main mode of transportation, and – unlike the unpressurized Apollo lunar rover – also allow them to go on long excursions without the restrictions imposed by spacesuits. The pressurized cabin has a suitport that allows the crew to get into their spacesuits and out of the vehicle faster than before, enabling multiple, short spacewalks as an alternative to one long spacewalk.

The surface exploration version of the SEV also features pivoting wheels that enable "crab style" sideways movement, which helps the vehicle maneuver over difficult terrain. Its tiltable cockpit provides the drivers the best possible view of the terrain ahead. Astronauts can drive the mobility chassis, called Chariot, without the pressurized cabin by riding in rotating turrets while wearing spacesuits. Additionally, Chariot can be used to carry cargo. The modular design allows various tools – winches, cable reels, backhoes, cranes and bulldozer blades – to be attached for special missions. It could even pick up and reposition solar-powered charging stations, communication relays and scientific packages.

The in-space version of the SEV would have the pressurized cabin on a flying platform and allow astronauts to live inside for up to 14 days. It would provide robotic manipulators to grasp objects for observation, and allow astronauts easy access to space via the suitports, to maximize their productivity performing spacewalks outside of the cabin.

Functional Requirements:

- The SEV must be able to hold a crew of two, but can support a crew of four in an emergency
- It can travel at about 10 kilometers per hour
- The mobility chassis wheels are able to pivot 360 degrees, allowing it to drive in any direction

SEV (Surface Concept) Specifications:

Weight: 6,600 pounds
Payload: 2,200 pounds
Length: 14.7 feet
Wheelbase: 13 feet
Height: 10 feet
Wheels: 4.7x39 inches in diameter, 12 inches wide

One of the goals for testing prototypes on Earth is to identify the features that are going to be the most useful in space. Although not all features currently being tested will end up on the flight vehicles, the following features are being designed and considered:

Range of Exploration

On the surface of distant destinations, travel range is limited primarily by how quickly astronauts can get back to a safe, pressurized environment in case of an emergency. During the Apollo program, exploration was confined to the distance astronauts could expect to walk back wearing spacesuits if their rovers broke down: about 6 miles. The presence of two or more service SEVs on a planetary surface would extend that potential range to more than 125 miles in any direction, greatly increasing the scientific opportunities during missions. Even in the midst of challenging terrain, emergency shelter and support can be less than an hour away.

Astronaut Protection

The greatest risk to space explorers is from unanticipated solar particle events. With a heavily shielded cabin, the SEV doubles as a storm shelter. The rapidly accessible, pressurized, radiation-hard safe haven can sustain and protect exploring crew members for up to 72 hours against solar particle events, acute suit malfunctions and other medical emergencies. The radiation shielding in the SEV cabin provides protection that the Apollo crew did not have on their unpressurized rover – or even on their lander.

Rapid Ingress/Egress

The SEV system's suitport concept allows astronauts to go out for a spacewalk at almost a moment's notice. The suitport will allow the crew to enter and exit their spacesuits without bringing the suit inside, keeping the internal space mostly free of dust and other contaminants and reducing wear and tear on the suits. The suitport also minimizes the loss of air inside the cabin when it is depressurized for spacewalks, extending mission durations by maximizing available SEV resources.

Intra Vehicular Activity (IVA) Capability

By combining a pressurized cabin with a suitport, the SEV gives crew members the unprecedented flexibility of being able to easily switch between working in plain clothes or spacesuits. Although astronauts may want to exit the vehicle to take a closer look at something outside, activities requiring fine manipulation and unfettered visual access are best performed without the confines of bulky gloves and helmets. Astronauts can sit comfortably in a cabin and look at workstations or geologic formations without the continuous exertion of working in a spacesuit, which allows them better use of computers, robotic operation, maps and dialogue between crew members. The cabin can also serve as a rolling science lab for studying samples.

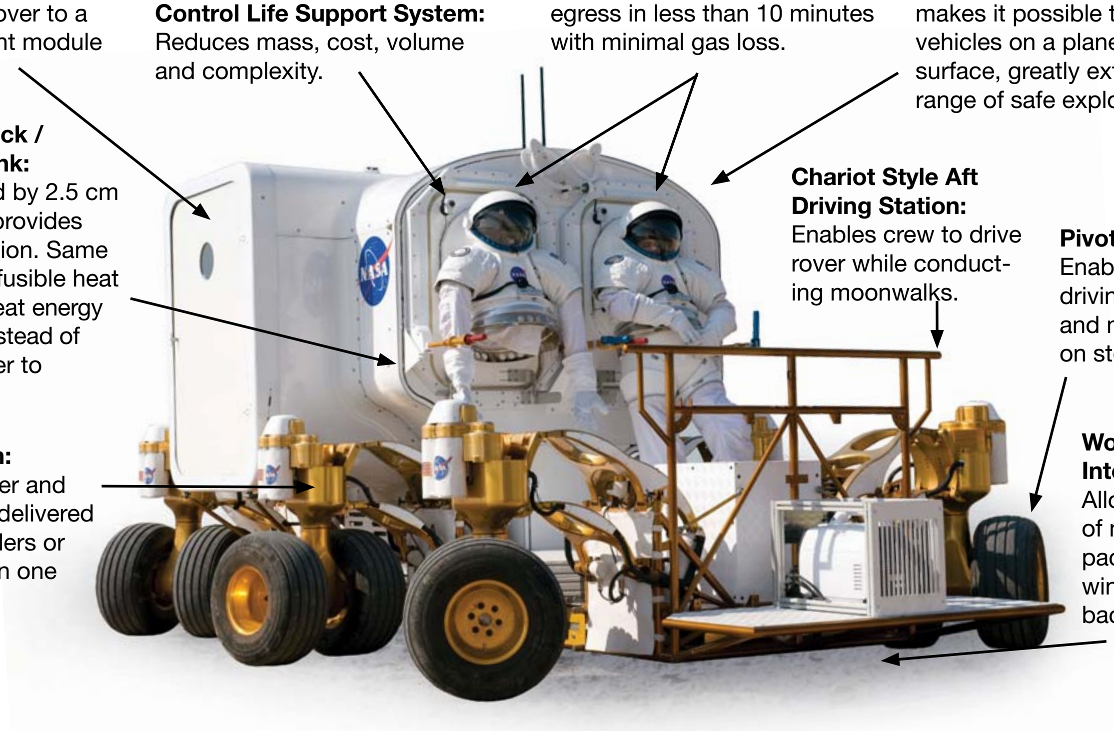
Docking Hatch

Rather than a door, a docking hatch allows crew members to move from the rover to a habitat, an ascent module or another rover.

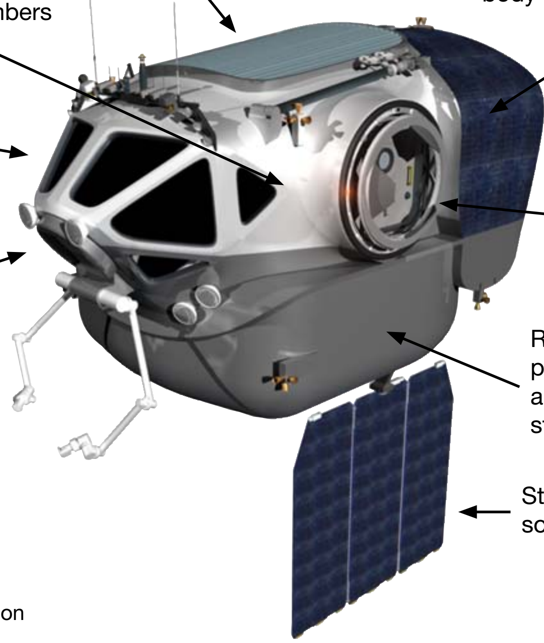
Extended Range on Earth and Elsewhere

Like electric cars here at home, the SEV will rely on batteries to travel. NASA is developing batteries that weigh less and provide more power than those currently being used in earthly automobiles. The same technology that will someday allow astronauts to see more of space could also lead to better, more efficient transportation on Earth. Electric commuter vehicles, off-road vehicles, transport trucks and construction equipment may one day benefit from NASA's battery innovations.

The Space Exploration Vehicle Characteristics (Surface Concept)



The Space Exploration Vehicle Characteristics (In-Space Concept)



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The Space Exploration Vehicle Concept will rely on the incorporation of many advanced technologies. Examples include: **Fuel Cells, Regenerative Brake, Wheels, Light-Weight Structures and Materials, Active Suspension, Avionics and Software, Extravehicular Activity (EVA) Suitport, Thermal Control Systems, Automated Rendezvous and Docking, High Energy Density Batteries and Gaseous Hydrogen/Oxygen RCS system.**