Mechanics/Machinery

Dual-Compartment Inflatable Suitlock

Lyndon B. Johnson Space Center, Houston, Texas

There is a need for an improvement over current NASA Extravehicular Activity (EVA) technology. The technology must allow the capacity for quicker, more efficient egress/ingress, allow for "shirtsleeve" suit maintenance, be compact in transport, and be applicable to environments ranging from planetary surface (partial-g) to orbital or deep space zero-g environments. The technology must also be resistant to dust and other foreign contaminants that may be present on or around a planetary surface. The technology should be portable, and be capable of docking with a variety of habitats, ports, stations, vehicles, and other pressurized modules.

The Dual-Compartment Inflatable Suitlock (DCIS) consists of three hard inline bulkheads, separating two cylindrical membrane-walled compartments. The Inner Bulkhead can be fitted with a variety of hatch types, docking flanges, and mating hardware, such as the Common Berthing Mechanism (CBM), for the purpose of mating with vehicles, habitats, and other pressurized modules. The Inner Bulkhead and Center Bulkhead function as the end walls of the Inner Compartment, which during operations, would stay pressurized, either matching the pressure of the habitat or acting as a lower-pressure transitional volume.

The Inner Compartment contains donning/doffing fixtures and inner suitport hatches. The Center Bulkhead has two integrated suitports along with a maintenance hatch. The Center Bulkhead and Outer Bulkhead function as the end walls of the Outer Compartment, which stays at vacuum during normal operations. This allows the crewmember to quickly don a suit, and egress the suitlock without waiting for the Outer Compartment to depressurize. The Outer Compartment can be pressurized infrequently for both nominal and off-nominal suit maintenance tasks, allowing shirtsleeve inspections and maintenance/repair of the environmental suits. The Outer Bulkhead has a pressure-assisted hatch door that stays open and stowed during EVA operations, but can be closed for environmental protection of the suits, suit maintenance, and pressurization.

This work was done by Kriss J. Kennedy, Peggy L. Guirgis, and Robert M. Boyle of Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-24914-1

Modular Connector Keying Concept

Lyndon B. Johnson Space Center, Houston, Texas

For panel-mount-type connectors, keying is usually "built-in" to the connector body, necessitating different part numbers for each key arrangement. This is costly for jobs that require small quantities. This invention was driven to provide a cost savings and to reduce documentation of individual parts.

The keys are removable and configurable in up to 16 combinations. Since the key parts are separate from the connector body, a common design can be used for the plug, receptacle, and key parts. The keying can then be set at the next higher assembly.

This work was done by Scott Ishman, Scott Dukes, and Gary Warnica of Honeywell, and Guy Conrad and Steven Senigla of Lockheed Martin for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-25074-1

Genesis Ultrapure Water Megasonic Wafer Spin Cleaner

Lyndon B. Johnson Space Center, Houston, Texas

A device removes, with high precision, the majority of surface particle contamination greater than 1-micron-diameter in size from ultrapure semiconductor wafer materials containing implanted solar wind samples returned by NASA's Genesis mission. This cleaning device uses a 1.5-liter/minute flowing stream of heated ultrapure water (UPW) with 1-MHz oscillating megasonic pulse energy focused at 3 to 5 mm away from the wafer surface spinning at 1,000 to 10,000 RPM, depending on sample size.

The surface particle contamination is removed by three processes: flowing UPW, megasonic cavitations, and centripetal force from the spinning wafer. The device can also dry the wafer fragment after UPW/megasonic cleaning by continuing to spin the wafer in the cleaning chamber, which is purged with flowing ultrapure nitrogen gas at 65 psi (≈448 kPa). The cleaner also uses three types of vacuum chucks that can accommodate all Genesis-flown array fragments in any dimensional shape between 3 and 100 mm in diameter. A sample vacuum chuck, and the manufactured UPW/megasonic nozzle holder, replace the human deficiencies by maintaining a consistent distance between the nozzle and wafer surface as well as allowing for longer cleaning time. The 3- to 5-mm critical distance is important for the ability to remove particles by megasonic cavitations. The increased UPW sonication time and exposure to heated UPW improve the removal of 1- to 5-micron-sized particles.

This work was done by Judith H. Allton and Eileen K. Stansbery of Johnson Space Center, Michael J. Calaway of Jacobs Technology, and Melissa C. Rodriguez of Geocontrol Systems Inc. Further information is contained in a TSP (see page 1). MSC 24499-1

Piezoelectrically Initiated Pyrotechnic Igniter

Lyndon B. Johnson Space Center, Houston, Texas

This innovation consists of a pyrotechnic initiator and piezoelectric initiation system. The device will be capable of being initiated mechanically; resisting initiation by EMF, RF, and EMI (electromagnetic field, radio frequency, and electromagnetic interference, respectively); and initiating in water environments and space environments.

Current devices of this nature are initiated by the mechanical action of a firing pin against a primer. Primers historically are prone to failure. These failures are commonly known as misfires or hang-fires. In many cases, the primer shows the dent where the firing pin struck the primer, but the primer failed to fire. In devices such as "T" handles, which are commonly used to initiate the blowout of canopies, loss of function of the device may result in loss of crew. In devices such as flares or smoke generators, failure can result in failure to spot a downed pilot.

The piezoelectrically initiated ignition system consists of a pyrotechnic device that plugs into a mechanical system (activator), which on activation, generates a high-voltage spark. The activator, when released, will strike a stack of electrically linked piezo crystals, generating a high-voltage, low-amperage current that is then conducted to the pyro-initiator. Within the initiator, an electrode releases a spark that passes through a pyrotechnic first-fire mixture, causing it to combust. The combustion of the first-fire initiates a primary pyrotechnic or explosive powder. If used in a "T" handle, the primary would ramp the speed of burn up to the speed of sound, generating a shock wave that would cause a high explosive to go "high order." In a flare or smoke generator, the secondary would produce the heat necessary to ignite the pyrotechnic mixture.

The piezo activator subsystem is redundant in that a second stack of crystals would be struck at the same time with the same activation force, doubling the probability of a first strike spark generation. If the first activation fails to ignite, the device is capable of multiple attempts.

Another unique aspect is in the design of the pyrotechnic device. There is an electrode that aids the generation of a directed spark and the use of a conductive matrix to support the first-fire material so that the spark will penetrate to the second electrode.

This work was done by Asia Quince, Maureen Dutton, Robert Hicks, and Karen Burnham of Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-24841-1

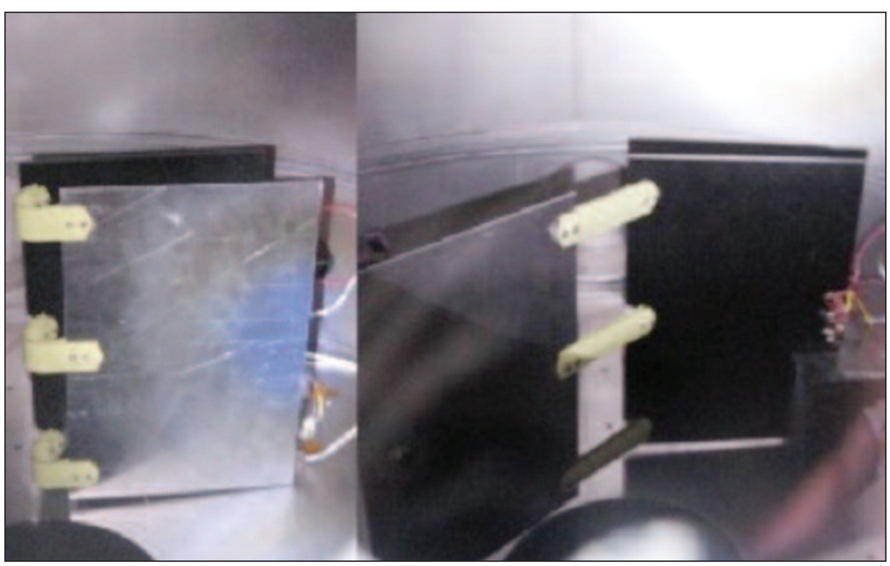
Folding Elastic Thermal Surface — FETS

By using tape-spring hinges, the FETS avoids the need for lubricants.

NASA's Jet Propulsion Laboratory, Pasadena, California

The FETS is a light and compact thermal surface (sun shade, IR thermal shield, cover, and/or deployable radiator) that is mounted on a set of offset tape-spring hinges. The thermal surface is constrained during launch and activated in space by a thermomechanical latch such as a wax actuator.

An application-specific embodiment of this technology developed for the MATMOS (Mars Atmospheric Trace Molecule Occultation Spectrometer) project serves as a deployable cover and thermal shield for its passive cooler. The FETS fits compactly against the instrument within the constrained launch envelope, and then unfolds into a larger area once in space. In this application, the FETS protects the passive cooler from thermal damage and contamination during ground operations, launch,



The figure depicts the **FETS** in its stowed and deployed states during high vacuum testing at JPL.