Mechanics/Machinery

Implementation of a Non-Metallic Barrier in an Electric Motor

Lyndon B. Johnson Space Center, Houston, Texas

Electric motors that run in pure oxygen must be sealed, or "canned," for safety reasons to prevent the oxygen from entering into the electrical portion of the motor. The current canning process involves designing a metallic barrier around the rotor to provide the separation. This metallic barrier reduces the motor efficiency as speed is increased. In higher-speed electric motors, efficiency is greatly improved if a very thin, non-metallic barrier can be utilized. The barrier thickness needs to be approximately 0.025-in. (≈0.6-mm) thick and can be made of a brittle material such as glass. The motors, however, designed for space applications are typically subject to high-vibration environments.

A fragile, non-metallic barrier can be utilized in a motor assembly if held in place by a set of standard rubber O-ring seals. The O-rings provide the necessary sealing to keep oxygen away from the electrical portion of the motor and also isolate the fragile barrier from the harsh motor vibration environment. The compliance of the rubber O-rings gently constrains the fragile barrier and isolates it from the harsh external motor environment. The use of a non-metallic barrier greatly improves motor performance, especially at higher speeds, while isolating the electronics from the working fluid with an inert liner.

This work was done by George M'Sadoques, Michael Carra, and Woody Beringer of Hamilton Sundstrand for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809.

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)} to Hamilton Sundstrand. Inquiries concerning licenses for its commercial development should be addressed to:

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Refer to MSC-24876-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

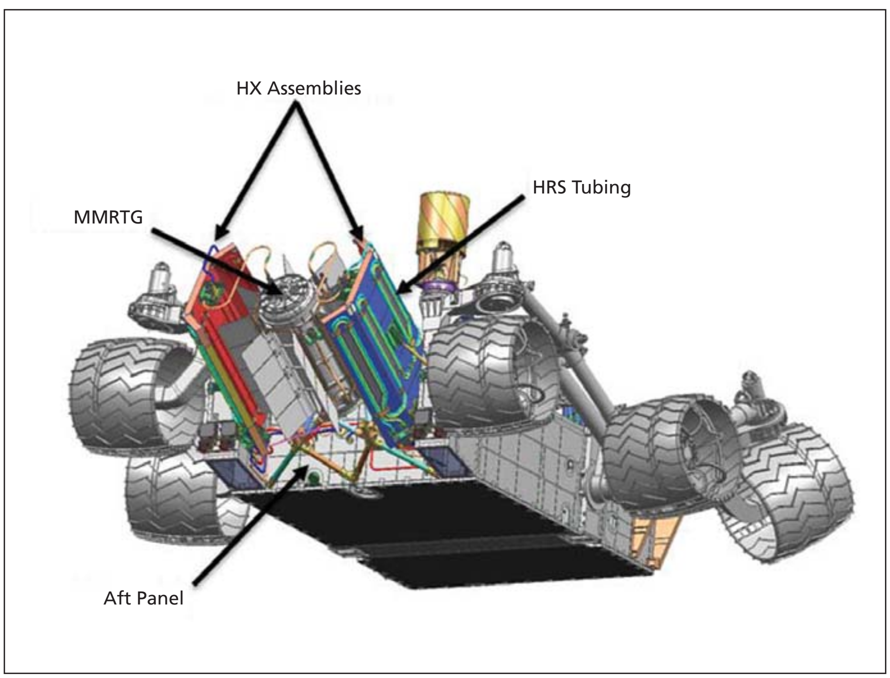
Multi-Mission Radioisotope Thermoelectric Generator Heat Exchangers for the Mars Science Laboratory Rover

These heat exchangers can be used in any application in which heat loads must be simultaneously collected and rejected from opposite sides of the same structure.

NASA's Jet Propulsion Laboratory, Pasadena, California

The addition of the Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) to the Mars Science Laboratory (MSL) Rover requires an advanced thermal control system that is able to both recover and reject the waste heat from the MMRTG as needed in order to maintain the onboard electronics at benign temperatures despite the extreme and widely varying environmental conditions experienced both on the way to Mars and on the Martian surface (See figure).

Based on the previously successful Mars landed mission thermal control schemes, a mechanically pumped fluid loop (MPFL) architecture was selected as the most robust and efficient means for meeting the MSL thermal requirements. The MSL heat recovery and rejection system (HRS) is comprised of two Freon (CFC-11) MPFLs that interact closely with one another to provide comprehensive thermal management throughout all mission phases. The first loop, called the Rover HRS (RHRS), consists of a set of pumps,



MSL Rover in Stowed Cruise Configuration showing HXs positioned on both sides of finned MMRTG.

thermal control valves, and heat exchangers (HXs) that enables the transport of heat from the MMRTG to the rover electronics during cold conditions or from the electronics straight to the environment for immediate heat rejection during warm conditions. The second loop, called the Cruise HRS (CHRS), is thermally coupled to the RHRS during the cruise to Mars, and provides a means for dissipating the waste heat more directly from the MMRTG as well as from both the cruise stage and rover avionics by promoting circulation to the cruise stage radiators.

A multifunctional structure was developed that is capable of both collecting waste heat from the MMRTG and rejecting the waste heat to the surrounding environment. It consists of a pair of honeycomb core sandwich panels with HRS tubes bonded to both sides. Two similar HX assemblies were designed to surround the MMRTG on the aft end of the rover. Heat acquisition is accomplished on the interior (MMRTG facing) surface of each HX while heat rejection is accomplished on the exterior surface of each HX. Since these two surfaces need to be at very different temperatures in order for the fluid loops to perform efficiently, they need to be thermally isolated from one another. The HXs were therefore designed for high in-plane thermal conductivity and extremely low through-thickness thermal conductivity by using aluminum facesheets and aerogel as insulation inside a composite honeycomb core. Complex assemblies of hand-welded and uniquely bent aluminum tubes are bonded onto each side of the HX panels, and are specifically designed to be easily mated and demated to the rest of the RHRS in order to ease the integration effort.

This work was done by A. J. Mastropietro, John S. Beatty, Frank P. Kelly, Pradeep Bhandari, David P. Bame, Yuanming Liu, Gajanana C. Birur, Jennifer R. Miller, Michael T. Pauken, and Peter M. Illsley of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-47619

Uniform Dust Distributor for Testing Radiative Emittance of Dust-Coated Surfaces

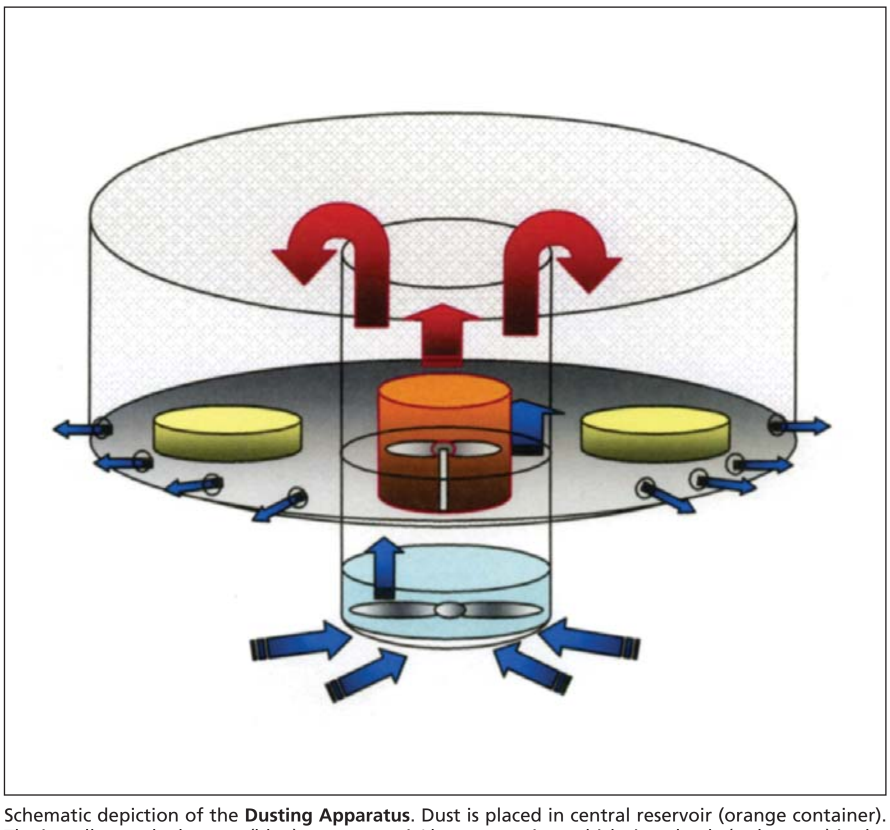
This device could be used in applying uniform amounts of dust on surfaces to which coatings may be applied.

Lyndon B. Johnson Space Center, Houston, Texas

This apparatus distributes dust (typical of the Martian surface) in a uniform fashion on the surface of multiple samples simultaneously. The primary innovation is that the amount of dust deposited on the multiple surfaces can be controlled by the time that the apparatus operates, and each sample will be subject to the same amount of dust deposition. The exact weight of dust that is added per unit of sample area is determined by the use of slides that can be removed sequentially after each dusting.

The objective was to produce the same weight of dust per unit sample area on each of eight samples that were part of an apparatus that measured the effective radiative emittance of dust-coated surfaces. The uniformity of dust deposition across all the samples was to be maintained as additional layers of dust were added. The unique nature of this problem is that the dust deposition was required to be spatially uniform on each sample, and deposited equally on all samples subjected to the dusting process. The dusting device also had to be movable so that after a dust layer is applied, the device could be removed and the samples could remain stationary in the experimental apparatus. In this way, the dust layer was not disturbed throughout the course of the experiments.

The dusting device comprises three parts: an aluminum sample table on which the samples are placed, a Plexiglas aerator tube that contains a fan and the dust aerator, and a chamber top for containment. The table supports the chamber top and the aerator tube as dusting is performed. The tube and the chamber top are removed after each dust layer is applied.



Schematic depiction of the **Dusting Apparatus**. Dust is placed in central reservoir (orange container). The impeller on the bottom (blue) creates an air/dust suspension, which rises slowly (red arrows) in the tube surrounding the reservoir. The suspension settles on the coupons (yellow) below.