Mars Rocket Propulsion System

Marshall Space Flight Center, Alabama

A report discusses the methane and carbon monoxide/LOX (McLOx) rocket for ascent from Mars as well as other critical space propulsion tasks. The system offers a specific impulse over 370 s — roughly 50 s higher than existing space-storable bio-propellants. Current Mars *in-situ* propellant production (ISPP) technologies produce impure methane and carbon monoxide in various combinations. While separation and purification of methane fuel is possible, it adds complexity to the propellant production process and discards an otherwise useful fuel product. The McLOx makes such complex and wasteful processes unnecessary by burning the methane/CO mixtures produced by the Mars ISPP systems without the need for further refinement.

Despite the decrease in rocket-specific impulse caused by the CO admixture, the improvement offered by concomitant increased propellant density can provide a net improvement in stage performance. One advantage is the increase of the total amount of propellant produced, but with a decrease in mass and complexity of the required ISPP plant. Methane/CO fuel mixtures also may be produced by reprocessing the organic wastes of a Moon base or a space station, making McLOx engines key for a human Lunar initiative or the International Space Station (ISS) program. Because McLOx propellant components store at a common temperature, very lightweight and compact common bulkhead tanks can be employed, improving overall stage performance further.

This work was done by Robert Zubrin and Dan Harber of Pioneer Astronautics for Marshall Space Flight Center. For further information, contact Sammy Nabors, MSFC Commercialization Lead, at sammy.a.nabors@nasa.gov.
MFS-32541-1

Two-Stage Passive Vibration Isolator

NASA's Jet Propulsion Laboratory, Pasadena, California

The design and testing of a structural system were implemented to hold the optics of the planned Space Interferometry Mission (SIM) at positions and orientations characterized by vibrational translation and rotation errors of no more than a few nanometers or a few milliarcseconds, respectively. Much of the effort was devoted to a test bed for verifying the predicted behavior of a vibration-isolation structural subsystem working together with an active control system for positioning and orienting the SIM optics.

There was considerable emphasis on the vibration-isolation subsystem, which was passive and comprised two stages. The main sources of vibration were six reaction wheels in an assembly denoted the “backpack.” The first vibration-isolation stage consisted of hexapod isolator mounts — one for each reaction wheel — characterized by a natural vibration frequency of 10 Hz. The second stage was a set of three beams, disposed between the backpack and the structure that held the SIM optics, that were flexured such that they transmitted only bending loads, with a natural vibrational frequency and damping of about 5 Hz and 4 percent, respectively. Preliminary test results were presented and characterized as demonstrating the effectiveness of the two-stage vibration-isolation design.

This work was done by Renaud Goullioud, Yekta Gursel, Timothy Neville, Allen J. Bronowicki, David Platus, and Rhonda MacDonald of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov.
NPO-30734

Improved Thermal Design of a Compression Mold

John H. Glenn Research Center, Cleveland, Ohio

A compression tool used to make 1-in. (2.5-cm) diameter disks of high-temperature polymers was designed to be shorter and of larger diameter than conventional tools to reduce heat loss to the surrounding air, thus making more efficient use of applied heat. This system is less sensitive to the amount and quality of insulation than previous tools, provides more repeatable processing, and improves the quality of the samples produced. These improvements come without increasing the weight of the punch portion of the tool over that of a conventional version, an important quality when handling lower-viscosity resins.

In use, the base and body of the tool are assembled, and the polymer to be processed is placed into the body of the tool. The punch is inserted, and the assembled tool is placed into the press. A temperature/pressure profile appropriate to the nature of the polymer is applied. A series of computational and experimental runs were made using a conventional tool to validate the computational model. The new tool design was then modeled, and when the performance showed a marked improvement, the new tool was manufactured. A new series of experimental runs showed that the thermal performance of the new tool agreed well with model predictions.

This work was done by Maria A. Kuczmarski and James C. Johnston of Glenn Research Center and DeNise Hardy-Green of the University of Akron. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17990-1.