



## Fastener Starter

**This tool is superior to prior screw and nut starters.**

*John F. Kennedy Space Center, Florida*

The Fastener Starter is a creative solution to prevent the loss of small fasteners during their installation. This is the only currently available tool that can firmly grip and hold a single screw, bolt, nut, washer, spacer, or any combination of these parts. Other commercially available fastener starters are unable to accommodate a variety of parts simultaneously. The Fastener Starter is a more capable and easier tool to use than prior tools. Its compact size allows it to be used effectively in cramped, difficult-to-see locations. Its design also allows it to be used with or without handles and extenders in other difficult-to-reach locations. It provides better protection against cross threading and loss of fasteners and associated parts. The Fastener Starter is non-magnetic and does not off-gas, thus meeting flight hardware requirements.

The Fastener Starter incorporates a combination of features of several commercially available tools, providing an improved means of installing small fasteners. The Fastener Starter includes a custom molded insert that can be removed easily and replaced with a con-

ventional tool bit (e.g., a screwdriver or hex-driver bit). When used with the insert, the Fastener Starter prevents cross threading and damage to internal threaded holes. This is achieved by allowing the fastener to slip within the tool insert when used without a conventional tool bit. Alternatively, without the insert and with a tool bit, the Fastener Starter can torque a fastener. The Fastener Starter has a square recess hole that accepts a conventional square drive handle or extension to accommodate a variety of applications by providing flexibility in handle style and length.

In a typical operation sequence, the user opens the tool, places a screw, screw/washer combination, nut, or nut/washer combination against and within the insert (or tool bit), and closes the tool, which firmly grasps the hardware. The user then guides the fastener to its destination and turns the tool to attach the fastener. Once the fastener is attached, the user simply pulls back on the tool to open it and release the fastener.

In tests that involved the installation of more than 300 screws and washers, in

several orientations and at different distances from the users, the tool did not drop any parts. In addition, most of the users participating in the tests expressed their preference to use this tool rather than only their hands to start a fastener installation.

*This work was done by Faith Chandler, Harry Garton, Bill Valentino, and Mike Amett of The Boeing Company for Kennedy Space Center.*

*Title to this invention, covered by U.S. Patent No. 6,606,924, has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)}, to The Boeing Company. Inquiries concerning licenses for its commercial development should be addressed to:*

*Terrance Mason, Boeing Patent Licensing Professional*

*Boeing Management Co.*

*Mail Stop 1650-7002*

*15460 Laguna Canyon Road*

*Irvine, CA 92618*

*Phone No.: (949) 790-1331*

*E-mail: terrance.mason@boeing.com*

*Refer to KSC-12224, volume and number of this NASA Tech Briefs issue, and the page number.*

## Multifunctional Deployment Hinges Rigidified by Ultraviolet

**These hinges provide both structural support and electrical connections.**

*John H. Glenn Research Center, Cleveland, Ohio*

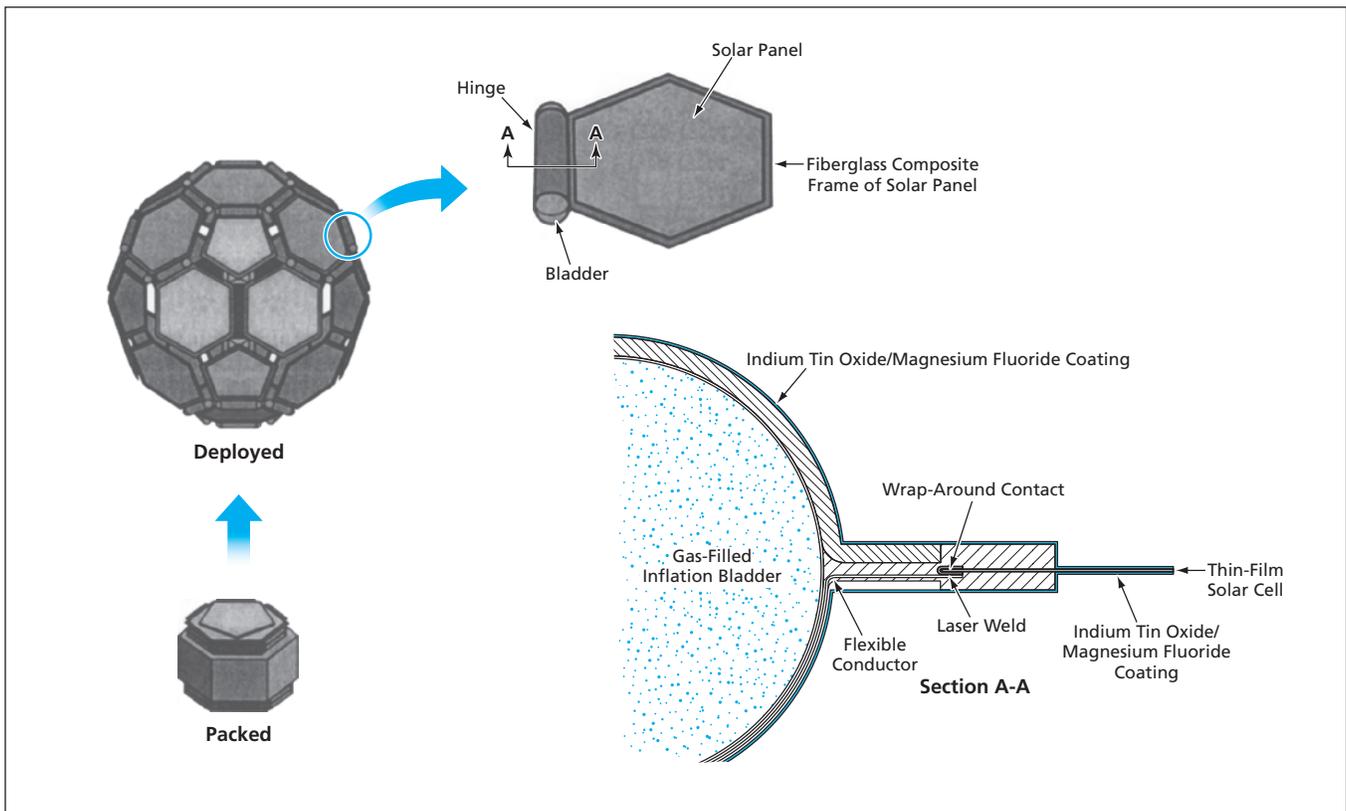
Multifunctional hinges have been developed for deploying and electrically connecting panels comprising planar arrays of thin-film solar photovoltaic cells. In the original intended application of these hinges, the panels would be facets of a 32-sided (and approximately spherical) polyhedral microsatellite (see figure), denoted a PowerSphere, that would be delivered to orbit in a compact folded configuration, then deployed by expansion of gas in inflation bladders. Once deployment was complete, the hinges would be

rigidified to provide structural connections that would hold the panels in their assigned relative positions without backlash. Such hinges could also be used on Earth for electrically connecting and structurally supporting solar panels that are similarly shipped in compact form and deployed at their destinations.

As shown in section A-A in the figure, a hinge of this type is partly integrated with an inflation bladder and partly integrated with the frame of a solar panel. During assembly of the

hinge, strip extensions from a flexible circuit harness on the bladder are connected to corresponding thin-film conductors on the solar panel by use of laser welding and wrap-around contacts. The main structural component of the hinge is a layer of glass fiber impregnated with an ultraviolet-curable resin. After deployment, exposure to ultraviolet light from the Sun cures the resin, thereby rigidifying the hinge.

1. In the original intended satellite application, it would protect the under-



A Polyhedral Assembly of Solar Panels would be deployed from compact stowage in two stacks, each containing ten hexagonal and six pentagonal panels. The deployment hinges between the panels would be key components that would accommodate the unfolding during deployment, hold the panels in their proper alignments after deployment, and provide electrical connections for the panels.

- lying polymeric components against erosion by monatomic oxygen in low orbit around the Earth;
- 2. It is sufficiently ultraviolet-transmissive to enable curing of the resin by exposure to ultraviolet light from the Sun or another suitable source;
- 3. It exhibits improved (relative to prior coating materials) transmittance of visible light for collection by solar cells; and

- 4. It resists darkening under long-term exposure to ultraviolet light.

This work was done by Thomas W. Kerslake of **Glenn Research Center**; Edward J. Simburger, James Matusmoto, Thomas W. Giants, and Alexander Garcia of *The Aerospace Corporation*; Alan Perry, Suraj Rawal, and Craig Marshall of *Lockheed Martin Corp.*; and John Kun Hung Lin, Jonathan Robert Day, and Stephen

*Emerson Scarborough of ILC Dover, Inc.* 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, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17476-1.

## Temperature-Controlled Clamping and Releasing Mechanism

NASA's Jet Propulsion Laboratory, Pasadena, California

A report describes the development of a mechanism that automatically clamps upon warming and releases upon cooling between temperature limits of  $\approx 180$  K and  $\approx 293$  K. The mechanism satisfied a need specific to a program that involved repeated excursions of a spectrometer between a room-temperature atmospheric environment and a cryogenic vacuum testing environment. The mechanism was also to be utilized in the intended application of the spectrometer, in which

the spectrometer would be clamped for protection during launch of a spacecraft and released in the cold of outer space to allow it to assume its nominal configuration for scientific observations. The mechanism is passive in the sense that its operation does not depend on a control system and does not require any power other than that incidental to heating and cooling. The clamping and releasing action is effected by bolt-preloaded stacks of shape-memory-alloy (SMA)

cylinders. In designing this mechanism, as in designing other, similar SMA mechanisms, it was necessary to account for the complex interplay among thermal expansion, elastic and inelastic deformation under load, and SMA thermomechanical properties.

This work was done by David Rosing and Virginia Ford of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). Further information is contained in a TSP (see page 1). NPO-40541