Mechanics/Machinery

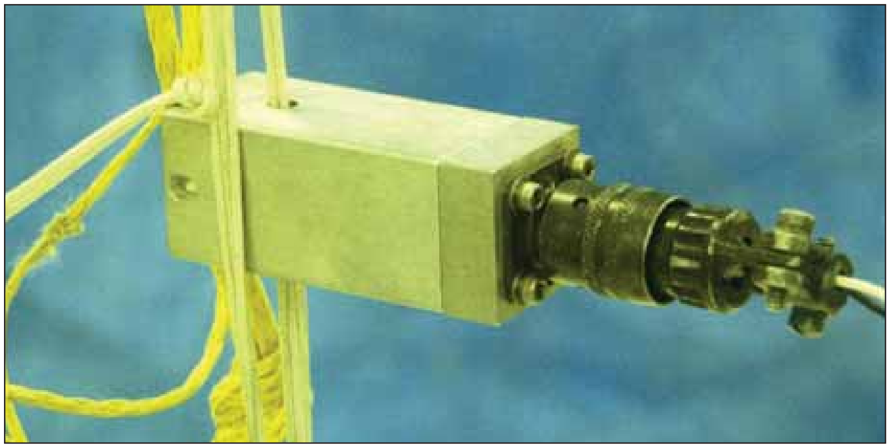
Reusable Hot-Wire Cable Cutter

This device can be used to cut any type of small synthetic cable.

NASA's Jet Propulsion Laboratory, Pasadena, California

During the early development stage of balloon deployment systems for missions, nichrome wire cable cutters were often used in place of pyro-actuated cutters. Typically, a nichrome wire is wrapped around a bundle of polymer cables with a low melting point and connected to a relay-actuated electric circuit. The heat from the nichrome reduces the strength of the cable bundle, which quickly breaks under a mechanical load and can thus be used as a release mechanism for a deployment system. However, the use of hand-made heated nichrome wire for cutters is not very reliable. Often, the wrapped nichrome wire does not cut through the cable because it either pulls away from its power source or does not stay in contact with the cable being cut. Because nichrome is not readily soldered to copper wire, unreliable mechanical crimps are often made to connect the nichrome to an electric circuit.

A self-contained device that is reusable and reliable was developed to sever cables for device release or deployment. The nichrome wire in this new device is housed within an enclosure to prevent it from being damaged by handling. The electric power leads are internally connected within the unit to the nichrome wire using a screw terminal connection. A bayonet plug, a quick and secure method of connecting the cutter to the power source, is used to connect the cutter to the power leads similar to those used in pyro-cutter devices.



The **Reusable Hot-Wire Cable Cutter** installed on a deployment line.

A small ceramic tube [0.25-in. wide 0.5-in. long (≈6.4-mm wide 13-mm long)] houses a spiraled nichrome wire that is heated when a cable release action is required. The wire is formed into a spiral coil by wrapping it around a mandrel. It is then laid inside the ceramic tube so that it fits closely to the inner surface of the tube. The ceramic tube provides some thermal and electrical insulation so that most of the heat generated by the wire is directed toward the cable bundle in the center of the spiral. The ceramic tube is cemented into an aluminum block, which holds it in position. The leads of the nichrome wire are attached to screw terminals that connect them to power leads. A bayonet plug mounted at the bottom of the rectangular block connects the power leads to a relay circuit. A thin aluminum shell encloses the entire structure, leaving access points to attach to the bayonet plug and to feed a cable into the cylinder. The access holes for the deployment cable are a smaller diameter than the nichrome coil to prevent the cable from coming in direct contact with the nichrome when loaded.

It uses the same general method of severing a cable with a heated wire as was used previously, but implements it in such a way that it is more reliable and less prone to failure. It creates a mechanism to create repeatability that was nonexistent in the previous method.

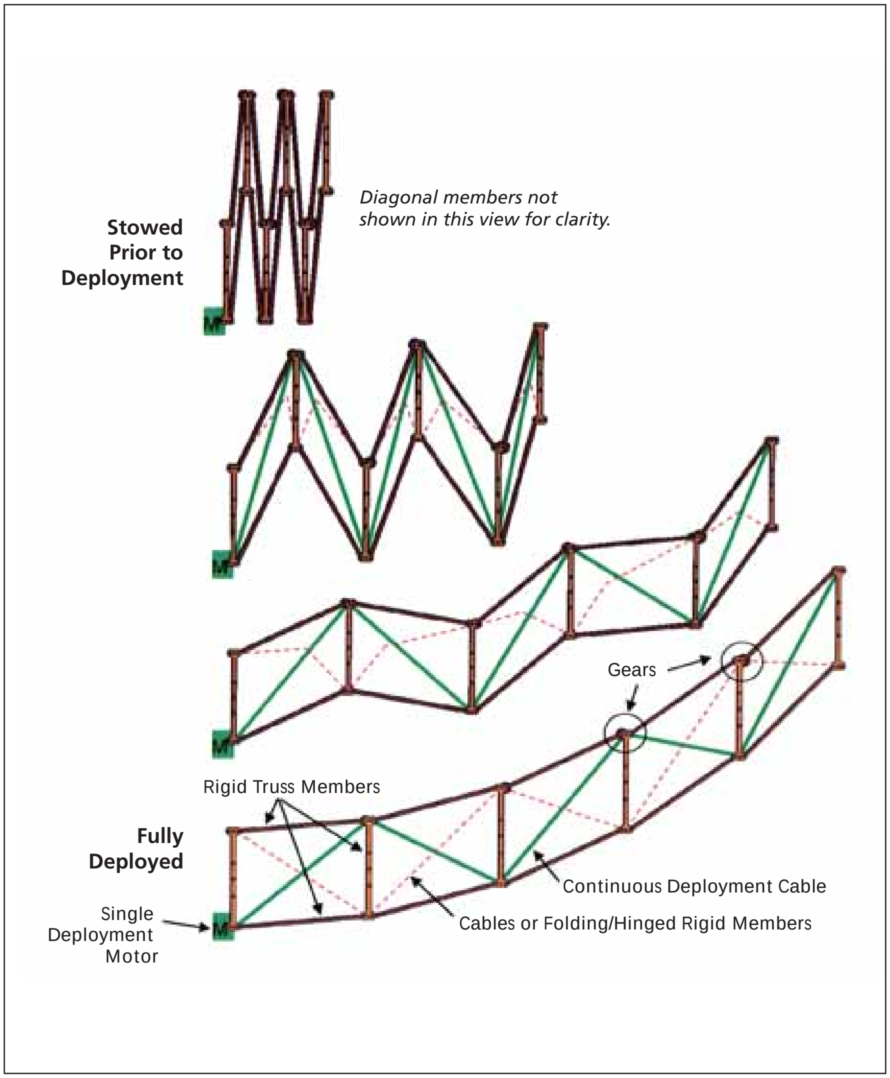
This work was done by Michael T. Pauken and Joel M. Steinkraus of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). *NPO-47265*

Deployment of a Curved Truss

This structure is potentially useful to the military or emergency service providers to rapidly deploy enclosures for shelter or storage.

NASA's Jet Propulsion Laboratory, Pasadena, California

Structures capable of deployment into complex, three-dimensional trusses have well known space technology applications such as the support of spacecraft payloads, communications antennas, radar reflectors, and solar concentrators. Such deployable trusses could also be useful in terrestrial applications such as the rapid establishment of structures in military and emergency service situations, in particular with regard to the deployment of enclosures for habitat or storage. To minimize the time required to deploy such an enclosure, a single arch-shaped truss is preferable to multiple straight trusses



The **Deployment Sequence of the Truss**. The truss is stowed in a compact volume (top), and deployment begins when the motor is activated and begins drawing in the continuous deployment cable (bottom).

arranged vertically and horizontally. To further minimize the time required to deploy such an enclosure, a synchronous deployment with a single degree of freedom is also preferable.

One method of synchronizing deployment of a truss is the use of a series of gears; this makes the deployment sequence predictable and testable, allows the truss to have a minimal stowage volume, and the deployed structure exhibits the excellent stiffness-to-mass and strength-to-mass ratios characteristic of a truss. A concept for using gears with varying ratios to deploy a truss into a curved shape has been developed and appears to be compatible with both space technology applications as well as potential use in terrestrial applications such as enclosure deployment. As is the case with other deployable trusses, this truss is formed using rigid elements (e.g., composite tubes) along the edges, one set of diagonal elements composed of either cables or folding/hinged rigid members, and the other set of diagonal elements formed by a continuous cable that is tightened by a motor or hand crank in order to deploy the truss. Gears of varying ratios are used to constrain the deployment to a single degree of freedom, making the deployment synchronous, predictable, and repeatable. The relative sizes of the gears and the relative dimensions of the diagonal elements determine the deployed geometry (e.g. curvature) of the truss.

This work was done by Louis R. Giersch and Kevin Knarr of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47269

High-Volume Airborne Fluids Handling Technologies To Fight Wildfires

Airborne flame retardants are used in a highly efficient firefighting system.

Dryden Flight Research Center, Edwards, California

NASA recently partnered with the U.S. Forest Service (USFS) on a project to examine mission suitability and recommend policies and procedures for the use of very large aerial firefighting aircraft such as the Boeing 747 and DC-10 aerial retardant delivery aircraft. The aircraft under study included a 10Tanker DC-10 and an Evergreen B-747. NASA's Dryden Flight Research Center and Ames Research Center worked with the USFS to help determine the safe flight envelope for these Very Large Air Tanker (VLAT) aircraft for the USFS and the Department of the Interior (DOI). This new generation of "supertankers" includes aircraft like these that have as much as four times the delivery capacity of the previous generation of aerial firefighting aircraft.

Dryden performed operational test and evaluation assessments and reported findings and recommendations on these aircraft in cooperation with Ames. The team developed, implemented, and directed an evaluation test plan for use in flight test and in simulation. Ames provided support using pilot-in-the-loop simulations and coordinated simulator models, flight profiles, and data analysis with Dryden. The test plan was designed to evaluate the suitability of VLAT aircraft as a function of mission environment. Based on this analysis, NASA generated interim flight envelope limitations to enhance safety and opera-