Both models were also found to predict similar results for most quantities analyzed with respect to the LHMEL tests. The explicit model was found to surpass the implicit one by being able to predict reasonable mechanical strain and stress in the warp direction. This ability leads to the prediction of pocketing erosion in LHMEL tests. Moreover, the explicit model can also be used to indicate the depth, temperature, and time of occurrence of a pocket.

The analyses revealed that the predictions of the implicit and explicit models are similar except in the cases of certain stress and strain components associated with free expansion under a thermal load. For prediction by the explicit model, these stress components have been shown to be useful for predicting material failures of a CCP used in a solid-fuel rocket motor. Such failures cannot be predicted as easily, if at all, by use of the implicit model. The only major disadvantage of the explicit model is that in order to use it, one must have accurate values of pore pressure, data from low-heating-rate tests, and porosity; standard procedures for measuring these quantities have not yet been established.

This work was done by Danton Gutierrez-Lemini and Curt Ehle of Thiokol Corp., Inc., for **Marshall Space Flight Center**. *Further information is contained in a TSP* *(see page 1).*
MFS-31501

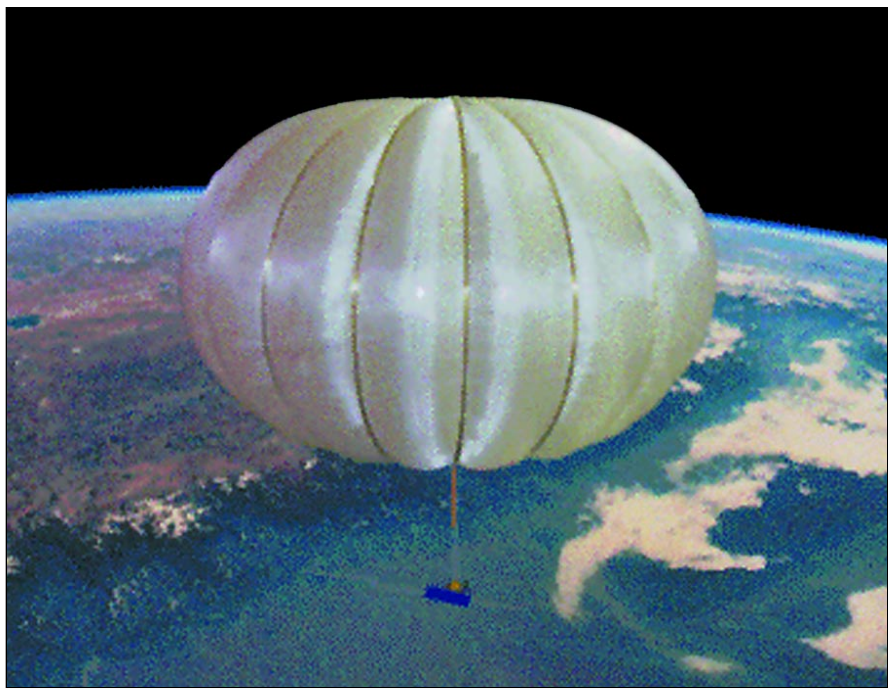
Meshed-Pumpkin Super-Pressure Balloon Design

Masses of long-life, high-altitude balloons could be decreased substantially.

NASA's Jet Propulsion Laboratory, Pasadena, California

An improved, lightweight design has been proposed for super-pressure balloons used to carry scientific instruments at high altitudes in the atmosphere of Earth for times as long as 100 days. [A super-pressure balloon is one in which the pressure of the buoyant gas (typically, helium) is kept somewhat above ambient pressure in order to maintain approximately constant density and thereby regulate the altitude.] The proposed design, called "meshed pumpkin," incorporates the basic concept of the pumpkin design, which is so named because of its appearance (see figure). The pumpkin design entails less weight than does a spherical design, and the meshed-pumpkin design would reduce weight further.

The basic idea of the meshed-pumpkin design is to reinforce the membrane of a pumpkin balloon by attaching a strong, lightweight fabric mesh to its outer surface. The reinforcement would make it possible to reduce the membrane mass to one-third or less of that of the basic pumpkin design while retaining sufficient strength to enable the balloon to remain at approximately constant altitude for months.



This **Pumpkin Balloon** weighs less than a spherical balloon of equal payload capacity. The corresponding meshed pumpkin balloon would have only a fraction of the weight of a pumpkin balloon.

For example, the pumpkin balloon shown in the figure is made from a complex composite of polyester fabric, adhesive, polyethylene terephthalate film, and polyethylene film. The balloon has an areal mass density of 62 g/m^2 and a total mass of 2,800 kg. The balloon can carry a payload of 1,600 kg at an altitude of 33 km. One corresponding meshed-pumpkin design calls for reinforcement of the membrane with a 1-by-1-in. (2.54-by-2.54-cm) mesh of polybenzoxazole scrim fiber of 25 denier (a lineal mass density of about 2.8 mg/m). With this reinforcement, the complex composite membrane could be replaced by a simple polyethylene film 0.5 mil (12.7 μm) thick, reducing the mass of the balloon to <400 kg. The mesh would provide a strength of 400 N/m, giving a factor of safety of 5, relative to the strength required for a pumpkin balloon with a bulge radius of 8 m.

This work was done by Jack Jones and Andre Yavrouian of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP* *(see page 1).*

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