NASA TECH BRIEF

NASA Pasadena Office

Structural Analysis of Viscoelastic Materials under Thermal and Pressure Loading

The designer of a solid-propellant rocket motor system must consider the structural problems that will arise because of thermal loading and pressure loading resulting from the burning of fuel and the stresses of the space environment. In order to predict the maximum imposed loading at which either excessive deformation or fracture threshold is reached, estimates must be made of the stresses or strains in a viscoelastic propellant material caused by applied loads.

A technique has been developed for computing the stresses resulting from an axisymmetric transient thermal loading in a circular solid-propellant grain section with circular ports. The propellant is assumed to be a linear, thermal rheologically simple, viscoelastic material; material properties are represented by an exponential series in time. In the expansion of the series, the relaxation time of each term is selected to provide the best fit of experimental data. The series expansion leads to a recurrence relation, which eliminates the problem of recalculating the history of material response at each time step. Finally, the recurrence matrix is used with a finite-difference general computer code to determine the effect of internal pressure on the stresses.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
NASA Pasadena Office
4800 Oak Grove Drive
Pasadena, California 91103
Reference: TSP 73-10301

Source: Jay C. Chen of
Caltech/JPL
under contract to
NASA Pasadena Office
(NPO-11727)

Category 09