NASA TECH BRIEF
Langley Research Center

Program for the Transient Response of Ablating Axisymmetric Bodies Including the Effects of Shape Change

The problem:

To perform calculations and to analyze the transient response of an ablating axisymmetric body, including the effects of shape change.

The solution:

A computer program has been developed to analyze the transient response of ablating axisymmetric bodies including the effects of shape change.

How it's done:

The governing differential equation, the boundary conditions for the analysis on which the computer program is based, and the method of solution of the resulting finite-difference equations are discussed in the documentation.

Some of the features of the analysis and the associated program are: (1) the ablation material is considered to be orthotropic with temperature-dependent thermal properties; (2) the thermal response of the entire body is considered simultaneously; (3) the heat transfer and pressure distribution over the body are adjusted to the new geometry as ablation occurs; (4) the governing equations and several boundary-condition options are formulated in terms of generalized orthogonal coordinates for fixed points in a moving coordinate system; (5) the finite-difference equations are solved implicitly; and (6) other instantaneous body shapes can be displayed with a user-supplied plotting routine.

The physical problem to be modeled with the analysis is described by FORTRAN input variables. For example, the external body geometry is described in the W,Z coordinates; material density is given, and the stagnation cold-wall heating rate is given in a time-dependent array. Other input variables are required which control the solution, specify boundary conditions, and determine output from the program. The equations have been programmed so that either the International System of Units or the U.S. Customary Units may be used.

Calculations from this program may be saved for plotting purposes, but the user will have to supply his own plotting routines.

Notes:
1. This program is written in FORTRAN IV to be utilized by the CDC-6000 Series computers. If plots are desired, a plotter is required along with user supplied plot routines.

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