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Computer Program for Thermal Analysis of Shadow Shields in a Vacuum

The problem:

To perform a thermal analysis of shadow shielded cryogenic storage tanks. Shadow shields are used to reduce radiation heat transfer rates in a vacuum environment, a necessity in the storage of cryogenics in space for long periods of time. The thermal analysis of a shadow shielded system must consider varying temperatures and surface properties of the shields and tank, as well as their geometric arrangement. Similar properties of the heat source must also be taken into consideration.

The solution:

A computer program which determines temperature profiles and heat transfer rates for a shadow shielded cryogenic tank. The tank, shields, and thermal radiation heat source are all axisymmetric.

How it's done:

The program was developed using Gebhardt's grey body radiation interchange method for diffuse surfaces. The non-uniform radiosity results are obtained through the use of successively smaller areas in a finite element analysis.

The surfaces of the heat source and the tank are arranged so that no surface views more than one other surface. When more than one element is used to represent the surface of a shield, temperature profiles may be calculated across the shield. It is also possible to assume that the shield has a uniform temperature even though the radiosity varies across the two surfaces. The system of shields is divided into enclosures and the temperatures are found in an iterative fashion. Variations in surface emissivity and shield conductivity with variations in temperature can be accomplished. For an increase in running time, results can also be obtained for a finite conductivity shield.

Notes:

1. This program is written in FORTRAN IV for use on the IBM-7094 computer.
2. Inquiries may be directed to:
   COSMIC
   Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B71-10115

Patent status:

No patent action is contemplated by NASA.

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Category 09

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