# NASA TECH BRIEF

*Marshall Space Flight Center*



## Thermal Scale Modeling

Thermal scale modeling simulation criteria for large complex systems involving conductive and radiative heat transfer have been studied. The information derived from the investigation may provide the basis for judging the applicability of thermal scaling to specific problems, and for identifying inherent difficulties and limitations of thermal scaling techniques.

The range of probable errors (due to uncertainties in thermophysical properties, geometric configurations, and physical environment) was derived statistically as a function of the overall scaling ratio. In general, scale ratios below one-tenth result in excessive errors in the modeling techniques. Special problem areas considered involved: transient response, thermal control coatings, multilayer insulation, thermal gradient effects, instrumentation effects, and test-environment effects.

A detailed numerical thermal analysis was conducted in conjunction with the statistical studies and the experimental tests on a prototype and half-scale thermal system in a simulated environment. The observed random experimental errors showed good agreement with the probable errors predicted in the statistical studies and with the results of the numerical analysis. The numerical analysis technique was also used to correct the experimental data for compromises of the scaling criteria established in the program. These corrections improved the agreement between the experimental data for the prototype and the half-scale model by reducing the systematic differences resulting from violations of the scaling criteria.

For the system investigated, it was concluded that: (1) Factors associated with multilayer insulation pose a major problem in scale modeling; (2) numerical analysis can be used to correct for known compromises of the scaling criteria; and (3) the probable errors in the scale-modeling experiments fall within the range predicted by the statistical analysis.

### Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference:

NASA-CR-102671 (N70-28600), Limitations in Thermal Similitude

### Patent status:

No patent action is contemplated by NASA

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