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Brief 70-10555

NASA TECH BRIEF

Saturn S-II Base Environment for Flight Evaluation

A computer program has been devised to furnish data on flight prediction and stage evaluation of a space vehicle. The program reduces the Saturn S-II base region flight data to isothermal and cold wall condition and predicts instrument readings before and after flight.

The flight prediction portion of the program establishes the base region thermal environment including the cold wall convective heating rates, adiabatic wall temperatures and base pressures for a specific Saturn S-II stage engine gimballing time history during flight. Structural temperatures are evaluated by using cold wall convective heating rates and the adiabatic wall temperature. The cold wall convective heating rates are combined with radiation heating rates and used with structural temperatures to predict the indicated total heat flux during flight. These analytical predictions are based on semi-empirical correlations which are based in turn on the 1/25 scale model test data without turbo-pump exhaust. For flight evaluation, the indicated flight heating rates are reduced to isothermal and cold wall conditions and the flight data is made appropriate for nominal J-2 engine combustion pressures.

The base region is instrumented with asymptotic type total heating rate calorimeter transducers installed in an isothermal wall. Because the thermal boundary layer is altered by the transducer presence, the heating values indicated by the instrument cannot be used directly. Correlations have been derived to correct the heat transfer coefficient over the calorimeter sensor for temperature mismatch effects. These effects are important when the flow is parallel to the transducers, but not if the flow is normal to the transducers.

Notes:

1. This program is written in FORTRAN IV for use on the IBM-7094 computer.
2. This program can be used in flight evaluation of the Saturn S-II stage vehicle or adapted to future vehicles. It may be used for any five-engined stage with center engine fixed.
3. Inquiries should be made to:

   COSMIC
   Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: B70-10555

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: F. D. Georgatsos of
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Category 09