NASA TECH BRIEF

Lewis Research Center

Main Tank Injection Pressurization Program

The problem:

For cryogenic vehicles, particularly those that require multi-burn operations, the tank pressurization system can contribute significantly to the weight, complexity, and cost of the propulsion feed system.

The solution:

A computer program has been developed that predicts the performance of a fluorine-hydrogen Main Tank Injection (MTI) pressurization system for the full range of liquid-hydrogen-fueled space vehicles. MTI is a technique in which a hypergolic reactant is injected into a full-scale propellant tank, and the resultant heat release pressurizes the tank.

How it's done:

The analytical model includes provisions for heat transfer, injectant jet penetration, and ullage gas mixing. A large scale MTI control system was designed, fabricated, and tested in a flight-weight LH_2 tank. Seventeen tests were performed at various ullage volumes with both straight-pipe and diffuser-type injectors, and at varied LH_2 and GF_2 injection flow-rates. Pre-pressurization, constant-pressure hold, and LH_2 expulsion at controlled tank pressures were demonstrated. The analysis accurately predicted GF_2 usage, ullage gas and tank wall temperatures, and LH_2 quantities evaporated. The analysis was used to predict the performance of an MTI pressure control system for a Centaur vehicle configuration and mission specified by NASA. The study reveals that MTI can be effectively applied to a space vehicle and that substantial pressurization system performance benefits could be realized.

Notes:

1. This program was written in FORTRAN IV for use on the IBM-7094 computer.
2. Inquiries concerning this program should be directed to:

   COSMIC
   112 Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: LEW-11368

Patent status:

No patent action is contemplated by NASA.

Source: E. C. Cady and D. W. Kendle of
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