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Computer Program Calculates Peripheral Water Injection Cooling of Axisymmetric Subsonic Diffuser

The problem:

To compute the cooling effectiveness and the flow characteristics resulting from the mixing of a cool liquid injectant (water) with a hot sonic or subsonic gas stream (hydrogen).

The solution:

A digital computer program which approximates the mixing of a cool liquid injectant with a hot sonic or subsonic gas stream.

How it's done:

The computer program provides for (1) four different but simultaneous sets of peripheral liquid coolant injection characteristics; (2) variable mixing-duct pressure to satisfy the conservation equations; (3) nonflat (arbitrary) axisymmetric inlet hot-gas velocity profiles; and (4) independent and arbitrary selection of momentum mixing coefficient, mass mixing coefficient, and degree of approach to evaporate equilibrium. Input to the program consists of geometry data, inlet conditions, water flow rates, and readout locations. The output of the program provides pressure, temperature, velocity, density, composition, and Mach number profiles at any location in the mixing duct.

The program only considers mixing in a duct of constant diameter. The program could be modified to consider variable diameter. It could also be modified to consider "dumping" into a large plenum where three fluids would need to be considered: The water, the hydrogen, and the completely mixed fluid composed of water and hydrogen, which would serve as the atmosphere for a free-jet solution.

The program analysis is restricted to the assumptions of thermal and kinetic equilibrium, but will allow chemical nonequilibrium to be considered in an approximate way. Although the program is presently restricted to consideration of condensed water injection into gaseous hydrogen flow, it is a simple matter to modify it to consider any other two fluids.

Notes:

1. The program is written in Fortran IV for the IBM 7094 computer.
2. Inquiries concerning this program may be made to:
   COSMIC
   Computer Center
   University of Georgia
   Athens, Georgia 30601
   Reference: B67-10543

Patent status:

No patent action is contemplated by AEC or NASA.

Source: Dr. Jerry Grey
of Greyrad Corporation
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