NASA TECH BRIEF

Computer Program Determines Gas Flow Rates in Piping Systems

The problem:

Calculating the steady state flow of an ideal compressible gas in a complex piping system is normally a tedious job. A wide variety of calculations must be performed to account for such diverse system elements as orifices, heat exchangers, area changes, constant loss factor elements, adiabatic pipes, diabatic pipes, radius bends, and mitre bends.

The solution:

A computer program that will calculate the steady state flow characteristics of a piping system containing any of the eight standard elements. The program calculates and prints out the stagnation and total temperature, static and total pressure, loss factor, and forces on each element. The output data also includes flow rate and approximate volume through each subsystem.

How it's done:

The program user supplies a description of the system and of each element in the proper format and the temperature at each inlet of the system. If the system contains parallel paths of flow it is necessary to provide initial estimates of the flow rate for one or more of the branches. If the system involves heat transfer it is necessary to provide initial estimates of the temperature at each internal branching point and exit.

Flow rates are calculated from known values of the system, starting at the downstream end. Where all pertinent values are known, the continuity equation and equations relating total and stagnation temperatures and pressure are used. Where estimated values are employed, calculations are made by more than one method and errors are thereby minimized.

Notes:

1. The program is coded for the Fortran II, version 3 monitor in assembly language for the IBM 7094 computer. The program can handle systems containing up to 25 subsystems connecting not more than 25 junctions. In addition, three times the number of subsystems plus the total number of elements must not exceed 1000.

2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B66-10300

Patent status:

No patent action is contemplated by NASA.

Source: Richard Franke
of the Boeing Company
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