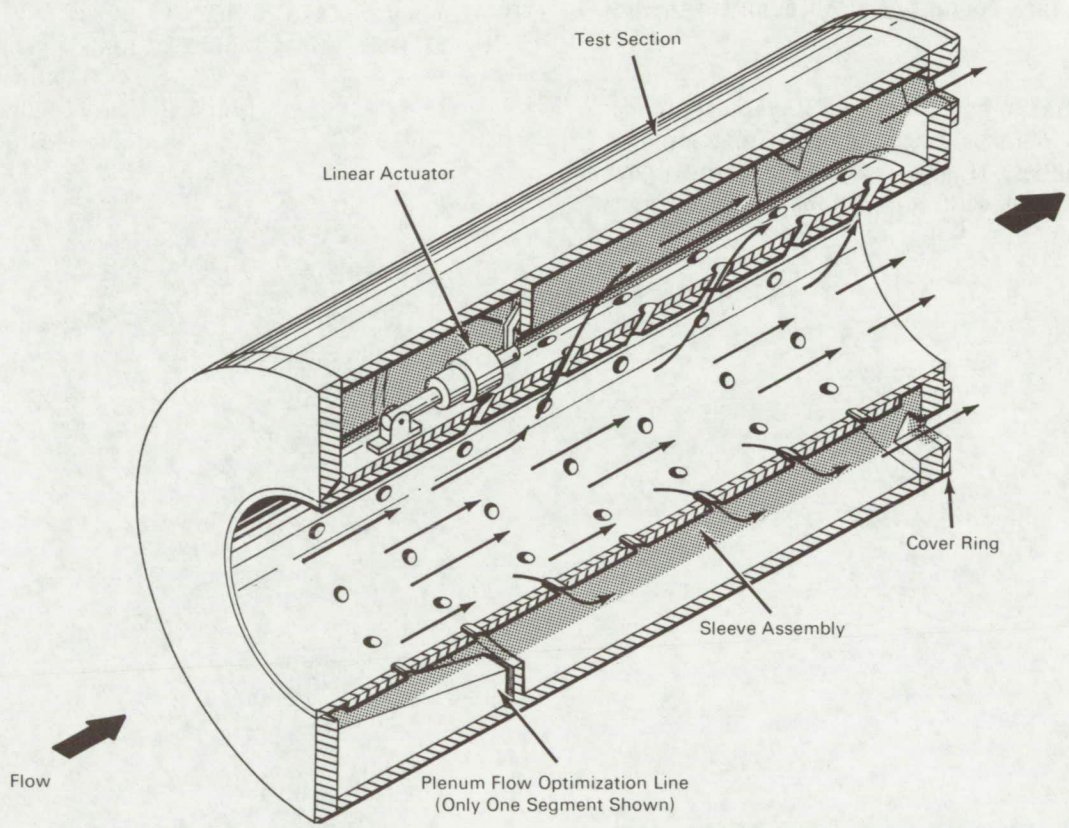
September 1970 Brief 70 10256

NASA TECH BRIEF

Short-Duration, Transonic Flow, Variable-Porosity Test Section



A relatively inexpensive short-duration test facility has been constructed in which extremely high Reynolds number flows are obtained in the subsonic, transonic, and supersonic speed ranges. This device, a section of which is illustrated, has been found useful in solving a number of Reynolds number-dependent aerodynamic and thermodynamic problems in the design and testing of large, high speed vehicles.

Basically, the method employs a type of blowdown wind tunnel in which the usual air storage vessels have been replaced by a long tube filled with highly pressurized gas. Upon bursting of a diaphragm, a short-duration steady flow on the order of 500 ms is achieved behind a centered rarefaction fan, which propagates into the gas supply tube. Useful testing has been accomplished during this period by expanding the gas to the desired test condition.

Action of the rarefaction fan sets the gas in motion and results in a reduction of its pressure and temperature. The lowered pressure causes flow to pass

(continued overleaf)

through the inclined holes in the sleeve assembly, through the plenum chamber, and out the covering.

In conventional chambers, at any given mach number larger then 1, shock and expansion waves, orginating at the test model, travel to the chamber wall, reflect back to the model and confuse the data. This design, employing a sleeve assembly composed of an inner and an outer wall, each with an identical inclined hole pattern with a maximum of 10 percent open area, avoids this problem. By translating the outer wall with respect to the inner wall, the percent open area can be changed from zero to 10 percent, allowing optimum transient wave cancellation at any mach number in the range of interest. Inclined holes restrict outflow from the plenum chamber back to the free stream and a plenum flow optimization liner maintains uniform flow conditions at all points in the test region.

Notes:

1. This equipment has produced Reynolds number flows 4 to 6 times larger than existing long-duration facilities. It also avoids the aerodynamic noise associated with conventional valve diffusers and turbines.
2. The following documentation may be obtained from:

   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.65)

   Reference:
   NASA-TM-X-53571 (N68-18190)
   Feasibility Studies of a Short Duration High Reynolds Number Tube Wind Tunnel

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: John W. Davis and Olen E. Hill
Marshall Space Flight Center
(MFS-20509)