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NASA TECH BRIEF

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Hydraulic Calipers

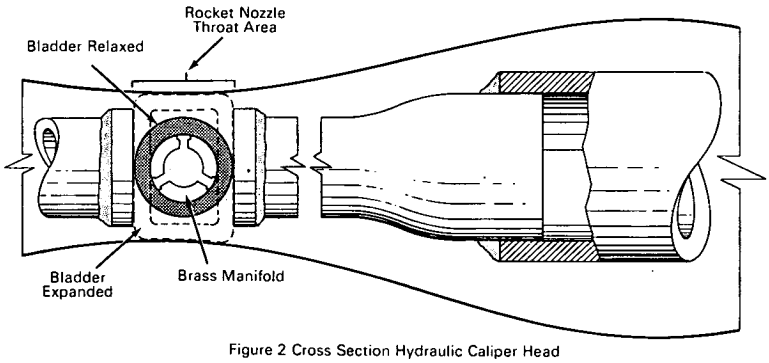

Figure 2 Cross Section Hydraulic Caliper Head

Hydraulic calipers have been proposed as a tool for determining the area of annular openings that cannot be conveniently measured by conventional methods. The calipers are being designed to measure the very small irregular throat area of an aerospike rocket nozzle, but application of the device could be readily extended to precise area determinations of other irregular or concealed passages. Also, with modification the device could be adapted to investigations of cross-sectional changes in heat flow passages, ducts, conduits, and heat exchanger elements.

Operation of the calipers is based on the hydraulic displacement principle. A controlled pneumatic pressure source supplies the force for expanding a sealed flexible sensor against a known length of the rocket nozzle's throat wall. A rigid metal housing restricts the expansion of the sensor to the direction of the annular width; this assures that the displacement caused by the expansion is directly related to the area over the length being measured. After the sensor is fully expanded, the volume displaced is measured by a sight gauge calibrated in thousandths of a square inch of area per inch of peripheral length. The difference in volume between the relaxed and expanded bladder is, therefore, a direct measure of the annular area of the segment of the throat being measured.

In operation the sensor is inserted into the annular gap and pressurized. The minimum area is found by moving the sensor back and forth until a maximum reading is obtained on the sight gauge. When this position is established, the gauge is set to zero by a diaphragm controlled reservoir between the sensor and gauge. Depressurization returns the sensor to its relaxed position and causes the sight gauge level to rise a distance proportional to the difference in volume between the expanded and relaxed states. Since the gauge has been calibrated with a passage of known area, the reading is a direct measure of the minimum annular area of the rocket throat. Repetitive measurements traversing the entire periphery can be added to give the total throat area, or random locations around the periphery can be averaged to give the mean throat width.

Notes:

1. A prototype tool, sized to match the current 40K aerospike design, is presently under construction by the innovator.

(continued overleaf)

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2. The sensor for the prototype is restrained by a machined steel housing that permits measurement of one inch of peripheral length. It is supported internally by a brass manifold through which pressure is supplied. The bladder, or sensor, is sealed to both the housing and manifold on both ends.
3. This development is in the conceptual stage only, and as of date of publication of this Tech Brief, neither model nor prototype has been constructed.
4. No further documentation is available. Inquiries may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B69-10399

Patent status:

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

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