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NASA TECH BRIEF

Automated Measurement of Thermal Conductivity

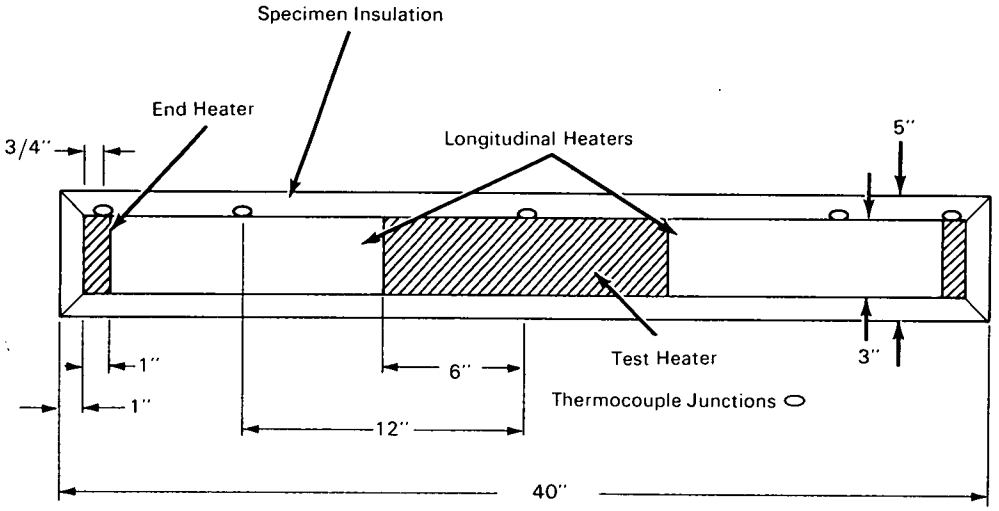

Fig. 1. Longitudinal Section of the Cylindrical Calorimeter

The problem:

Development of methods of applying efficient thermal-insulating material and predicting its performance.

The solution:

A newly developed testing technique permits accurate measurement of temperature-dependent thermal conductivity, by virtue of the small temperature differential required across a specimen.

How it's done:

The central portion of a 3-inch-diameter fiberglass cylinder, 38.5 inches long and having a wall thickness of 0.63 inch (Fig. 1), is wound with a heating filament—the main test heater—that is surrounded by four electrically automated guard heaters that reduce longitudinal temperature gradients to less than 0.05°F/foot. The design permits the derivation of data with a driving temperature differential of 10°F or less.

The insulation under test is wrapped circumferentially about the cylinder and diagonally jointed to end caps of the same material so that edges of the insulation are eliminated. The temperature differential is maintained across the insulation by the heaters inside and by a surrounding heated or cooled environmental shroud. The resultant thermal system closely approximates an infinite tube. The insulation-backside pressure is recorded for each specimen with an ion gauge installed in the calorimeter's cylinder. The effects of gaps of various dimensions in the insulation are evaluated by circumferential slitting of the insulation and by forcing of the cut edges apart to various degrees.

The permissible mean insulation temperature ranges from cryogenic to the upper limit for the in-

(continued overleaf)

sulation under test. The heat flux, per square foot of heated area, ranges from about 1 mw to 1 watt at pressures between 10^{-6} torr and 1 atm. The cost of preparation of each specimen is about $400; of each test, about $200 per datum point. The test operation is fully automated, requiring attendance for only from 3 to 5 hours per 24-hour day. The device has been used especially for comparing the efficiencies of various insulants, and different methods of applying and jointing them.

Notes:

1. This calorimeter may be of interest to heating and electrical engineers, chemists, and biologists.
2. Documentation is available from:
   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10283

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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