NASA TECH BRIEF

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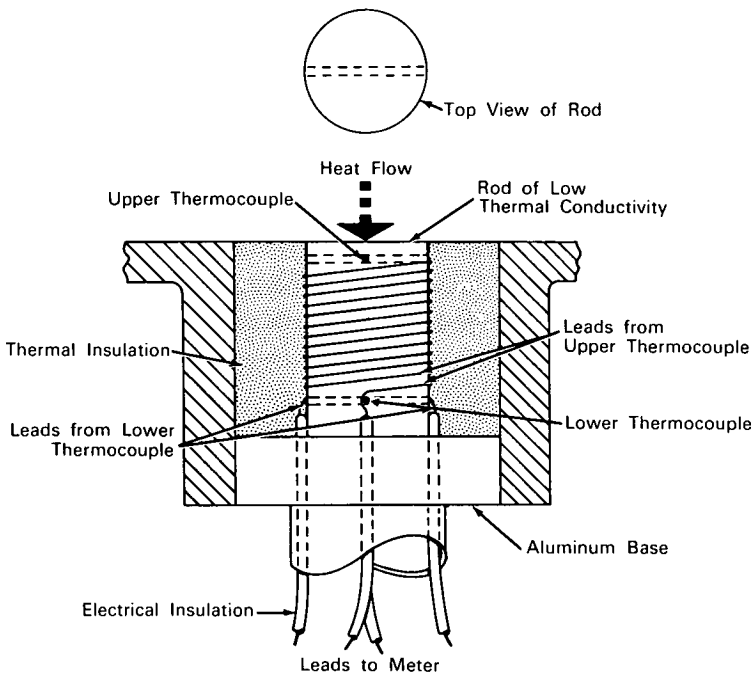
Simple Transducer Measures Low Heat-Transfer Rates



The problem: Measuring low rates (0.1 to 2.0 BTU/sq ft/sec) of convective and conductive heat transfer from a fluid to a cooled surface under steady-state conditions.

The solution: A small device (approx. 1/2″ long × 1/2″ O.D.) employing a rod of low thermal conductivity in which two thermocouples are imbedded to measure the temperature drop in the direction of heat flow.

How it's done: The main element of the transducer, a rod of polytetrafluoroethylene is mounted on a heavy aluminum base. Two thermocouple junctions of chromel-constantan are mounted in recesses in the rod, one near the top of the rod and the other near the bottom of the rod. Leads from the upper junction are wound in a spiral around the rod and pass out through holes in the aluminum base. This method of winding is to prevent the leads from conducting excess heat from the device and thus give a false temperature reading at the upper junction. The leads from both thermocouples are electrically insulated from the aluminum base. The wire-wound rod is surrounded by fibrous potassium titanate to minimize the loss of heat from the rod in a direction transverse to the axis of the rod.

(continued overleaf)

In operation of the device, it is necessary that heat be continuously removed from the aluminum base to ensure steady-state conditions. This may be done by directing a jet of cold inert gas (e.g., nitrogen) onto the base. Temperature readings obtained from the two thermocouples together with specific parameters of the device are inserted into equations which have been derived to yield a measure of the rate of heat transfer.

Notes:

1. A device employing a rod of polytetrafluoroethylene can be operated continuously at temperatures of up to only 350°F. For operation at higher temperatures a ceramic rod must be substituted for the plastic rod.
2. In calibrating the device, a correction factor must be determined to compensate for changes in the heat-transfer rate that would be effected by insertion of the device into the thermal environment.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
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   Reference: B64-10122

Patent status: NASA encourages the immediate commercial use of this invention. It is owned by NASA and inquiries about obtaining royalty-free rights for its commercial use may be made to NASA Headquarters, Washington, D.C., 20546.

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