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NASA TECH BRIEF

Langley Research Center

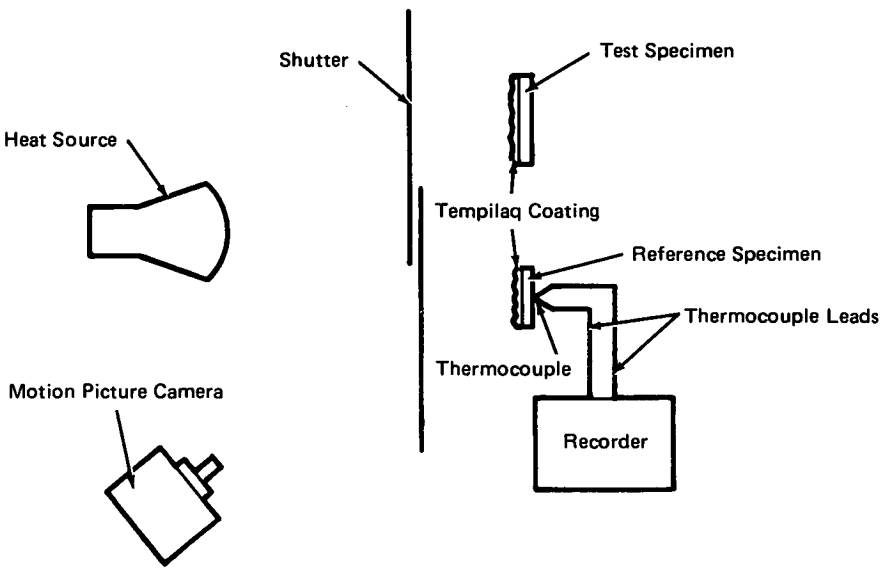
New Method for Determining Thermophysical Properties of Test Specimens

A new method has been developed for determining the thermophysical properties of test specimens ($\sqrt{\rho ck}$, where ρ is the density, c is the specific heat, and k is the thermal conductivity) directly from a specimen such as a wind tunnel model. The illustration shows one example of use, but the method is adaptable to numerous modifications and variations. A model can be tested directly, which eliminates the costly, time-consuming, and inaccurate method of making test models solely for the purpose of determining thermophysical properties.

The apparatus used includes the following:

a. A heat source,
b. The means for locating a test specimen and a reference specimen at a given distance from the heat source,
c. The means for exposing the test and reference specimens to the heat source (a shutter),
d. The equipment for determining the time required to heat the specimens to a given temperature (a motion picture camera), and
e. The equipment for measuring the temperature of the reference specimen as a function of time (a thermocouple and a recorder).

The test specimen and the reference specimen of known specific heat are positioned a given distance from the heat source. A coating, such as a phase-change coating, is placed on the specimens to give a visual indication that a given temperature has been reached. The coating also ensures that both specimens have the same absorbtivity and receive the same heat rate. A motion picture camera is used to provide a record of the time from the beginning of the heating step (the opening of the shutter) to the melt of the phase-change coating.



Apparatus for Determining Thermophysical Properties of Test Specimens

(continued overleaf)

After the heat source (a lamp bank) has reached its operating temperature, the camera is started; and then the shutter, which is interposed between the heat source and the specimens, is opened. The temperature of the reference specimen is recorded as a function of time. The heat rate to which the reference specimen has been subjected is determined from the temperature-time response of the reference specimen (as measured by the thermocouple), using the conventional thin-skin calorimeter equation. This heat rate, together with the measured time required to melt the phase-change coating, then is used to determine the thermophysical properties of the test specimen from the transient, one-dimensional, heat-conduction equation for a semi-infinite solid subjected to a step-heat input at a constant heat rate.

Notes:

1. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $5.75
   (or microfiche $2.25)
   Reference: NASA CR-2434 (N75-10104/LK), Development of an Apparatus To Measure Thermophysical Properties of Wind Tunnel Heat Transfer Models
2. Technical questions may be directed to:
   Technical Utilization Officer
   Langley Research Center
   Mail Stop 139-A
   Hampton, Virginia 23665

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,789,654). Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Langley Research Center
Mail Stop 313
Hampton, Virginia 23665

Source: Robert A. Jones
Langley Research Center and
R. F. Romanowski and I. H. Steinberg of
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