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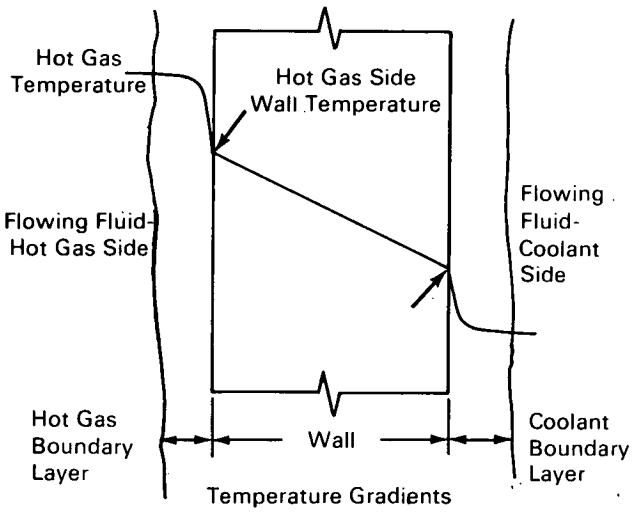
NASA TECH BRIEF

A Simplified Method for Determining Convective Heat-Transfer Coefficients



Convective heat-transfer coefficients on both sides of a wall can now be determined by measuring the temperatures of the hot and cold fluids separated by the wall, and the temperature of the wall at a single point. The method used is generally applicable to heat exchangers and particularly to rocket engines. This simplified transient method requires measurement of the response of the wall temperature to a sinusoidally varied hot gas temperature. Prior, steady-state methods for determining the heat transfer coefficients required measurement of two wall temperatures, and the distance separating them, so that a temperature gradient could be determined for use in the heat conduction equation. When the heat flux is high and the wall thermal conductivity is low, thin walls are necessary to maintain the wall temperature at an acceptable level. Measuring one temperature accurately on a thin wall is possible, but measuring two wall temperatures and determining the temperature gradient accurately are extremely difficult due to the geometries involved. By requiring only one wall temperature measurement, the instrumentation problem is resolved.

The convective heat-transfer coefficients can be determined experimentally if a single wall temperature, the hot gas temperature, and the coolant temperature are known as a function of time. From temperature-time traces of the hot gas, the coolant, and just one location in the wall, the phase lag angle and ratio of the amplitude of the wall to the hot gas temperature are determined. Either the phase lag angle or the ratio is used in accordance with an analysis to calculate the convective heat transfer coefficients which exist on the two surfaces of the wall.

An experimental verification of the method is described in NASA-TM-X-1980. An analysis of the method and derivation of the equations for solution of the heat-transfer coefficients can be found in NASA-TN-D-5520.

Notes:

1. 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)

   References:

   NASA-TN-D-5520 (N69-40789), Convective Heat-Transfer Coefficients from a Solution of the Conduction Equation for a Wall Separating Two Fluids, One Having an Oscillating Temperature

(continued overleaf)

NASA-TM-X-1980 (N70-21745), Experimental Evaluation of an Oscillating Temperature Technique for Obtaining Convective Heat-Transfer Coefficients

2. Technical questions may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B70-10575

Patent status:

No patent action is contemplated by NASA.

Source: R.G. Huff
Lewis Research Center
(LEW-11156)