NASA TECH BRIEF

Lewis Research Center

Heat Transfer Correlations for Kerosene Fuels and Mixtures and Physical Properties for Jet A Fuel

Heat transfer correlations have been developed for conventional Jet A fuel for both laminar and turbulent flow in circular tubes. These correlations are based on data obtained at extreme conditions and for a wide range of variables including heat fluxes of 0.02 to 4.0 BTU/sec-in^2, bulk fuel temperatures of 38 to 538°C, Reynolds numbers of 40 to 600,000, and Grashof numbers up to 20,000,000. The correlation for laminar flow includes the important contribution of free convection, which improved heat transfer over that for laminar flow alone. These correlations were developed for cooling in turbine engines but may have broader applications in petroleum and chemical processing and other industrial applications. These correlations very likely can be used where other kerosene fuels or mixtures are involved.

The Nusselt number of heat transfer in laminar flow with free convection was dependent primarily on the Grashof number, and to a lesser extent on the Prandtl number and the ratio of bulk fuel density to the fuel density at the wall conditions. The Nusselt, Reynolds, and Prandtl numbers, and ratio of bulk fuel temperature to wall temperature were used in heat transfer correlations for turbulent flow.

During the course of these experiments, physical properties of Jet A fuel were calculated over a wide range of conditions using a digital computer program developed for the purpose. Liquid properties calculated over a range of temperatures from -18 to 371°C included density, enthalpy, specific heat at constant pressure, viscosity, and thermal conductivity. Gas properties calculated at pressures of 0, 500, and 1000 psia (0, 3.45 and 6.90 MN/m^2) and over a temperature range from 399 to 538°C included compressibility factor, density, enthalpy, specific heat at constant pressure, viscosity, and thermal conductivity. The calculated values for these properties of Jet A fuel are tabulated in the report, NASA CR-72951, referenced below. The computer program developed for calculating these properties is available from COSMIC as shown below.

Notes:

1. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)

   Reference: NASA CR-72951(N71-31482), Heat Sink Capability of Jet A Fuel: Heat Transfer and Coking Studies
2. The computer program may be obtained from:
   COSMIC
   112 Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: LEW-11653
3. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B72-10742

Patent status:

NASA has decided not to apply for a patent.

Source: L. E. Faith and G. H. Ackerman of
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Category 04