

# NASA TECH BRIEF

## Lewis Research Center



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

### Properties of Air and Combustion Products of Fuel with Air

Thermodynamic and transport properties have been calculated for air, the combustion products of natural gas and air, and the combustion products of ASTM-A-1 jet fuel and air. Properties calculated include: ratio of specific heats, molecular weight, viscosity, specific heat, thermal conductivity, Prandtl number, and enthalpy. These properties have been calculated for temperatures from 300 to 2800 K (80 to 4580°F) in 100 K (180°F) increments at pressures of 20, 30 and 40 atmospheres. The data for natural gas and ASTM-A-1 were calculated for fuel-air ratios from 0.01 to stoichiometric in 0.01 increments. The data are presented in the referenced report.

The calculated property data in the report are for the combustion products of defined fuels. However, it is estimated that the difference between calculated thermodynamic and transport properties of the combustion products of ASTM-A-1 burned in air and the properties of any of the typical JP fuels burned in air will be less than 0.5 percent for the same equivalence ratio. Likewise, errors of less than 0.5 percent will be introduced if the thermodynamic and transport properties of the combustion products of natural gas are used for the properties of the combustion products of methane or any natural gas composition.

The analytical investigation described was conducted to determine properties for the gas compositions, pressures, and temperatures encountered in current and projected jet engine cooling studies. Accurate values of the thermodynamic and transport properties are not available in the literature over the required range of pressure and temperature. These property data are required for designing jet cooling configurations for combustor liners and turbine vanes, blades, and end walls.

The data should be useful for generation applications in gas turbines and for a variety of industrial combustion processes.

#### Notes:

1. Further information is available in the following report:

NASA TN-D-7488 (N74-12575), Thermodynamic and Transport Properties of Air and Its Products of Combustion with ASTM-A-1 Fuel and Natural Gas at 20, 30 and 40 Atmospheres

- Copies may be obtained at cost from:

Aerospace Research Applications Center  
Indiana University  
400 East Seventh Street  
Bloomington, Indiana 47401  
Telephone: 812-337-7833  
Reference: B75-10004

2. Previously calculated properties of the same kind for pressures of 3 to 10 atmospheres, announced in Tech Brief 69-10711, are available in the following report:  
NASA TN-D-5452 (N69-37936), Thermodynamic and Transport Properties of Air and the Combustion Products of Natural Gas and ASTM-A-1 with Air

Copies may be obtained at cost from the Aerospace Research Applications Center at the address above.

3. Specific technical questions may be directed to:

Technology Utilization Officer  
Lewis Research Center  
21000 Brookpark Road  
Cleveland, Ohio 44135  
Reference: B75-10004

#### Patent Status:

NASA has decided not to apply for a patent.

Source: D.J. Poferl and R. Svehla  
Lewis Research Center  
(LEW-12402)

Category 03