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Comparison of Themodynamic and Transport Property Models for Computing Equilibrium High Enthalpy Flows VEDA KRISHNA VYAS RAMASAHAYAM, ANANT DIWAKAR, KOWSIK BODI, IIT Bombay — To study the flow of high temperature air in vibrational and chemical equilibrium, accurate models for thermodynamic state and transport phenomena are required. In the present work, the performance of a state equation model and two mixing rules for determining equilibrium air thermodynamic and transport properties are compared with that of curve fits. The thermodynamic state model considers 11 species which computes flow chemistry by an iterative process and the mixing rules considered for viscosity are Wilke and Armaly-Sutton. The curve fits of Srinivasan, which are based on Grabau type transition functions, are chosen for comparison. A two-dimensional Navier-Stokes solver is developed to simulate high enthalpy flows with numerical fluxes computed by AUSM+-up. The accuracy of state equation model and curve fits for thermodynamic properties is determined using hypersonic inviscid flow over a circular cylinder. The performance of mixing rules and curve fits for viscosity are compared using hypersonic laminar boundary layer prediction on a flat plate. It is observed that steady state solutions from state equation model and curve fits match with each other. Though curve fits are significantly faster the state equation model is more general and can be adapted to any flow composition.

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