Current Status of Thermodynamic Properties of Hydrogen

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If the projected future utilization of hydrogen is to be realized by replacement of conventional fuels in transportation and other applications, accurate thermodynamic properties of normal hydrogen and parahydrogen will be needed to ensure both the safety and integrity of new engineered systems using hydrogen as an energy carrier or fuel. The currently accepted standards for thermodynamic properties of hydrogen were based on experimental and correlation work that was completed before the mid 1980s. It is especially important to provide accurate property values for systems analysis and design at high temperatures for applications in hydrogen production (e.g. high temperature electrolysis), in storage and transportation of gas and liquid hydrogen and in utilization (e.g. fuel cells and internal combustion engines). Prediction or extrapolation of properties at extreme temperatures and pressures will be needed to satisfy such requirements in the immediate future.

This paper includes a review of the current standard thermophysical properties models for hydrogen and parahydrogen with comparisons of properties calculated using those models to available experimental data. Property values measured and published after the completion of the current standards for both normal hydrogen and parahydrogen are included in the comparisons. Recommendations for new experimental data needed and new thermodynamic property formulations for normal hydrogen and parahydrogen are included.