

## REFPROP - Reference Fluid Thermodynamic and Transport Properties

Eric W. Lemmon, Marcia Huber, Ian H. Bell<sup>C, S</sup> and Mark McLinden  
*Applied Chemicals and Materials Division, NIST, Boulder, CO, U.S.A.*  
*ian.bell@nist.gov*

Version 10.0 of the REFPROP software will be demonstrated. The code in this version has gone under extensive revisions, with two new routines developed that users can call to obtain every property available in the software, thus greatly increasing the ease of learning how to link with the software. The revisions have also focused on increased calculation speed and better convergence, especially with complex mixtures. The REFPROP program uses the latest high accuracy equations of state based on the Helmholtz energy for thermodynamic properties with typical uncertainties of 0.1 % in densities, vapor pressures, and speeds of sound, 0.5 % in heat capacities, and 0.1 % in pressure in the critical region. Many transport equations have been updated. New plotting capabilities including  $p$ - $x$  and  $T$ - $x$  diagrams have been added. The software allows the user to calculate properties of the liquid, vapor, and supercritical states, including two-phase properties for both pure fluids and mixtures. Nearly 150 fluids are available in the program, including cryogenes, refrigerants (including new low-GWP fluids), and hydrocarbons. The latest updates to the GERG-2008 equation (for combustion gases with emphasis on water mixtures) for the properties of natural gas systems is included as a dedicated equation with very high accuracies for typical natural gases found throughout the world. Links with other applications such as Excel, Visual Basic, C++, and so forth are available and example files come with the program.