journal of applied mechanics

book reviews

Steam Tables

Steam Tables. By J. H. Keenan, F. G. Keyes, P. H. Hill, and J. G. Moore. John Wiley & Sons, Inc., New York, 1969. vii and 162 pages. $9.95.

REVIEWED BY DR. J. M. H. LEVELT SENGERS[1]

These Steam Tables are derived from an entirely new formulation of the experimental thermodynamic properties of steam. Rather than the piecemeal approach of the 1967 IFC, one fundamental equation for the Helmholtz free energy as a function of the variables density and temperature is used for the entire range of vapor, liquid, and supercritical states. The nonideal part of the equation is a product of polynomials in inverse temperature and of polynomials and exponentials in the density, with 51 adjustable constants. The equation has been fitted to saturated vapor enthalpies and to PVT data up to 1000 bars and 800 deg C; a number of constraints were imposed, such as the location of the critical point. All thermodynamic properties were derived from this fundamental equation.

The range of the tables (available both in English and in metric units) is from 0–1000 bars and from 0–1300 deg C. The organization is rather different from that of the 1967 ASME Tables. The temperature is listed vertically in increasing order. At each pressure entry four columns of properties are given; namely, volume, enthalpy, entropy and, in addition, energy. The pressure grid is roughly equivalent to that of the ASME Tables.

The principal tables list data for vapor and supercritical phases but not for the liquid. This permits a flexible temperature spacing with small steps where needed, such as in the critical region. The liquid phase, tabulated separately, takes up little space because a coarse pressure grid is sufficient. A separate table for the critical region is presented with, quite appropriately, density rather than pressure as an independent variable.

The Appendix gives a careful and extensive intercomparison of calculated and experimental values. It demonstrates impressively how well a good fundamental equation, based on PVT data mainly, can predict Joule-Thomson coefficients and even the sharply peaked C_P values in the supercritical region. Discrepancies between different sets of experimental data also show up vividly; for instance, between second virial coefficients at low temperatures, and between specific volumes at high temperatures.

The tabulated values are, in general, within the tolerances of the 1963 Skeleton Tables. There are some regions of small discrepancies, mainly at pressures above 500 bars. Where deviations exist, they usually exceed the tolerance just barely; moreover, the present tables are generally closer to experiment than the Skeleton Tables.

The only criticism this reviewer has concerns the treatment of the critical region. A minor problem is that, while the book was in press, a new value for the critical temperature has been reported appreciably below the one used here. A more serious problem is that a fundamental equation of the structure used here must have a cubic critical isotherm, a quadratic coexistence curve, and a finite specific heat C_V in the vicinity of the critical point; however, steam, just like other gases, does not behave that way. Thus a reformulation of the immediate vicinity of the critical point may be needed.

Summarizing, this is a forceful and elegant approach to the formulation of properties of steam. It is recommended not only for engineering applications, but also as an instructive example of thermodynamic data correlation, and as a guide in the critical evaluation of experimental steam data.

[1] 110 North Van Buren Street, Rockville, Md.

Plastic Methods

Plastic Design of Frames. (Vol. 1—Fundamentals) By Sir John Baker and Jacques Heyman. Cambridge University Press, Cambridge, England. vii plus 227 pages. $9.50.

REVIEWED BY P. S. SYMONDS[2]

This book gives an account of elementary theory of "plastic methods" for the analysis and design of beams and frames. Only the most basic topics are treated, leading up to solutions (by combining mechanisms) of frames of moderate complexity. Methods for arches and grillages are also briefly outlined. The style is elegant. The omitted topics (such as comparisons with tests, deflections, stability, shakedown, and, hopefully, numerical methods) are apparently reserved for a second volume.

No citations or bibliographical data of any sort are given. This lack seriously impairs an otherwise useful book. The reader is given no idea where to go for original sources or more complete treatments, nor does he gain any sense of historical perspectives of a "live" subject. The main loss is simply that of interest, in the reviewer's opinion. The loss seems doubly unfortunate in this case because the authors are superbly well qualified in these matters of history and growth.

[2] Professor, Division of Engineering, Brown University, Providence, R. I.