Survey and evaluation of *P-V-T* data

There exist seven and eleven different measurements an the *P-V-T* relations of gaseous ethane and ethene, respectively, under high pressures as listed below :

Ethane

A. Michels, W. Van Straaten and J. Dawson	(1954) [2]
A. Michels, snd G. W. Nederbragt	(1939) [3]
J. A. Beattie, G. J. Su and G. L. Simard	(1939) [4]
J. A. Beattie, C. Hadlock and N. Poffenberger	(1935) [5]
H. H. Reamer, R. H. Olds, B. H. Sage and W. N. Lacey	(1944) [6]
B. H. Sage, D. C. Webster and W. N. Lacey	(1937) [7]
V. M. Miniovich and G. A. Sorina	(1971) [8]

Ethene

A. Michels and M. Geldermans	(1942) [9]
A. Michels, J. De Gruyter and F. Niesen	(1936) [10]
A. Sass, B. F. Dodge and R. H. Bretton	(1967) [11]
W. Thomas and M. Zander	(1966) [12]
P. S. Ku and B. F. Dodge	(1967) [13]
R. J. Walters, J. H. Tracht, E. B. Weinberger and J. K. Rodgers	(1954) [14]
R. C. Lee and W. C. Edmister	(1970) [15]
H. G. McMath and W. C. Edmister	(1969) [16]
V. H. Danneel and H. Stoltzenberg	(1929) [17]
C. A. Crommelin and H. G. Watts	(1927) [18]

2) A. Michels, W. Van Straaten and J. Dawson, *Physica*, **20**, 17 (1954)
3) A. Michels and G. W. Nederbragt, *ibid.*, **6**, 656 (1939)
4) J. A. Beattie, G. J. Su and G. L. Simard, *J. Am. Chem. Soc.*, **61**, 926 (1939)
5) J. A. Beattie, C. Hadlock and N. Poffenberger, *J. Chem. Phys.*, **3**, 93 (1935)
6) H. H. Reamer, R. H. Olds, B. H. Sage and W. N. Lacey, *Ind. Eng. Chem.*, **36**, 956 (1944)
7) B. H. Sage, D. C. Webster and W. N. Lacey, *ibid.*, **29**, 658 (1937)
8) V. M. Miniovich and G. A. Sorina, *Zh. Fiz. Khim.*, **1971**, 45 (3) 552 (1971)
9) A. Michels and M. Geldermans, *Physica*, **9**, 967 (1942)
10) A. Michels, J. De Gruyter and F. Niesen, *ibid.*, **3**, 346 (1936)
11) A. Sass, B. F. Dodge and R. H. Bretton, *J. Chem. Eng. Data*, **12**, 168 (1967)
12) W. Thomas and M. Zander, *Z. angew. Phys.*, **20**, 417 (1966)
13) P. S. Ku and B. F. Dodge, *J. Chem. Eng. Data*, **12**, 158 (1967)
14) R. J. Walters, J. H. Tracht, E. B. Weinberger and J. K. Rodgers, *Chem. Eng. Progess*, **50**, 511 (1954)
15) R. C. Lee and W. C. Edmister, *A. I. Ch. E. Journal*, **16**, 1047 (1970)
16) H. G. McMath and W. C. Edmister, *ibid.*, **15**, 370 (1969)
17) V. H. Danneel and H. Stoltzenberg, *Z. angew. Chem.*, **42**, 1121 (1929)
18) C. A. Crommelin and H. G. Watts, *Comm. Phys. Lab. Leiden*, No. 189–C (1927)

I. Masson and L. G. F. Dolley (1923)[19]

The original papers were carefully read through and examined from viewpoint of the reliability of the reported data by the same operations as in the previous work for gaseous methane[1].

The final evaluation was performed by the Committee members and several researchers in this field as described above. As the results for ethane, the set of data by Michels *et al.*[2] was considered to be the most reliable and given the highest weight. The weight second to the above were given to other four sets of data[3~6]. The weight third to the above was given to the set of data[7] and no weight was given to the remainder[8] in which the data were reported only in the limited range around the critical point. For ethene, the set of data by Michels *et al.*[9] was considered to be the most reliable and given the highest weight. The weight second to the above were given to other two sets of data[11,12]. The weight third to the above was given to the set of data[13]. The weights fourth to the above were given to three sets of data[14~16]. No weight was given to three earlier data[17~19]. It was also given to the early data by Michels *et al.*[10] because they were represented in the set of their new data[9] with some corrections.

Methods and results of correlation

The *P-V-T* properties of gases in original papers were expressed in various forms such as compressibility factor Z, specific volume V, PV in Amagat unit and so on, with various units of pressure, temperature, volume and mass. At first, they were reduced to the common expression Z with the SI units of pressure and temperature :

compressibility factor, $Z=PV/\boldsymbol{R}T$,

pressure, P, in 10^5 Pa (=1 bar=0.986923 atm) and in atm,

temperature, T, in K,

specific volume, V, in cm^3/mole.

In these processes, the atomic weights recommended by IUPAC (1969)[20] were adopted as follows; C=12.011±0.001 and H=1.0080±0.0003. For the universal gas constant, the numerical value recommended by IUPAC (the 23rd Conference)[21~23] was adopted :

$\boldsymbol{R}$=8.31433±0.00044 (J/K·mole)

=82.056±0.004 (cm^3·atm/K·mole).

The maximum relative uncertainties of Z due to the uncertainties of atomic weights, which amount to 1.2×10^{-4} for ethane and ethene, are not significantly lower than the experimental errors in the precisest measurements. The relative uncertainty of Z due to the uncertainties of $\boldsymbol{R}$ amounts to

19) I. Masson and L. G. F. Dolley, *Proc. Roy. Soc.*, **A103**, 524 (1923)
20) Commission on Atomic Weights, *Pure and Appl. Chem.*, **21**, 95 (1970)
21) M. L. McGlashan, *ibid.*, **21**, 37 (1970)
22) F. R. Rossini, *ibid.*, **9**, 453 (1964)
23) Thermodynamics Research Center Project, "Selected Values of Properties of Chemical Compounds", Texas A and M Univ., pp. 11~20 (1966)