

Figure 1.

If the atmospheric pressure  $P_0$  is selected as datum, then

Comparing Equations (4) (7) and (9) and eliminating the viscosity terms, one arrives at

The group  $\frac{n}{sRT}$  is an unknown function of temperature. Equa-

tion (10) may be written as

$$P - P_0 = K \left[ \frac{1}{v_R^4} - \frac{1}{v_R^2} \right]^q$$
 (11)

where  $v_R$  is equal to  $(v/v_0)$ .

Equation (11) is the proposed equation of state. This equation can also be expanded as the following power series

$$\frac{1}{q}\log\frac{P-P_0}{K} = -4\log v_R - v_R^2 - \frac{v_R^4}{2} - \frac{v_R^6}{3}\dots(12)$$

For a very small  $v_R$ , that is, for extremely high pressure, Equation (12) reduces to

## Correlation of P-V-T Data

The equation of state proposed here is tested for its validity against aldehydes data that have been obtained by the authors. In addition, the literature data have been utilized to facilitate a comparison of the proposed equation with the Hudleston equation of state. The experimental data on aldehydes are presented in Figures 1 and 2. These data were obtained in a high pressure set-up capable of simultaneous compressibility and viscosity determinations. The liquid volume was measured by piston displacement while the viscosity was determined by noting the time of fall of a plummet. The pressure range investigated was from atmospheric to 20,000 psi (1.39 *kb*). The details of the experimental procedure are available elsewhere<sup>(22)</sup>.

The experimental data on aldehydes were correlated by Equation (11). For the purpose of correlation, the equation was rewritten as

where 
$$y = P$$
 (for  $P \gg P_0$ ) and  $x = \frac{1}{v_k^4} - \frac{1}{v_k^2}$ . The coeffi-

cients of correlation were calculated between y and x. Regression analysis was performed on an IBM 1620 II computer.



The results of the analysis are presented in Table 1. The average coefficient of correlation is 0.9993.

To further test the validity of the proposed equation of state, existing data on several components were correlated. The results of the analysis are presented in Tables 2, 3 and 4. It is seen that excellent fit is obtained for all the substances in question.

TABLE 1 (Pressure Range 0 to 20,000 psi)

Compound	Temp. °F	K	9	Degree of Fit
Acetaldehyde Propionaldehyde Iso-Butyraldehyde Iso-Butyraldehyde Iso-Valeraldehyde Heptaldehyde Caprylic Aldehyde Benzaldehyde Anisaldehyde Trans- Cinnamaldehyde	71.6 74.3 84.0 82.8 81.0 71.1 69.3 71.7 76.7 84.3	$\begin{array}{c} 5.958 \times 10^5 \\ 7.308 \times 10^5 \\ 7.757 \times 10^5 \\ 6.820 \times 10^5 \\ 8.871 \times 10^5 \\ 9.639 \times 10^5 \\ 10.383 \times 10^5 \\ 15.137 \times 10^5 \\ 17.087 \times 10^5 \\ 20.253 \times 10^5 \end{array}$	$\begin{array}{c} 1.0587\\ 1.0249\\ 1.0790\\ 1.0575\\ 1.2234\\ 1.0473\\ 1.0516\\ 1.0669\\ 1.0318\\ 1.1719\end{array}$	0.9998 0.9999 0.9999 0.9950 0.9994 0.9998 0.9998 0.9999 0.9999 0.9999

TABLE 2\* (Pressure range 1–5000 atmospheres)

Compound	Temp. °C	K	q	Degree of Fit
N-Hexane	$     \begin{array}{c}       0 \\       25 \\       40 \\       60     \end{array} $	$\begin{array}{c} 6.1453 \times 10^{3} \\ 5.0727 \times 10^{3} \\ 4.4964 \times 10^{3} \\ 3.8053 \times 10^{3} \end{array}$	1.1805 1.1983 1.2089 1.2489	0.9996 0.9996 0.9997 0.9997
N-Heptane	0 25 40 60	$\begin{array}{c} 6.7270 \times 10^{3} \\ 5.4883 \times 10^{3} \\ 5.1068 \times 10^{3} \\ 4.4422 \times 10^{3} \end{array}$	1.1726 1.0716 1.1984 1.2379	0.9996 0.9735 0.9997 0.9998
N-Octane	0 25 40 60	$\begin{array}{c} 7.3560 \times 10^3 \\ 6.7269 \times 10^3 \\ 6.0034 \times 10^3 \\ 5.3064 \times 10^3 \end{array}$	1.1245 1.1750 1.1823 1.2252	0.9998 0.9984 0.9996 0.9998

\*Data obtained from Reference (14).

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