



Table 4 Experimental equations of state for nitrogen-ammonia system at 50°C

Composition, mol%	$Z = 1 + B(1/V) + C(1/V)^2 + D(1/V)^3$			$1/V$ , mol/l	
	$N_2 - NH_3$	$B$	$C$	$D$	Range of $1/V$
100.0 — 0.0	— 100.0	-0.00037	0.00131	—	up to 3.0
87.3 — 12.7	— 12.7	-0.0082	0.00114	—	up to 1.8
77.0 — 23.0	— 23.0	-0.0219	0.0034	—	up to 1.07
62.3 — 37.7	— 37.7	-0.0479	0.0123	—	up to 0.7
0.0 — 100.0	— 0.0	-0.2172	0.0628	-0.0566	up to 0.9

  

Composition, mol%	$Z = 1 + B'P + C'P^2 + D'P^3$			$P$ , atm	
	$N_2 - NH_3$	$B' \cdot 10^3$	$C \cdot 10^6$	$D' \cdot 10^6$	Range of $P$
100.0 — 0.0	— 100.0	-0.022	1.98	—	up to 100
87.3 — 12.7	— 12.7	-0.038	1.6	—	up to 48
77.0 — 23.0	— 23.0	-0.829	5.0	—	up to 28
62.3 — 37.7	— 37.7	-1.828	16.8	—	up to 18
0.0 — 100.0	— 0.0	-7.477	-34.6	-2.90	up to 19

They were compared with the values calculated theoretically as follows. The Lennard-Jones (12-6) potential function,

$$\varphi(r) = 4\epsilon[(r_0/r)^{12} - (r_0/r)^6], \quad (1)$$

was adopted on the intermolecular forces between argon and argon, argon and ammonia, nitrogen and nitrogen, and nitrogen and ammonia. The Stockmayer potential function,

$$\varphi(r, \theta_1, \theta_2, \phi_2 - \phi_1) = 4\epsilon[(r_0/r)^{12} - (r_0/r)^6] - (\mu^2/r^3) g(\theta_1, \theta_2, \phi_2 - \phi_1), \quad (2)$$

was adopted on the intermolecular forces between ammonia and ammonia. The figures of the parameters in the functions were given by Hirschfelder *et al.*<sup>6)</sup> as below:

	$r_0(\text{\AA})$	$b_0 = (2/3)Nr_0^3$ (cc/mol)	$\epsilon/k$ (K)	$\mu$ (debyes)
Ar — Ar	3.405	49.80	119.8	—
Ar — NH <sub>3</sub>	3.002	34.14	195.8	—
N <sub>2</sub> — N <sub>2</sub>	3.698	63.78	95.05	—
N <sub>2</sub> — NH <sub>3</sub>	3.126	38.54	190.5	—
NH <sub>3</sub> — NH <sub>3</sub>	2.60	22.12	320	1.47

where the force constants between a polar (subscript  $p$ ) and a non-polar molecule (subscript  $n$ ) were obtained from the empirical combination laws represented by the following equations:

$$(r_0)_{np} = (1/2) [(r_0)_n + (r_0)_p] \xi^{-1/6} \quad (3)$$

$$\epsilon_{np} = (\epsilon_n \epsilon_p)^{1/2} \xi^2 \quad (4)$$

6) J. O. Hirschfelder, C. F. Curtiss and C. B. Bird, "Molecular Theory of Gases and Liquids", John Wiley and Sons, New York (1954)