

Table 3 Compressibility factor of nitrogen-ammonia system at 50°C

P , atm	$Z = PV/RT$				
	Composition, mol%				
	N ₂ 100.0 NH ₃ 0.0	N ₂ 87.3 NH ₃ 12.7	N ₂ 77.0 NH ₃ 23.0	N ₂ 62.3 NH ₃ 37.7	N ₂ 0.0 NH ₃ 100.0
0	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	0.9994	0.9984	0.9965	0.9856
4	0.9999	0.9988	0.9968	0.9930	0.9704
6	1.0000	0.9982	0.9952	0.9896	0.9544
8	1.0000	0.9976	0.9937	0.9865	0.9372
10	1.0000	0.9971	0.9922	0.9834	0.9188
12	1.0001	0.9965	0.9908	0.9805	0.8993
14	1.0001	0.9960	0.9894	0.9777	0.8793
16	1.0002	0.9955	0.9880	0.9751	0.8592
18	1.0002	0.9950	0.9867	0.9725	0.8385
20	1.0004	0.9944	0.9854	0.9701	
22	1.0005	0.9940	0.9842		
24	1.0006	0.9935	0.9830		
26	1.0007	0.9931	0.9818		
28	1.0010	0.6626	0.9807		
30	1.0012	0.9922	0.9796		
40	1.0023	0.9903			
50	1.0038	0.9886			

Table 3 (continued)

$1/V$, mol/l	$Z = PV/RT$				
	Composition, mol%				
	N ₂ 100.0 NH ₃ 0.0	N ₂ 87.3 NH ₃ 12.7	N ₂ 77.0 NH ₃ 23.0	N ₂ 62.3 NH ₃ 37.7	N ₂ 0.0 NH ₃ 100.0
0	1.0000	1.0000	1.0000	1.0000	1.0000
0.2	0.9999	0.9984	0.9958	0.9909	0.9595
0.4	1.0000	0.9969	0.9919	0.9828	0.9195
0.6	1.0003	0.9955	0.9882	0.9757	0.8798
0.8	1.0005	0.9941	0.9849	0.9696	0.8393
1.0	1.0009	0.9929	0.9818		
1.2	1.0015	0.9918			
1.4	1.0021	0.9907			
1.6	1.0028	0.9898			
1.8	1.0036	0.9889			
2.0	1.0045				

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	-0.00037	0.00131	—	up to 3.0
87.3	12.7	-0.0082	0.00114	—	up to 1.8
77.0	23.0	-0.0219	0.0034	—	up to 1.07
62.3	37.7	-0.0479	0.0123	—	up to 0.7
0.0	100.0	-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' · 10 ³	C' · 10 ⁶	D' · 10 ⁶	Range of P
100.0	0.0	-0.022	1.98	—	up to 100
87.3	12.7	-0.038	1.6	—	up to 48
77.0	23.0	-0.829	5.0	—	up to 28
62.3	37.7	-1.828	16.8	—	up to 18
0.0	100.0	-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.*⁶⁾ as below:

	$r_0(\text{Å})$	$b_0 = (2/3)Nr_0^3$ (cc/mol)	ϵ/k (K)	μ (debyes)
Ar — Ar	3.405	49.80	119.8	—
Ar — NH ₃	3.002	34.14	195.8	—
N ₂ — N ₂	3.698	63.78	95.05	—
N ₂ — NH ₃	3.126	38.54	190.5	—
NH ₃ — NH ₃	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)