

Components: 1. 1-Butanol, C₄H₁₀O [71-36-3]
 2. Butyl methanoate, C₅H₁₀O₂ [592-84-7]
State: Binary system, single-phase liquid in equilibrium with vapor; pure components, both liquid in equilibrium with vapor
Variables: T, temperature
 x_i, mole fraction of component i in liquid phase
 y_i, mole fraction of component i in vapor phase
Parameters: P, pressure
Method: Direct measurement of T, x_i, and y_i at constant P; ref. 1

Author(s) Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain)

Edited by: Mączynski, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

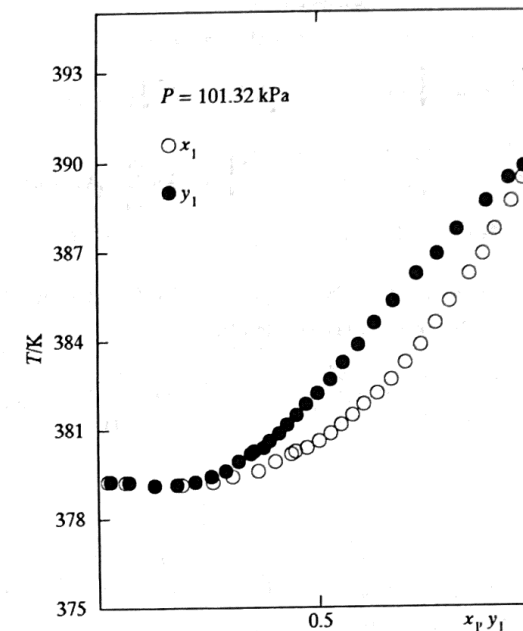
SOURCE OF DATA

Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

P/kPa = 101.32

x ₁	T/K	y ₁	x ₁	T/K	y ₁
0.0226	379.28	0.0286	0.7023	383.25	0.5584
0.0625	379.26	0.0703	0.7368	383.86	0.5940
0.1288	379.14	0.1289	0.7705	384.58	0.6313
0.1901	379.16	0.1793	0.8033	385.33	0.6737
0.2611	379.26	0.2222	0.8492	386.23	0.7278
0.3066	379.44	0.2582	0.8820	386.90	0.7753
0.3639	379.63	0.2908	0.9097	387.72	0.8210
0.4038	379.95	0.3206	0.9478	388.67	0.8888
0.4396	380.20	0.3471	0.9731	389.44	0.9421
0.4492	380.29	0.3549	0.9895	389.83	0.9765
0.4759	380.39	0.3767			
0.5030	380.63	0.3914			
0.5290	380.88	0.4118			
0.5531	381.17	0.4314			
0.5793	381.49	0.4520			
0.6063	381.87	0.4740			
0.6370	382.23	0.5003			
0.6688	382.70	0.5288			



Points, direct experimental T values.

AUXILIARY INFORMATION

Apparatus: The apparatus was a glass ebulliometer employing continuous circulation of the liquid and vapor phases with a charge capacity of approx. 50 cm³, ref. 3. Turbulent mixing of the phases enabled equilibrium to be reached in a relatively short time. The ebulliometer was connected to vacuum pump and the pressure controlled by a Vakuumat electronic instrument (Normschliff Gerätebau Wertheim) and measured with a digital electronic system (MKS Inst., France).
Procedure: Operation described in ref. 3. The equilibrium temperatures were measured with an accuracy of ±0.01 K with a digital thermometer, Comark, Model 6900, calibrated against ITS-90. Compositions were determined by densimetric analysis, using an Anton Paar, Model DMA-55 vibrating-tube digital densimeter. Pressure was maintained constant to within 0.02 kPa.
Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 805.68; n(D, 298.15 K) = 1.3971.
 2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 887.64; n(D, 298.15 K) = 1.3872.
Errors: |δT(estd.)|/K = 0.05; |δP(estd.)|/Pa = 50; |δx₁| = 0.005; |δy₁| = 0.02.

- REFERENCES**
1. *Int. DATA Ser., Ser. A, Guideline 3k*, 1994, 22(4).
 2. Gonzales, E.; Ortega, J. *J. Chem. Eng. Data*, 1996, 41, 53.
 3. Ortega, J.; Pena, J. A.; de Alfonso, C. *J. Chem. Eng. Data* 1986, 31, 339.

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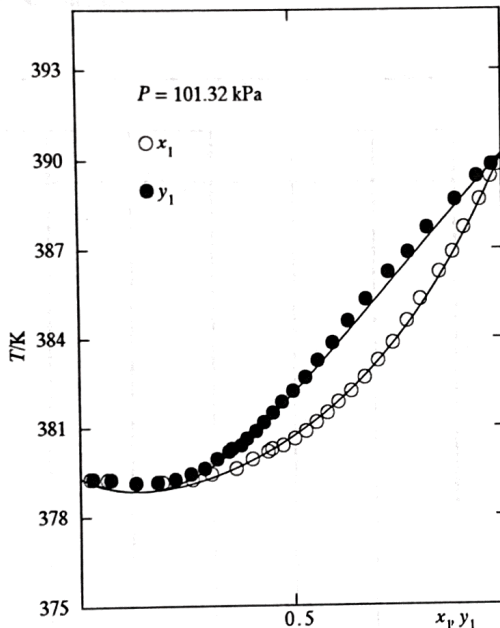
Author(s) Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain)
Compiled by: Oracz, P. (Wydział Chemii, Uniwersytet Warszawski, ul. Pasteura 1, 02-093 Warszawa, Poland)

SOURCE OF DATA

Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain); FIRST PUBLISHED RESULTS

Notes: The table reports smoothed values of T and calcd. values of y₁

P/kPa=101.32						
x ₁	T/K	y ₁				
0.00	379.36	0.0000				
0.05	379.07	0.0563				
0.10	378.93	0.1047				
0.15	378.91	0.1476				
0.20	378.97	0.1869				
0.25	379.12	0.2236				
0.30	379.32	0.2588				
0.40	379.92	0.3278				
0.50	380.75	0.3991				
0.60	381.84	0.4775				
0.70	383.25	0.5683				
0.75	384.09	0.6204				
0.80	385.05	0.6785				
0.85	386.12	0.7437				
0.90	387.33	0.8176				
0.95	388.69	0.9022				
1.00	390.22	1.0000				



Points, direct experimental T values, curves, T(x₁) and T(y₁), calculated from the equations.

EQUATIONS

$$G^E/RT = -x_1 \ln(x_1 + c_2 x_2) - x_2 \ln(x_2 + c_1 x_1)$$

$$c_1 = \exp \left[-\left(a_1 + \frac{a_2}{T} \right) / T \right] \quad c_2 = \exp \left[-\left(a_3 + \frac{a_4}{T} \right) / T \right]$$

$$P = P_1 + P_2 = \sum_{i=1}^2 x_i P_i^0 \exp \left[\frac{\mu_i^E - (B_{ii} - V_i^0)(P - P_i^0) - 2PB_{12}^E(1-y)^2}{RT} \right]$$

$$\mu_1^E = G^E - x_2 (\partial G^E / \partial x_2)_{T,P} \quad \mu_2^E = G^E - x_1 (\partial G^E / \partial x_1)_{T,P}$$

$$B_{12}^E = B_{12} - (B_{11} + B_{22})/2; \quad y_i = P_i/P; \quad P_i^0/kPa = \exp [A_i + B_i/(C_i + T/K)]$$

COEFFICIENTS IN THE EQUATIONS

P/kPa	a ₁	a ₂	a ₃	a ₄	a ₅
101.32	7.343 (13.9)	0 (0)	221.03 (18.8)	0 (0)	

The std. deviations σ(a_i) of the coeffs. a_i are given in parentheses.

P/kPa	A ₁	B ₁	C ₁	A ₂	B ₂	C ₂
101.32	15.92700	-3620.84	-70.04	15.02712	-3530.78	-40.15

AUXILIARY INFORMATION

Measurements: The T_{exp} data at 101.32 kPa are reported in ref. 2.

Computations: The 28 T_{exp} data at 101.32 kPa were reduced using the modified Wilson eq., ref. 3, for the partial molar excess Gibbs energies μ_i^E.

Corrections: Vapor pressure equation parameters were taken from ref. 4 and parameters A_i were modified according to the experimental VLE data. Vapor-phase imperfection and the variation of the Gibbs energy of the pure liquid components with pressure were accounted for in terms of the 2nd molar virial coeffs. B_{ij} (ref. 5) and the molar volumes under saturation pressure V_i⁰ (ref. 6).

Errors: Std. dev. σ(T) = [Σ(T - T_{exp})²/(N-n)]^{1/2},
Rel. std. dev. 100σ(ΔP/P) = 100[Σ((P - P_{exp})/P_{exp})²/(N-n)]^{1/2},
N, no. of exp. points, ref. 2,
n, no. of coefficients in the smoothing equation.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 3m*, 1995, 23(2).
2. Gonzales, E.; Ortega, J. *Int. DATA Ser., Sel. Data Mixtures, Ser. A* 1996, 24, 247.
3. Wilson, G. M. *J. Am. Chem. Soc.* 1964, 86, 127.
4. *TRC Thermodynamic Tables - Hydrocarbons & Non-Hydrocarbons*, 1976, k-5000, 1969, k-5520, Thermodynamics Research Center, The Texas A&M University System, College Station, TX, USA.
5. Tsionopoulos, C. *AIChE J.* 1974, 20, 263; 1975, 21, 827.
6. Yen, L. C.; Woods, S. S. *AIChE J.* 1966, 12, 95.

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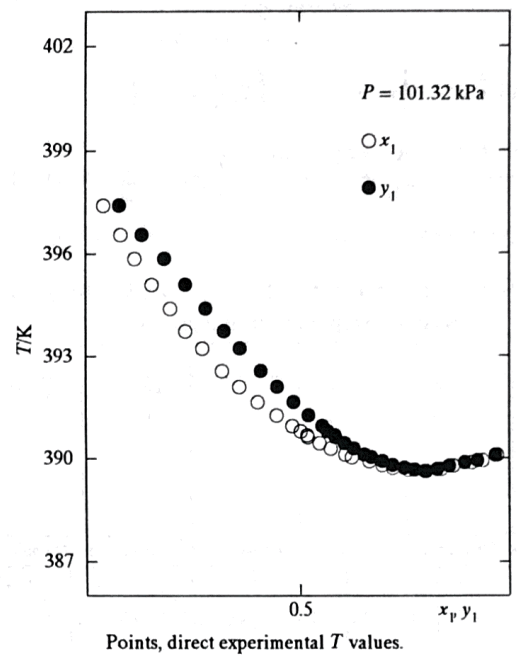
Components: 1. 1-Butanol, C₄H₁₀O [71-36-3]
2. Butyl ethanoate, C₆H₁₂O₂ [123-86-4]
State: Binary system, single-phase liquid in equilibrium with vapor; pure components, both liquid in equilibrium with vapor
Variables: T, temperature
x_i, mole fraction of component i in liquid phase
y_i, mole fraction of component i in vapor phase
Parameters: P, pressure
Method: Direct measurement of T, x_i, and y_i at constant P; ref. 1

Author(s) of table: Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain)
Edited by: Mączyński, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

SOURCE OF DATA
Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

P/kPa = 101.32															
x ₁	T/K	y ₁	x ₁	T/K	y ₁										
0.0430	397.43	0.0804	0.6241	390.07	0.6715										
0.0832	396.59	0.1321	0.6654	389.94	0.6964										
0.1158	395.89	0.1843	0.6966	389.84	0.7219										
0.1551	395.12	0.2335	0.7211	389.76	0.7485										
0.1977	394.42	0.2818	0.7589	389.69	0.7744										
0.2341	393.77	0.3247	0.8019	389.65	0.7990										
0.2731	393.25	0.3623	0.8375	389.72	0.8282										
0.3203	392.60	0.4115	0.8658	389.82	0.8566										
0.3599	392.13	0.4487	0.9108	389.90	0.8933										
0.4036	391.67	0.4874	0.9371	389.96	0.9239										
0.4479	391.29	0.5231	0.9729	390.13	0.9678										
0.4841	390.97	0.5551													
0.5039	390.82	0.5682													
0.5194	390.71	0.5844													
0.5217	390.65	0.5866													
0.5495	390.48	0.6083													
0.5755	390.32	0.6299													
0.6087	390.15	0.6536													



Points, direct experimental T values.

AUXILIARY INFORMATION

Apparatus: The apparatus was a glass ebulliometer employing continuous circulation of the liquid and vapor phases with a charge capacity of approx. 50 cm³, ref. 3. Turbulent mixing of the phases enabled equilibrium to be reached in a relatively short time. The ebulliometer was connected to vacuum pump and the pressure controlled by a Vakumat electronic instrument (Normschliff Gerätebau Wertheim) and measured with a digital electronic system (MKS Inst., France).
Procedure: Operation described in ref. 3. The equilibrium temperatures were measured with an accuracy of ±0.01 K with a digital thermometer, Comark, Model 6900, calibrated against ITS-90. Compositions were determined by densimetric analysis, using an Anton Paar, Model DMA-55 vibrating-tube digital densimeter. Pressure was maintained constant to within 0.02 kPa.
Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 805.68; n(D, 298.15 K) = 1.3971.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 875.89; n(D, 298.15 K) = 1.3920.
Errors: |δT(estd.)|/K = 0.05; |δP(estd.)|/Pa = 20; |δx₁| = 0.002; |δy₁| = 0.01.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 3k*, 1994, 22(4).
2. Gonzales, E.; Ortega, J. *J. Chem. Eng. Data*, 1996, 41, 53.
3. Ortega, J.; Pena, J. A.; de Alfonso, C. *J. Chem. Eng. Data* 1986, 31, 339.

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249 Int. DATA Ser., Ser. A 1996, 24(4), 247-258

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Variables: T, temperature
y_i, mole fraction of component i in vapor phase
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Parameters: P, pressure
Method: Calculation from direct experimental liquid-vapor equilibrium temperature, T_{exp}, data at variable x_i and constant P; ref. 1

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Compiled by: Oracz, P. (Wydział Chemii, Uniwersytet Warszawski, ul. Pasteura 1, 02-093 Warszawa, Poland)

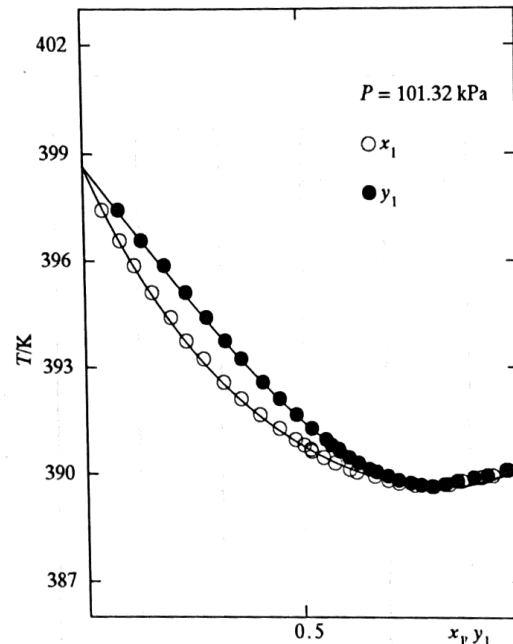
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Notes: The table reports smoothed values of T and calcd. values of y₁

P/kPa=101.32		
x ₁	T/K	y ₁
0.00	398.69	0.0000
0.05	397.36	0.0839
0.10	396.21	0.1585
0.15	395.19	0.2256
0.20	394.30	0.2864
0.25	393.52	0.3421
0.30	392.83	0.3936
0.40	391.70	0.4866
0.50	390.85	0.5701
0.60	390.24	0.6480
0.70	389.85	0.7243
0.75	389.73	0.7631
0.80	389.68	0.8034
0.85	389.68	0.8458
0.90	389.76	0.8917
0.95	389.94	0.9424
1.00	390.22	1.0000

Std. dev. σ(T)/K, rel. std. dev. 100σ(ΔP/P), and abs. max. dev. δ_m(T)/K at P/kPa = 101.32 are resp.: 0.052, 0.175, 0.115.



Points, direct experimental T values, curves, T(x₁) and T(y₁), calculated from the equations.

EQUATIONS

$$G^E/RT = -x_1 \ln(x_1 + c_2 x_2) - x_2 \ln(x_2 + c_1 x_1)$$

$$c_1 = \exp \left[-(a_1 + \frac{a_2}{T}) \right] \quad c_2 = \exp \left[-(a_3 + \frac{a_4}{T}) \right]$$

$$P = P_1 + P_2 = \sum_{i=1}^2 x_i P_i^0 \exp \left[\frac{\mu_i^E - (B_{ii} - V_i^0)(P - P_i^0) - 2PB_{12}^E(1 - y_i)^2}{RT} \right]$$

$$\mu_1^E = G^E - x_2(\partial G^E / \partial x_2)_{T,P} \quad \mu_2^E = G^E - x_1(\partial G^E / \partial x_1)_{T,P}$$

$$B_{12}^E = B_{12} - (B_{11} + B_{22})/2; \quad y_i = P_i/P; \quad P_i^0/kPa = \exp [A_i + B_i/(C_i + T/K)]$$

COEFFICIENTS IN THE EQUATIONS

P/kPa	a ₁	a ₂	a ₃	a ₄	a ₅
101.32	249.69 (10.9)	0 (0)	-60.523 (7.3)	0 (0)	

The std. deviations σ(a_i) of the coeffs. a_i are given in parentheses.

P/kPa	A ₁	B ₁	C ₁	A ₂	B ₂	C ₂
101.32	15.92700	-3620.84	-70.04	14.97940	-3676.54	-43.85

AUXILIARY INFORMATION

Measurements: The T_{exp} data at 101.32 kPa are reported in ref. 2.

Computations: The 29 T_{exp} data at 101.32 kPa were reduced using the modified Wilson eq., ref. 3, for the partial molar excess Gibbs energies μ_i^E.

Corrections: Vapor pressure equation parameters were taken from ref. 4, and parameters A_i were modified according to the experimental VLE data. Vapor-phase imperfection and the variation of the Gibbs energy of the pure liquid components with pressure were accounted for in terms of the 2nd molar virial coeffs. B_{ij} (ref. 5) and the molar volumes under saturation pressure V_i⁰ (ref. 6).

Errors: Std. dev. σ(T) = [Σ(T - T_{exp})²/(N-n)]^{1/2},
Rel. std. dev. 100σ(ΔP/P) = 100[Σ((P - P_{exp})/P_{exp})²/(N-n)]^{1/2},
N, no. of exp. points, ref. 2,
n, no. of coefficients in the smoothing equation.

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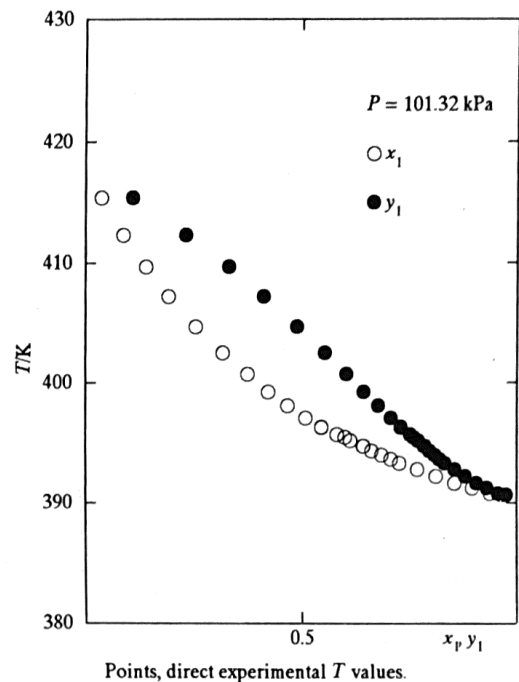
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DIRECT EXPERIMENTAL VALUES

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x ₁	T/K	y ₁	x ₁	T/K	y ₁												
0.0382	415.49	0.1110	0.6857	394.07	0.8090												
0.0885	412.38	0.2335	0.6861	394.06	0.8098												
0.1411	409.72	0.3341	0.7078	393.75	0.8202												
0.1938	407.31	0.4136	0.7270	393.40	0.8318												
0.2573	404.76	0.4904	0.7691	392.85	0.8556												
0.3201	402.58	0.5549	0.8120	392.31	0.8804												
0.3769	400.81	0.6044	0.8554	391.72	0.9055												
0.4241	399.34	0.6446	0.8973	391.30	0.9310												
0.4697	398.18	0.6785	0.9380	390.85	0.9570												
0.5107	397.18	0.7077	0.9643	390.78	0.9768												
0.5476	396.43	0.7306															
0.5479	396.38	0.7309															
0.5831	395.79	0.7524															
0.6008	395.54	0.7604															
0.6144	395.26	0.7711															
0.6434	394.84	0.7851															
0.6440	394.79	0.7854															
0.6627	394.44	0.7968															



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 2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 871.12; n(D, 298.15 K) = 1.3989.
Errors: |δT(estd.)|/K = 0.05; |δP(estd.)|/Pa = 20; |δx₁| = 0.002; |δy₁| = 0.01.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 3k*, 1994, 22(4).
2. Gonzales, E.; Ortega, J. *J. Chem. Eng. Data*, 1996, 41, 53.
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Parameters: P, pressure
Method: Calculation from direct experimental liquid-vapor equilibrium temperature, T_{exp} data at variable x_i and constant P; ref. 1

Author(s) Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain)

Compiled by: Oracz, P. (Wydział Chemii, Uniwersytet Warszawski, ul. Pasteura 1, 02-093 Warszawa, Poland)

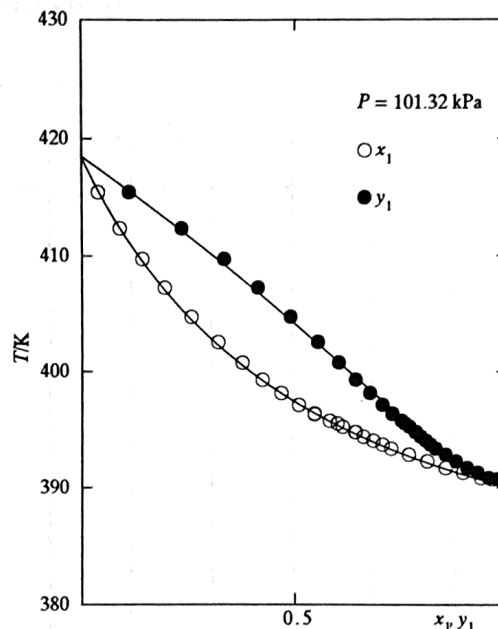
SOURCE OF DATA

Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain); FIRST PUBLISHED RESULTS

Notes: The table reports smoothed values of T and calcd. values of y₁

P/kPa=101.32							
x ₁	T/K	y ₁					
0.00	418.60	0.0000					
0.05	414.98	0.1365					
0.10	411.90	0.2467					
0.15	409.25	0.3378					
0.20	406.94	0.4145					
0.25	404.90	0.4803					
0.30	403.10	0.5373					
0.40	400.04	0.6322					
0.50	397.56	0.7087					
0.60	395.53	0.7732					
0.70	393.84	0.8302					
0.75	393.10	0.871					
0.80	392.42	0.8836					
0.85	391.79	0.9103					
0.90	391.22	0.9379					
0.95	390.70	0.9673					
1.00	390.22	1.0000					

Std. dev. $\sigma(T)/K$, rel. std. dev. $100\sigma(\delta P/P)$, and abs. max. dev. $\delta_m(T)/K$ at P/kPa = 101.32 are resp.: 0.107, 0.337, 0.218.



Points, direct experimental T values, curves, T(x₁) and T(y₁), calculated from the equations.

EQUATIONS

$$G^E/RT = -x_1 \ln(x_1 + c_2 x_2) - x_2 \ln(x_2 + c_1 x_1)$$

$$c_1 = \exp \left[-\left(a_1 + \frac{a_2}{T}\right)/T \right] \quad c_2 = \exp \left[-\left(a_3 + \frac{a_4}{T}\right)/T \right]$$

$$P = P_1 + P_2 = \sum_{i=1}^2 x_i P_i^0 \exp \left[\frac{\mu_i^E - (B_{ii} - V_i^0)(P - P_i^0) - 2PB_{12}^E(1-y)^2}{RT} \right]$$

$$\mu_1^E = G^E - x_2(\partial G^E / \partial x_2)_{T,P} \quad \mu_2^E = G^E - x_1(\partial G^E / \partial x_1)_{T,P}$$

$$B_{12}^E = B_{12} - (B_{11} + B_{22})/2; \quad y_i = P_i/P; \quad P_i^0/kPa = \exp [A_i + B_i/(C_i + T/K)]$$

COEFFICIENTS IN THE EQUATIONS

P/kPa	a ₁	a ₂	a ₃	a ₄	a ₅
101.32	328.47 (18.8)	0 (0)	-121.5 (10.9)	0 (0)	

The std. deviations $\sigma(a_i)$ of the coeffs. a_i are given in parentheses.

P/kPa	A ₁	B ₁	C ₁	A ₂	B ₂	C ₂
101.32	15.92700	-3620.84	-70.04	13.46639	-2837.50	-97.91

AUXILIARY INFORMATION

Measurements: The T_{exp} data at 101.32 kPa are reported in ref. 2.

Computations: The 28 T_{exp} data at 101.32 kPa were reduced using the modified Wilson eq., ref. 3, for the partial molar excess Gibbs energies μ_i^E .

Corrections: Vapor pressure equation parameters were taken from ref. 4, and parameters A_i were modified according to the experimental VLE data. Vapor-phase imperfection and the variation of the Gibbs energy of the pure liquid components with pressure were accounted for in terms of the 2nd molar virial coeffs. B_{ij} (ref. 5) and the molar volumes under saturation pressure V_i⁰ (ref. 6).

Errors: Std. dev. $\sigma(T) = [\sum(T - T_{exp})^2 / (N-n)]^{1/2}$,
 Rel. std. dev. $100\sigma(\delta P/P) = 100[\sum((P - P_{exp})/P_{exp})^2 / (N-n)]^{1/2}$,
 N, no. of exp. points, ref. 2,
 n, no. of coefficients in the smoothing equation.

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- Int. DATA Ser., Ser. A, Guideline 3m, 1995, 23(2).
- Gonzales, E.; Ortega, J. Int. DATA Ser., Sel. Data Mixtures, Ser. A 1996, 24, 251.
- Wilson, G. M. J. Am. Chem. Soc. 1964, 86, 127.
- TRC Thermodynamic Tables - Hydrocarbons & Non-Hydrocarbons, 1976, k-5000, 1969, k-5580, Thermodynamics Research Center, The Texas A&M University System, College Station, TX, USA.
- Tsonopoulos, C. AIChE J. 1974, 20, 263; 1975, 21, 827.
- Yen, L. C.; Woods, S. S. AIChE J. 1966, 12, 95.

Components: 1. 1-Butanol, C₄H₁₀O [71-36-3]
 2. Butyl butanoate, C₈H₁₆O₂ [109-21-7]
State: Binary system, single-phase liquid in equilibrium with vapor; pure components, both liquid in equilibrium with vapor
Variables: T, temperature
 x_i, mole fraction of component i in liquid phase
 y_i, mole fraction of component i in vapor phase
Parameters: P, pressure
Method: Direct measurement of T, x_i, and y_i at constant P; ref. 1

Author(s) of table: Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain)
Edited by: Mączynski, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

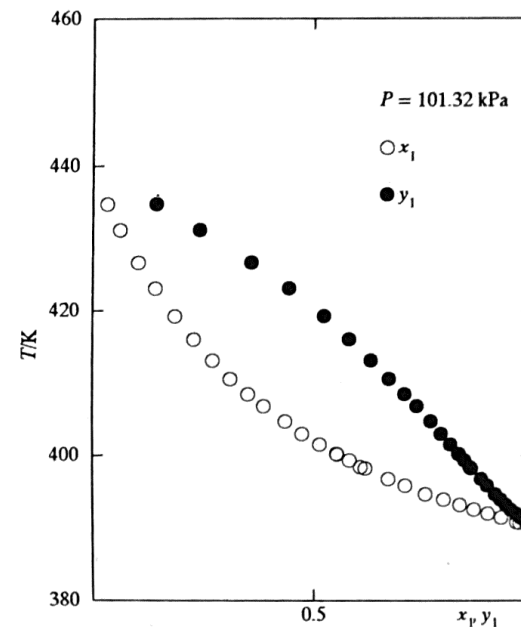
SOURCE OF DATA

Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

P/kPa = 101.32

x ₁	T/K	y ₁	x ₁	T/K	y ₁
0.0340	434.81	0.1453	0.6717	396.86	0.8849
0.0625	431.30	0.2436	0.7109	395.93	0.8990
0.1042	426.80	0.3604	0.7574	394.76	0.9175
0.1424	423.23	0.4455	0.7992	394.05	0.9297
0.1879	419.38	0.5259	0.8358	393.29	0.9423
0.2313	416.15	0.5826	0.8677	392.66	0.9528
0.2739	413.25	0.6318	0.8998	392.04	0.9639
0.3131	410.67	0.6743	0.9313	391.49	0.9749
0.3535	408.58	0.7087	0.9656	390.87	0.9870
0.3893	406.88	0.7367	0.9734	390.79	0.9896
0.4381	404.81	0.7686			
0.4767	403.08	0.7923			
0.5172	401.62	0.8135			
0.5554	400.29	0.8322			
0.5574	400.21	0.8332			
0.5840	399.36	0.8456			
0.6096	398.45	0.8586			
0.6204	398.29	0.8616			



Points, direct experimental T values.

AUXILIARY INFORMATION

Apparatus: The apparatus was a glass ebulliometer employing continuous circulation of the liquid and vapor phases with a charge capacity of approx. 50 cm³, ref. 3. Turbulent mixing of the phases enabled equilibrium to be reached in a relatively short time. The ebulliometer was connected to vacuum pump and the pressure controlled by a Vakuumat electronic instrument (Normschliff Gerätebau Wertheim) and measured with a digital electronic system (MKS Inst., France).
Procedure: Operation described in ref. 3. The equilibrium temperatures were measured with an accuracy of ±0.01 K with a digital thermometer, Comark, Model 6900, calibrated against ITS-90. Compositions were determined by densimetric analysis, using an Anton Paar, Model DMA-55 vibrating-tube digital densimeter. Pressure was maintained constant to within 0.02 kPa.
Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 805.68; n(D, 298.15 K) = 1.3971.
 2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 864.67; n(D, 298.15 K) = 1.4040.
Errors: |δT(estd.)|/K = 0.05; |δP(estd.)|/Pa = 20; |δx₁| = 0.002; |δy₁| = 0.02

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1. *Int. DATA Ser., Ser. A, Guideline 3k*, 1994, 22(4).
2. Gonzales, E.; Ortega, J. *J. Chem. Eng. Data*, 1996, 41, 53.
3. Ortega, J.; Pena, J. A.; de Alfonso, C. *J. Chem. Eng. Data* 1986, 31, 339.

Components: 1. 1-Butanol, C₄H₁₀O [71-36-3]
2. Butyl butanoate, C₈H₁₆O₂ [109-21-7]

State: Binary system, single-phase liquid in equilibrium with vapor; pure components, both liquid in equilibrium with vapor

Variables: T, temperature
y_i, mole fraction of component i in vapor phase
x_i, mole fraction of component i in liquid phase

Parameters: P, pressure

Method: Calculation from direct experimental liquid-vapor equilibrium temperature, T_{exp}, data at variable x_i and constant P; ref. 1

Author(s) Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain)

Compiled by: Oracz, P. (Wydział Chemii, Uniwersytet Warszawski, ul. Pasteura 1, 02-093 Warszawa, Poland)

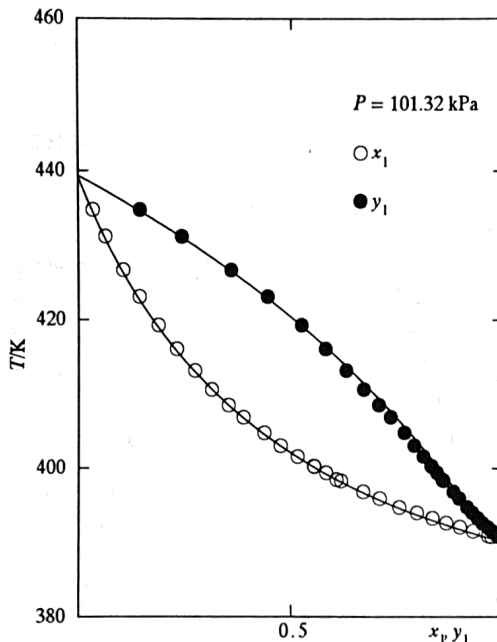
SOURCE OF DATA

Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain); FIRST PUBLISHED RESULTS

Notes: The table reports smoothed values of T and calcd. values of y₁

P/kPa=101.32		
x ₁	T/K	y ₁
0.00	439.48	0.0000
0.05	432.67	0.2050
0.10	427.06	0.3528
0.15	422.33	0.4636
0.20	418.27	0.5495
0.25	414.75	0.6178
0.30	411.66	0.6735
0.40	406.48	0.7585
0.50	402.31	0.8205
0.60	398.91	0.8677
0.70	396.13	0.9053
0.75	394.93	0.9216
0.80	393.85	0.9368
0.85	392.85	0.9514
0.90	391.93	0.9659
0.95	391.07	0.9815
1.00	390.22	1.0000

Std. dev. σ(T)/K, rel. std. dev. 100σ(ΔP/P), and abs. max. dev. δ_m(T)/K at P/kPa = 101.32 are resp.: 0.125, 0.395, 0.232.



Points, direct experimental T values, curves, T(x₁) and T(y₁), calculated from the equations.

EQUATIONS

$$G^E/RT = -x_1 \ln(x_1 + c_2 x_2) - x_2 \ln(x_2 + c_1 x_1)$$

$$c_1 = \exp \left[-(a_1 + \frac{a_2^2}{T})/T \right] \quad c_2 = \exp \left[-(a_3 + \frac{a_4}{T})/T \right]$$

$$P = P_1 + P_2 = \sum_{i=1}^2 x_i P_i^0 \exp \left[\frac{\mu_i^E - (B_{ii} - V_i^0)(P - P_i^0) - 2PB_{12}^E (1 - y_i)^2}{RT} \right]$$

$$\mu_1^E = G^E - x_2 (\partial G^E / \partial x_2)_{T,P} \quad \mu_2^E = G^E - x_1 (\partial G^E / \partial x_1)_{T,P}$$

$$B_{12}^E = B_{12} - (B_{11} + B_{22})/2; \quad y_i = P_i/P; \quad P_i^0/kPa = \exp [A_i + B_i/(C_i + T/K)]$$

COEFFICIENTS IN THE EQUATIONS

P/kPa	a ₁	a ₂	a ₃	a ₄	a ₅
101.32	556.95 (19.1)	0 (0)	-241.2 (6.7)	0 (0)	

The std. deviations σ(a_i) of the coeffs. a_i are given in parentheses.

P/kPa	A ₁	B ₁	C ₁	A ₂	B ₂	C ₂
101.32	15.92700	-3620.84	-70.04	20.01861	-8687.73	124.65

AUXILIARY INFORMATION

Measurements: The T_{exp} data at 101.32 kPa are reported in ref. 2.

Computations: The 28 T_{exp} data at 101.32 kPa were reduced using the modified Wilson eq., ref. 3, for the partial molar excess Gibbs energies μ_i^E.

Corrections: Vapor pressure equation parameters were taken from refs. 4, and parameters A_i were modified according to the experimental VLE data. Vapor-phase imperfection and the variation of the Gibbs energy of the pure liquid components with pressure were accounted for in terms of the 2nd molar virial coeffs. B_{ij} (ref. 5) and the molar volumes under saturation pressure V_i⁰ (ref. 6).

Errors: Std. dev. σ(T) = [Σ(T - T_{exp})²/(N-n)]^{1/2},
Rel. std. dev. 100σ(ΔP/P) = 100[Σ((P - P_{exp})/P_{exp})²/(N-n)]^{1/2},
N, no. of exp. points, ref. 2,
n, no. of coefficients in the smoothing equation.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 3m*, 1995, 23(2).
2. Gonzales, E.; Ortega, J. *Int. DATA Ser., Sel. Data Mixtures, Ser. A* 1996, 24, 253.
3. Wilson, G. M. *J. Am. Chem. Soc.* 1964, 86, 127.
4. *TRC Thermodynamic Tables - Hydrocarbons & Non-Hydrocarbons*, 1976, k-5000, 1978, k-5520, Thermodynamics Research Center, The Texas A&M University System, College Station, TX, USA.
5. Tsonopoulos, C. *AIChE J.* 1974, 20, 263; 1975, 21, 827.
6. Yen, L. C.; Woods, S. S. *AIChE J.* 1966, 12, 95.

Components: 1. 1-Butanol, C₄H₁₀O [71-36-3]
2. Butyl methanoate, C₅H₁₀O₂ [592-84-7]
State: Binary system, single-phase liquid; pure components, both liquid
Variables: V^E, molar excess volume
x_i, mole fraction of component i
Parameters: T, temperature
Constants: P, pressure
Method: Calculation of V^E from density measurements at constant T and P and variable x_i; ref. 1

Author(s) of table: Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain)
Edited by: Mącznyński, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

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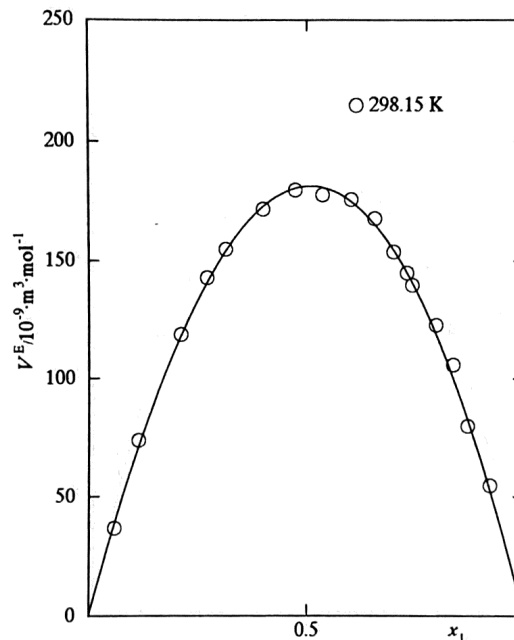
Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

Notes: P, atm.

T/K = 298.15

x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹						
0.0584	37						
0.1141	74						
0.2107	119						
0.2709	143						
0.3144	155						
0.3998	172						
0.4743	180						
0.5362	178						
0.6030	176						
0.6568	168						
0.7006	154						
0.7304	145						
0.7424	140						
0.7991	123						
0.8380	106						
0.8718	80						
0.9226	55						



Points, direct experimental V^E values, curve, V^E_{calc} calculated from the equation.

SMOOTHING EQUATION

$$V_{\text{calc}}^E = x_1 x_2 a_1 / [1 + \sum_{i=2}^n a_i (x_1 - x_2)^{i-1}]$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d, and max. deviation δ_m detd. by least-squares anal.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ ·m ³ ·mol ⁻¹						
298.15	727.49 (3.17)	-0.039 (0.011)				2.4	4.6

The std. deviations σ_a of the coeffs. a_i are given in parentheses
δ_m = max |V^E_{calc} - V^E|; σ_d = [Σ(V^E_{calc} - V^E)²/(N - n)]^{1/2}
N, no. of direct exptl. values; n, no. of coeffs. a_i
All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Vibrating tube densimeter type DMA 55 equipped with a cell model 602, (Anton-Paar, Graz, Austria). Temperature was controlled to within 0.01 K with a Heto Thermostat and was measured by means of a calibrated Pt thermometer.
Procedure: Density, ρ, was calcd. from period of vibration, τ: ρ = a + bτ². Consts. a and b were detd. by calibrating the app.(ref. 3) with doubly distd. and degassed H₂O, ρ(298.15 K)/kg·m⁻³ = 997.043 (ref. 4), and nonane (Fluka AG), "purum" grade material of stated purity > 99 mole %, ρ(298.15 K)/kg·m⁻³ = 713.855 (ref. 5). Mixtures were prepd. by mass. V^E was calcd. from V^E = V - (x₁V₁⁰ + x₂V₂⁰), where V = (x₁M₁ + x₂M₂)/ρ is the molar vol. of the mixt. and V_i⁰ = V(x_i = 1) and M_i are resp., the molar vol. and molar mass of component i.
Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 805.68; n(D, 298.15 K) = 1.3971.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification.
Errors: δT(reproducibility)/K = 0.01; δT(ITS-90)/K = 0.01; δx₁ = 0.0001; δV^E/10⁻⁹·m³·mol⁻¹ = 2.

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2. Gonzales, E.; Ortega, J. *J. Chem. Eng. Data, 1996, 41, 53.*
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4. Riddick, J. A.; Bunger, W. B.; Sakano, T. K. *Organic Solvents. Techniques of Chemistry, Vol. II. 4th ed., Wiley-Interscience, New York, 1986.*
5. *Anton Paar Information Bull. No. 6, March 1982.*

Components: 1. 1-Butanol, C₄H₁₀O [71-36-3]
 2. Butyl ethanoate, C₆H₁₂O₂ [123-86-4]
State: Binary system, single-phase liquid; pure components, both liquid
Variables: V^E, molar excess volume
 x_i, mole fraction of component i
Parameters: T, temperature
Constants: P, pressure
Method: Calculation of V^E from density measurements at constant T and P and variable x_i; ref. 1

Author(s) of table: Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain)
Edited by: Mącznyński, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

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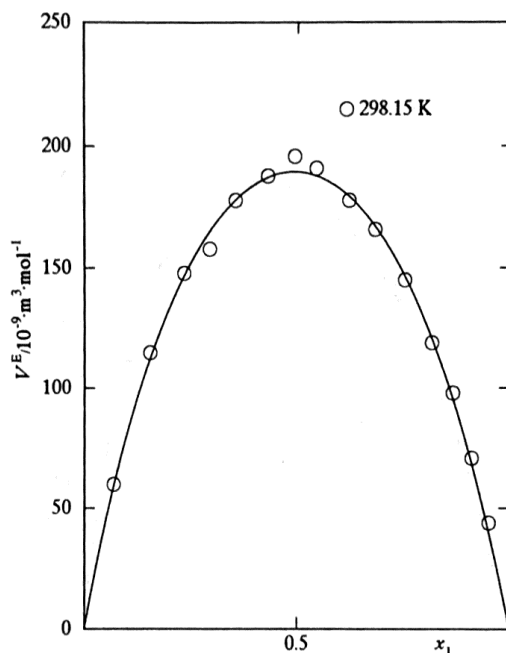
Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

Notes: P, atm.

T/K = 298.15

x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹					
0.0691	60					
0.1559	115					
0.2359	148					
0.2959	158					
0.3555	178					
0.4313	188					
0.4938	196					
0.5448	191					
0.6216	178					
0.6838	166					
0.7534	145					
0.8185	119					
0.8670	98					
0.9121	71					
0.9525	44					



Points, direct experimental V^E values, curve, V^E_{calc} calculated from the equation.

SMOOTHING EQUATION

$$V_{\text{calc}}^E = x_1 x_2 a_1 / [1 + \sum_{i=2}^n a_i (x_1 - x_2)^{i-1}]$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d, and max deviation δ_m detd. by least-squares anal.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ ·m ³ ·mol ⁻¹						
298.15	759.9 (6.1)	0.022 (0.015)	-0.205 (0.033)			3.4	7.5

The std. deviations σ_a of the coeffs. a_i are given in parentheses
 δ_m = max |V^E_{calc} - V^E_i|; σ_d = [Σ(V^E_{calc} - V^E_i)²/(N - n)]^{1/2}
 N, no. of direct exptl. values; n, no. of coeffs. a_i
 All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Vibrating tube densimeter type DMA 55 equipped with a cell model 602, (Anton-Paar, Graz, Austria). Temperature was controlled to within 0.01 K with a Heto Thermostat and was measured by means of a calibrated Pt thermometer.
Procedure: Density, ρ, was calcd. from period of vibration, τ: ρ = a + bτ². Consts. a and b were detd. by calibrating the app. (ref. 3) with doubly distd. and degassed H₂O, ρ(298.15 K)/kg·m⁻³ = 997.043 (ref. 4), and nonane (Fluka AG), "purum" grade material of stated purity > 99 mole %, ρ(298.15 K)/kg·m⁻³ = 713.855 (ref. 5). Mixtures were prepd. by mass. V^E was calcd. from V^E = V - (x₁V⁰₁ + x₂V⁰₂), where V = (x₁M₁ + x₂M₂)/ρ is the molar vol. of the mixt. and V⁰_i = V(x_i = 1) and M_i are resp., the molar vol. and molar mass of component i.
Materials: 1. Fluka AG (Buchs St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 805.68; n(D, 298.15 K) = 1.3971.
 2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification.
Errors: δT(reproducibility)/K = 0.01; δT(ITS-90)/K = 0.01; δx₁ = 0.0001; δV^E/10⁻⁹·m³·mol⁻¹ = 2.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 2c*, 1994, 22(1).
2. Gonzales, E.; Ortega, J. *J. Chem. Eng. Data*, 1996, 41, 53.
3. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jimenez, E. J. *J. Chem. Thermodyn.* 1985, 17, 1127.
4. Riddick, J. A.; Bunger, W. B.; Sakano, T. K. *Organic Solvents. Techniques of Chemistry*, Vol. II, 4th ed., Wiley-Interscience, New York, 1986.
5. *Anton Paar Information Bull.* No. 6, March 1982.

Components: 1. 1-Butanol, C₄H₁₀O [71-36-3]
 2. Butyl propanoate, C₇H₁₄O₂ [590-01-2]
State: Binary system, single-phase liquid; pure components, both liquid
Variables: V^E, molar excess volume
 x_i, mole fraction of component i
Parameters: T, temperature
Constants: P, pressure
Method: Calculation of V^E from density measurements at constant T and P and variable x_i; ref. 1

Author(s) of table: Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain)
Edited by: Mączyski, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

SOURCE OF DATA

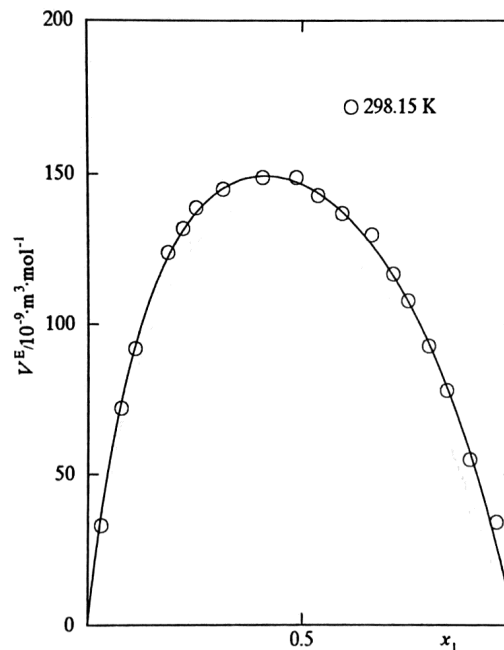
Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 -University of Las Palmas de G. C., Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

Notes: P, atm.

T/K = 298.15

x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹					
0.0314	33					
0.0767	72					
0.1091	92					
0.1864	124					
0.2223	132					
0.2527	139					
0.3149	145					
0.4076	149					
0.4866	149					
0.5373	143					
0.5937	137					
0.6626	130					
0.7143	117					
0.7496	108					
0.7982	93					
0.8418	78					
0.8951	55					
0.9576	34					



Points, direct experimental V^E values, curve, V^E_{calc} calculated from the equation.

SMOOTHING EQUATION

$$V_{calc}^E = x_1 x_2 a_1 / [1 + \sum_{i=2}^n a_i (x_1 - x_2)^{i-1}]$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d, and max. deviation δ_m detd. by least-squares anal.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ ·mol ⁻¹						
298.15	588.1 (4.6)	0.215 (0.013)	-0.350 (0.027)			2.6	7.6

The std. deviations σa_i of the coeffs. a_i are given in parentheses
 δ_m = max |V^E_{calc} - V^E_i|; σ_d = [Σ(V^E_{calc} - V^E_i)² / (N - n)]^{1/2}
 N, no. of direct exptl. values; n, no. of coeffs. a_i
 All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Vibrating tube densimeter type DMA 55 equipped with a cell model 602, (Anton-Paar, Graz, Austria). Temperature was controlled to within 0.01 K with a Heto Thermostat and was measured by means of a calibrated Pt thermometer.
Procedure: Density, ρ, was calcd. from period of vibration, τ: ρ = a + bτ². Consts. a and b were detd. by calibrating the app. (ref. 3) with doubly distd. and degassed H₂O, ρ(298.15 K)/kg·m⁻³ = 997.043 (ref. 4), and nonane (Fluka AG), "purum" grade material of stated purity > 99 mole %, ρ(298.15 K)/kg·m⁻³ = 713.855 (ref. 5). Mixtures were prepd. by mass. V^E was calcd. from V^E = V - (x₁V₁⁰ + x₂V₂⁰), where V = (x₁M₁ + x₂M₂)/ρ is the molar vol. of the mixt. and V_i⁰ = V(x_i = 1) and M_i are resp., the molar vol. and molar mass of component i.
Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; ρ(298.15 K)/kg·m⁻³ = 805.68; n_D(298.15 K) = 1.3971.
 2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification.
Errors: δT(reproducibility)/K = 0.01; δT(ITS-90)/K = 0.01; δx₁ = 0.0001; δV^E/10⁻⁹·m³·mol⁻¹ = 2.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 2c*, 1994, 22(1).
2. Gonzales, E.; Ortega, J. *J. Chem. Eng. Data*, 1996, 41, 53.
3. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jimenez, E. J. *J. Chem. Thermodyn.* 1985, 17, 1127.
4. Riddick, J. A.; Bunger, W. B.; Sakano, T. K. *Organic Solvents. Techniques of Chemistry*, Vol. II. 4th ed., Wiley-Interscience, New York, 1986.
5. *Anton Paar Information Bull.* No. 6, March 1982.

Components: 1. 1-Butanol, $C_4H_{10}O$ [71-36-3]
2. Butyl butanoate, $C_8H_{16}O_2$ [109-21-7]
State: Binary system, single-phase liquid; pure components, both liquid
Variables: V^E , molar excess volume
 x_i , mole fraction of component i
Parameters: T , temperature
Constants: P , pressure
Method: Calculation of V^E from density measurements at constant T and P and variable x_i ; ref. 1

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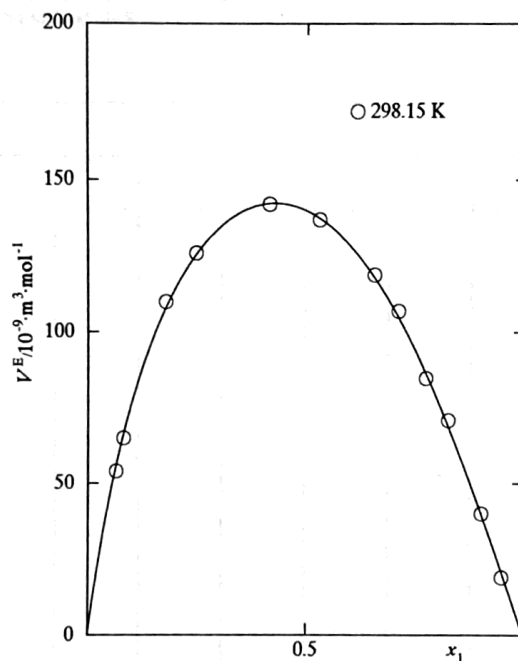
Gonzales, E.; Ortega, J. (Laboratorio de Termodinamica y Fisicoquimica, 35071 - University of Las Palmas de G. C., Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

Notes: P , atm.

T/K = 298.15

x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$						
0.0651	54						
0.0815	65						
0.1778	110						
0.2472	126						
0.4158	142						
0.5286	137						
0.6559	119						
0.7108	107						
0.7753	85						
0.8277	71						
0.9053	40						
0.9514	19						



Points, direct experimental V^E values, curve, V^E_{calc} calculated from the equation.

SMOOTHING EQUATION

$$V^E_{calc} = x_1 x_2 a_1 / [1 + \sum_{i=2}^n a_i (x_1 - x_2)^{i-1}]$$

Coeffs. a_i in the smoothing eq., std. deviation σ_d , and max. deviation δ_m detd. by least-squares anal.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$10^{-9} \cdot m^3 \cdot mol^{-1}$						
298.15	561.2 (4.1)	0.242 (0.024)	-0.109 (0.027)	0.146 (0.056)		1.7	2.1

The std. deviations σa_i of the coeffs. a_i are given in parentheses
 $\delta_m = \max |V^E_{calc} - V^E|$; $\sigma_d = [\sum (V^E_{calc} - V^E)^2 / (N - n)]^{1/2}$
 N , no. of direct exptl. values; n , no. of coeffs. a_i
All direct exptl. values equally weighted

AUXILIARY INFORMATION

Apparatus: Vibrating tube densimeter type DMA 55 equipped with a cell model 602, (Anton-Paar, Graz, Austria). Temperature was controlled to within 0.01 K with a Heto Thermostat and was measured by means of a calibrated Pt thermometer.

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Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification; $\rho(298.15 \text{ K})/\text{kg} \cdot \text{m}^{-3} = 805.68$; $n(D, 298.15 \text{ K}) = 1.3971$.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss." grade material of stated GLC purity > 99.5 mole %, degassed with ultrasound, dried over mol. sieve type 3A (Fluka AG), and used without further purification.

Errors: δT (reproducibility)/K = 0.01; δT (ITS-90)/K = 0.01; $\delta x_1 = 0.0001$; $\delta V^E/10^{-9} \cdot m^3 \cdot mol^{-1} = 2$.

REFERENCES

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