

Components: 1. 1-Chloropentane, $C_5H_{11}Cl$
2. Ethyl propanoate, $C_5H_{10}O_2$
State: Binary system, single-phase liquid; pure components, both liquid
Variables: V^E , molar excess volume
 x_2 , mole fraction of component 1
Parameters: T , temperature
Constants: P , pressure
Method: Calculation of V^E from density measurements at constant T and P and variable x_2 ; ref. 1

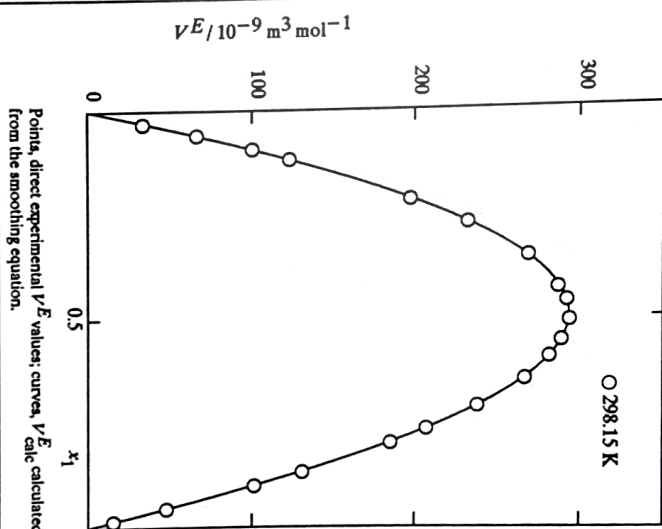
Author(s): Matos, J. S.; Ortega, J. (Universidad Politécnica de Las Palmas, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); García, M. V.
Edited by: Grollier, J.-P. E. (Laboratoire de Thermodynamique et Cinétique Chimique, U.A. CNRS 434, Université Blaise Pascal Clermont-Ferrand, 63170 Aubière, France)

Matos, J. S.; Ortega, J.; García, M. V. (Polytechnic University of Canarias, Canary Islands, Spain); ref. 2

SOURCE OF DATA

DIRECT EXPERIMENTAL VALUES

Notes: P , atm.				
$T/K = 298.15$				
x_1	$V^E/10^{-9}$ $m^3 \text{ mol}^{-1}$			
0.03008	33.2			
0.05908	65.8			
0.09287	100.2			
0.11740	123.1			
0.21420	197.5			
0.27102	232.6			
0.35280	269.5			
0.42998	287.6			
0.46160	292.9			
0.50938	294.4			
0.55839	289.5			
0.59548	282.2			
0.64796	267.6			
0.71319	238.6			
0.76768	207.5			
0.80026	185.6			
0.86984	131.0			
0.90222	101.2			
0.95606	47.4			
0.98512	15.1			



SMOOTHING EQUATION

$$V^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

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

T/K	a_1	a_2	a_3	a_4	a_5	σ_a	δ_m
	$10^{-9} m^3 \text{ mol}^{-1}$						
298.15	1176.1 (1.2)	-7.1 (4.9)	-18.0 (5.3)	-23 (11)	0.7	1.5	

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

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 2c*, 1979.
2. Matos, J. S.; Ortega, J.; García, M. V. *J. Chem. Eng. Data* 1988, 33, 260.
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5. *Anton Paar Information Bull. No. 6*, March 1982.

AUXILIARY INFORMATION

Apparatus: Vibrating tube densimeter type DMA 60 equipped with a cell model 602 (Anton Paar, Graz, Austria). Temp. was controlled to within 0.01 K with a Heio thermostat and was measured by means of a calibrated Pt resistance thermometer.

Procedure: Density, ρ , was calcd. from period of vibration, τ ; $\rho = a + b\tau^2$. Coeffs. a and b were detd. by calibrating the app. (ref. 3) with doubly dist. and degassed H_2O , $\rho(298.15 \text{ K})/kg \text{ m}^{-3} = 997.043$ (ref. 4) and nonane (Fluka AG, Buchs, Switzerland, purum, Lot No. 74252, of stated purity > 99 mole %), $\rho(298.15 \text{ K})/kg \text{ m}^{-3} = 713.855$ (ref. 5). Mixts. were prepd. by weighing V^E was calcd. from $V^E = V - (x_1 V_1 + x_2 V_2)$, where $V = (x_1 M_1 + x_2 M_2)/\rho$ is the molar vol. of the mixt. and $V_i = V(x_i = 1)$ and M_i are, resp., the molar vol. and the molar mass of component i .

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland) "puriss" grade material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/kg \text{ m}^{-3} = 876.92$; $n(D, 298.15 \text{ K}) = 1.4099$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) "puriss" grade material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/kg \text{ m}^{-3} = 883.98$; $n(D, 298.15 \text{ K}) = 1.3817$.
 $M_1/10^{-3} kg \text{ mol}^{-1} = 106.59504$.
 $M_2/10^{-3} kg \text{ mol}^{-1} = 102.1332$.
Errors: δT (reproducibility)/K < 0.01; δT (PTS-68)/K = 0.01; δx_1 < 0.0001; $\delta V^E/10^{-9} m^3 \text{ mol}^{-1}$ < 3.

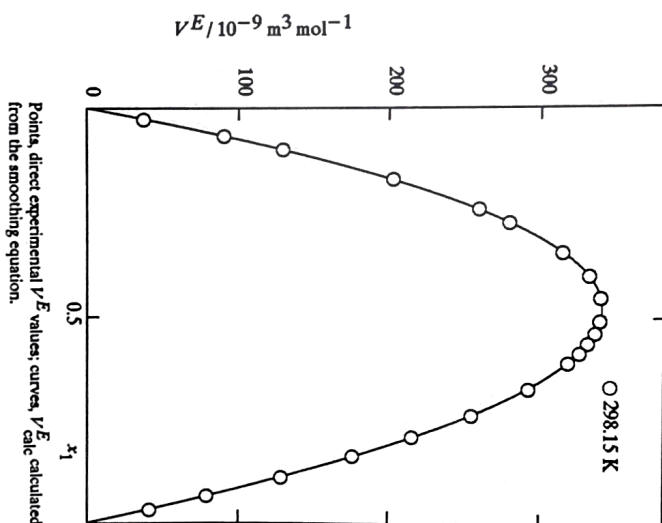
Components: 1. 1-Chlorohexane, $C_6H_{13}Cl$
2. Ethyl propanoate, $C_5H_{10}O_2$
State: Binary system, single-phase liquid; pure components, both liquid
Variables: V^E , molar excess volume
 x_1 , mole fraction of component 1
Parameters: T , temperature
Constants: P , pressure
Method: Calculation of V^E from density measurements at constant T and P and variable x_1 ; ref. 1

Author(s): Matos, J. S.; Ortega, J. (Universidad Politécnica de Las Palmas, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Garcia, M. V.
Edited by: Grolier, J.-P. E. (Laboratoire de Thermodynamique et Cinétique Chimique, U.A. CNRS 434, Université Blaise Pascal Clermont-Ferrand, 63170 Aubière, France)

SOURCE OF DATA
Matos, J. S.; Ortega, J.; Garcia, M. V. (Polytechnic University of Canarias, Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

$T/K = 298.15$			
x_1	$V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1}$	x_1	$V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1}$
0.02727	36.7	0.96782	40.6
0.06804	90.1		
0.10071	129.0		
0.17180	202.7		
0.24305	259.7		
0.27499	279.6		
0.34569	314.5		
0.40104	331.9		
0.45296	339.1		
0.50810	338.8		
0.53710	335.7		
0.56242	331.0		
0.58538	325.6		
0.60765	318.4		
0.67109	292.5		
0.73609	255.1		
0.79041	215.8		
0.83768	176.3		
0.89017	128.3		
0.93534	78.6		



SMOOTHING EQUATION

$$V^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

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
	$10^{-9} \text{ m}^3 \text{ mol}^{-1}$						
298.15	1358.61 (0.81)	-112.0 (3.5)	5.6 (3.9)	55.1 (8.5)		0.55	1.1

The std. deviations σ_d of the coeffs. a_i are given in parentheses
 $\delta_m = \max |V^E_{\text{calc}} - V^E|$; $\sigma_d = [\sum (V^E_{\text{calc}} - V^E)^2 / (N - n)]^{1/2}$
 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 60 equipped with a cell model 602 (Anton Paar, Graz, Austria). Temp. was controlled to within 0.01 K with a Heio thermostat and was measured by means of a calibrated Pt resistance thermometer.

Procedure: Density, ρ , was calcd. from period of vibration, τ : $\rho = a + b\tau^2$. Coeffs. a and b were detd. by calibrating the app. (ref. 3) with doubly distd. and degassed H_2O , $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 997.043$ (ref. 4) and nonane (Fluka AG, Buchs, Switzerland, purum, Lot No. 74252, of stated purity > 99 mole %), $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 713.855$ (ref. 5). Mixts. were prepd. by weighing. V^E was calcd. from $V^E = V - (x_1 V_1 + x_2 V_2)$, where $V = (x_1 M_1 + x_2 M_2)/\rho$ is the molar vol. of the mixt. and $V_i = V(x_i = 1)$ and M_i are, resp., the molar vol. and the molar mass of component i .

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland) "puriss" grade material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 873.33$; $n(D, 298.15 \text{ K}) = 1.4174$; $M_1/10^{-3} \text{ kg mol}^{-1} = 120.62192$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) "puriss" grade material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 883.98$; $n(D, 298.15 \text{ K}) = 1.3817$; $M_2/10^{-3} \text{ kg mol}^{-1} = 102.1332$.
 δT (reproducibility)/K < 0.01; δT (PTS-68)/K = 0.01; $\Delta x_1 < 0.0001$; $\delta V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1} < 3$.

- REFERENCES**
1. *Int. DATA Ser., Ser. A, Guideline 2c*, 1979.
 2. Matos, J. S.; Ortega, J.; Garcia, M. V. *J. Chem. Eng. Data* 1988, 33, 260.
 3. Ortega, J.; Matos, J. S.; Paz Andrade, M. I.; Jimenez, E. J. *J. Chem. Thermodyn.* 1988, 17, 1127.
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Components: 1. 1-Chloroheptane, C ₇ H ₁₅ Cl 2. Ethyl propanoate, C ₅ H ₁₀ O ₂		Author(s): Matos, J. S.; Ortega, J. (Universidad Politécnica de Las Palmas, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); García, M. V.	
State: Binary system, single-phase liquid; pure components, both liquid		Edited by: Grollier, J.-P. E. (Laboratoire de Thermodynamique et Cinétique Chimique, UA CNRS 434, Université Blaise Pascal Clermont-Ferrand, 63170 Aubière, France)	
Variables: V^E , molar excess volume x_2 , mole fraction of component i		SOURCE OF DATA SMOOTHING EQUATION $V^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$ Coeffs. a_i in the smoothing eq., std. deviation σ_d and max deviation δ_m detd. by least-squares anal.	
Parameters: T , temperature			
Constants: P , pressure			
Method: Calculation of V^E from density measurements at constant T and P and variable x_2 ; ref. 1			

DIRECT EXPERIMENTAL VALUES					
T/K	$T/K = 298.15$				
x_1	$V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1}$				
0.05234	85.6				
0.06087	98.0				
0.14415	208.0				
0.21930	282.7				
0.27204	321.6				
0.32120	348.1				
0.37962	369.1				
0.43800	379.9				
0.45509	380.8				
0.50473	378.9				
0.55533	367.2				
0.60290	351.7				
0.67137	317.8				
0.71412	291.1				
0.78192	239.6				
0.84111	187.2				
0.88910	138.4				
0.96280	53.5				

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

AUXILIARY INFORMATION							
Apparatus: Vibrating tube densimeter type DMA 60 equipped with a cell model 602 (Anton Paar, Graz, Austria). Temp. was controlled to within 0.01 K with a Heio thermostat and was measured by means of a calibrated Pt resistance thermometer.							
Procedure: Density, ρ , was calcd. from period of vibration, τ : $\rho = a + b\tau^2$. Constants, a and b were detd. by calibrating the app. (ref. 3) with doubly distd. and degassed H ₂ O, $\rho/(298.15 \text{ K})/\text{kg m}^{-3} = 997.043$ (ref. 4) and nonane (Fluka AG, Buchs, Switzerland, purum, Lot No. 74252, of stated purity > 99 mole %), $\rho/(298.15 \text{ K})/\text{kg m}^{-3} = 713.855$ (ref. 5). Mixts. were prepd. by weighing. V^E was calcd. from $V^E = V - (x_1 V_1 + x_2 V_2)$, where $V = (x_1 M_1 + x_2 M_2)/\rho$ is the molar vol. of the mixt. and $V_i = V(x_i = 1)$ and M_i are, resp., the molar vol. and the molar mass of component i.							
Materials: 1. ALFA Products (Danvers, MA, USA) material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 870.56$; $n(D, 298.15 \text{ K}) = 1.4232$; $M_1/10^{-3} \text{ kg mol}^{-1} = 134.6488$.							
2. Fluka AG (Buchs, St. Gallen, Switzerland) "puriss" grade material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 883.98$; $n(D, 298.15 \text{ K}) = 1.3817$; $M_2/10^{-3} \text{ kg mol}^{-1} = 102.1332$.							
Errors: $\delta T(\text{reproducibility})/K < 0.01$; $\delta T(\text{PTS-68})/K = 0.01$; $\delta x_1 < 0.0001$; $\delta V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1} < 3$.							

REFERENCES							
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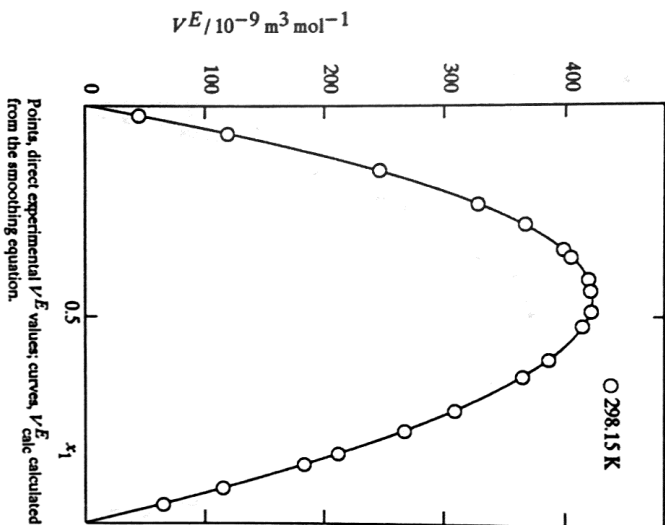
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SOURCE OF DATA
Matos, J. S.; Ortega, J.; Garcia, M. V. (Polytechnic University of Canarias, Canary Islands, Spain); ref. 2

DIRECT EXPERIMENTAL VALUES

Notes: P , atm.					
$T/K = 298.15$					
x_1	$V^E/10^{-9}$ $m^3 \text{ mol}^{-1}$				
0.02308	44.1				
0.06664	118.9				
0.15378	246.0				
0.23272	328.0				
0.28129	366.7				
0.34091	397.9				
0.35849	404.0				
0.41182	418.5				
0.43949	420.4				
0.48859	420.8				
0.52391	413.7				
0.60589	386.2				
0.64659	364.8				
0.72768	308.4				
0.77696	266.7				
0.83287	211.5				
0.85942	183.0				
0.91633	114.8				
0.95616	64.4				



Points, direct experimental V^E values; curve, V^E calculated from the smoothing equation.

AUXILIARY INFORMATION

Apparatus: Vibrating tube densimeter type DMA 60 equipped with a cell model 602 (Anton Paar, Graz, Austria). Temp. was controlled to within 0.01 K with a Heio thermostat and was measured by means of a calibrated Pt resistance thermometer.

Procedure: Density, ρ , was calcd. from period of vibration, τ : $\rho = a + b\tau^2$. Consts. a and b were detd. by calibrating the app. (ref. 3) with doubly distd. and degassed H_2O , $\rho/(298.15 \text{ K})/\text{kg m}^{-3} = 997.043$ (ref. 4) and nonane (Fluka AG, Buchs, Switzerland, 'purum', Lot No. 74252, of stated purity > 99 mole %), $\rho/(298.15 \text{ K})/\text{kg m}^{-3} = 713.855$ (ref. 5). Mixts. were prepd. by weighing. V^E was calcd. from $V^E = V - (x_1 V_1 + x_2 V_2)$ where $V = (x_1 M_1 + x_2 M_2)/\rho$ is the molar vol. of the mixt. and V_i are $V_i = V_i^0$ and M_i are, resp., the molar vol. and the molar mass of component i.

Materials:
1. Fluka AG (Buchs, St. Gallen, Switzerland) 'purum' grade material, of stated purity > 98 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 868.65$; $n(D, 298.15 \text{ K}) = 1.4280$; $M_1/10^{-3} \text{ kg mol}^{-1} = 148.67568$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'puriss' grade material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 883.98$; $n(D, 298.15 \text{ K}) = 1.3817$; $M_2/10^{-3} \text{ kg mol}^{-1} = 102.1332$.
Errors: $\delta T(\text{reproducibility})/K < 0.01$; $\delta T(\text{PTS-68})/K = 0.01$; $\delta x_1 < 0.0001$; $\delta V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1} < 3$.

SMOOTHING EQUATION

$$V^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

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

T/K	a_1	a_2	a_3	a_4	a_5	σ_a	δ_m
	$10^{-9} \text{ m}^3 \text{ mol}^{-1}$						
298.15	1674 (13)	-295 (50)	56.7 (6.1)	64 (13)		0.8	15

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

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Components: 1. 1-Chloropentane, $C_5H_{11}Cl$
2. Ethyl butanoate, $C_6H_{12}O_2$
State: Binary system, single-phase liquid; pure components, both liquid
Variables: V^E , molar excess volume
 x_1 , mole fraction of component 1
Parameters: T , temperature
Constants: P , pressure
Method: Calculation of V^E from density measurements at constant T and P and variable x_1 ; ref. 1

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Edited by: Grolier, J.-P. E. (Laboratoire de Thermodynamique et Cinétique Chimique, UA CNRS 434, Université Blaise Pascal Clermont-Ferrand, 63170 Aubière, France)
Matos, J. S.; Ortega, J.; García, M. V. (Polytechnic University of Canarias, Canary Islands, Spain); ref. 2

SOURCE OF DATA

SMOOTHING EQUATION

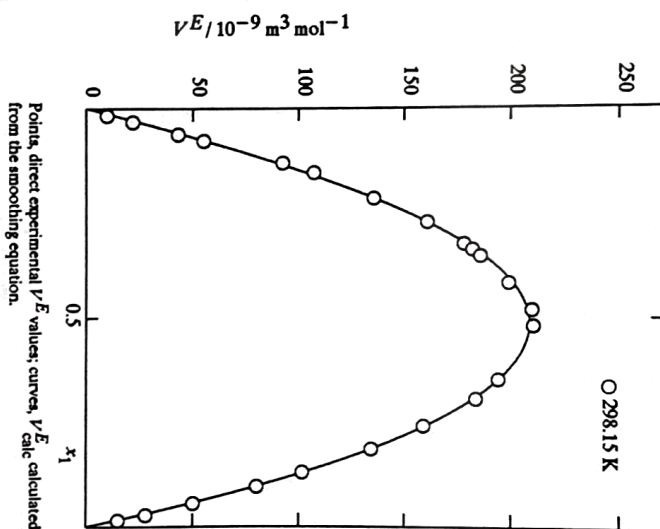
$$V^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

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

T/K	a_1	a_2	a_3	a_4	a_5	σ_a	δ_m
	$10^{-9} \text{ m}^3 \text{ mol}^{-1}$						
298.15	834.7 (3.4)	51 (12)	36 (14)	64 (28)		1.9	3.6

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

Notes: P , atm.			
$T/K = 298.15$			
x_1	$V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1}$	x_1	$V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1}$
0.01688	9.6	0.94566	49.9
0.032259	21.6	0.97309	27.8
0.06225	43.0	0.98593	14.9
0.07755	54.8		
0.13006	92.2		
0.15371	107.1		
0.21444	135.6		
0.27227	161.0		
0.32331	178.2		
0.33822	182.2		
0.35250	185.9		
0.41718	199.3		
0.48173	210.0		
0.52127	210.8		
0.65001	194.4		
0.69542	183.7		
0.75999	159.0		
0.81630	134.4		
0.87170	101.5		
0.90546	79.9		



AUXILIARY INFORMATION

Apparatus: Vibrating tube densimeter type DMA 60 equipped with a cell model 602 (Anton Paar, Graz, Austria). Temp. was controlled to within 0.01 K with a Heio thermostat and was measured by means of a calibrated Pt resistance thermometer.

Procedure: Density, ρ , was calcd. from period of vibration, τ ; $\rho = a + b\tau^2$. Coeffs. a and b were decid. by calibrating the app. (ref. 3) with doubly dist. and degassed H_2O , $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 997.043$ (ref. 4) and nonane (Fluka AG, Buchs, Switzerland, 'purum', Lot No. 74252, of stated purity > 99 mole %), $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 713.855$ (ref. 5). Mixts. were prep. by weighing. V^E was calcd. from $V^E = V - (x_1 V_1 + x_2 V_2)$, where $V = (x_1 M_1 + x_2 M_2)/\rho$ is the molar vol. of the mixt. and $V_i = V_i^0$ and M_i are, resp., the molar vol. and the molar mass of component i .
Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland) 'puriss' grade material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 876.92$; $n(D, 298.15 \text{ K}) = 1.4099$, $M_1/10^{-3} \text{ kg mol}^{-1} = 106.59504$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'purum' grade material, of stated purity > 98 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 872.73$; $n(D, 298.15 \text{ K}) = 1.3896$, $M_2/10^{-3} \text{ kg mol}^{-1} = 116.16008$.

$$\delta T(\text{reproducibility})/K < 0.01; \delta T(17^\circ\text{S}-68^\circ\text{S})/K = 0.01; \Delta x_1 < 0.0001; \delta V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1} < 3.$$

Errors:

REFERENCES

1. Int. DATA Ser., Ser. A, *Guideline 2c*, 1979.
2. Matos, J. S.; Ortega, J.; García, M. V. *J. Chem. Eng. Data* 1988, 33, 260.
3. Ortega, J.; Matos, J. S.; Paz Andrade, M. I.; Jimenez, E. *J. Chem. Thermodyn.* 1985, 17, 1127.
4. Riddick, J. A.; Bunger, W. B. *Organic Solvents*, II, in *Techniques of Chemistry*, Weissberger, A., Editor, Wiley-Interscience, New York, 1970.
5. *Anton Paar Information Bull.* No. 6, March 1982.

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2c. EXCESS VOLUME

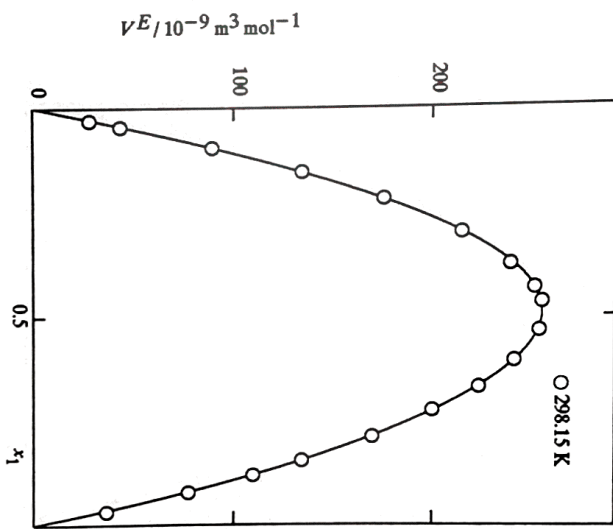
The Texas A&M University System, College Station, TX 77843-3111

Components:	1. 1-Chlorohexane, $C_6H_{13}Cl$ 2. Ethyl butanoate, $C_6H_{12}O_2$ Binary system, single-phase liquid; pure components, both liquid
State:	V^E , molar excess volume x_1 , mole fraction of component 1
Variables:	T , temperature P , pressure
Parameters:	Calculation of V^E from density measurements at constant T and P and variable x_1 ; ref. 1
Method:	

Author(s):	Matos, J. S.; Ortega, J. (Universidad Politécnica de Las Palmas, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Físicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); García, M. V.
Edited by:	Grollier, J.-P. E. (Laboratoire de Thermodynamique et Cinétique Chimique, UA CNRS 434, Université Blaise Pascal Clermont-Ferrand, 63170 Aubière, France)

Notes: P , atm.	
DIRECT EXPERIMENTAL VALUES	
$T/K = 298.15$	
x_1	$V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1}$
0.02978	27.8
0.04470	42.9
0.09502	88.9
0.15456	133.9
0.21897	175.1
0.30126	214.2
0.37782	238.7
0.43519	250.4
0.46851	254.3
0.53644	252.9
0.60757	240.6
0.67033	223.0
0.72574	199.9
0.78788	169.7
0.84589	134.1
0.88038	109.5
0.92201	76.8
0.96777	36.0

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



○ 298.15 K

The std. deviations σ_d of the coeffs. a_i are given in parentheses $\delta_m = \max V^E_{\text{calc}} - V^E $; $\sigma_d = [\sum (V^E_{\text{calc}} - V^E)^2 / (N - n)]^{1/2}$ N , no. of direct exptl. values; n , no. of coeffs. a_i All direct exptl. values equally weighted							
T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
298.15	1016.4 (21)	-30.1 (7.2)	-33 (22)	79 (17)	105 (35)	1.0	2.0

Apparatus: Vibrating tube densimeter type DMA 60 equipped with a cell model 602 (Anton Paar, Graz, Austria). Temp. was controlled to within 0.01 K with a Heio thermostat and was measured by means of a calibrated Pt resistance thermometer.

Procedure: Density, ρ , was calcd. from period of vibration, τ : $\rho = a + b\tau^2$. Coeffs. a and b were deid. by calibrating the app. (ref. 3) with doubly dist. and degassed H_2O , $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 997.043$ (ref. 4) and nonane (Fluka AG, Buchs, Switzerland; 'purum', Lot No. 74252, of stated purity > 99 mole %), $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 713.855$ (ref. 5). Mixts. were prep'd. by weighing. V^E was calcd. from $V^E = V - (x_1 V^*_1 + x_2 V^*_2)$, where $V = (x_1 M_1 + x_2 M_2)/\rho$ is the molar vol. of the mixt. and $V^*_i = V_i$ are, resp., the molar vol. and the molar mass of component i .

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland) 'puriss' grade material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/\text{kg m}^{-3} = 873.33$; $n(D, 298.15 \text{ K}) = 1.4174$; $M_1/10^{-3} \text{ kg mol}^{-1} = 120.62192$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'purum' grade material, of stated purity > 98 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/\text{kg m}^{-3} = 872.73$; $n(D, 298.15 \text{ K}) = 1.3896$; $M_2/10^{-3} \text{ kg mol}^{-1} = 116.16008$.
 δT (reproducibility)/K < 0.01; δT (PTS-68)/K = 0.01; $\delta x_1 < 0.0001$; $\delta V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1} < 3$.

Errors:

SOURCE OF DATA

SMOOTHING EQUATION

$$V^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

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

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 2c*, 1979.
2. Matos, J. S.; Ortega, J.; García, M. V. *J. Chem. Eng. Data* 1988, 33, 260.
3. Ortega, J.; Matos, J. S.; Paz Andrade, M. I.; Jimenez, E. J. *J. Chem. Thermodyn.* 1985, 17, 1127.
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5. *Anton Paar Information Bull.* No. 6, March 1982.

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Components: 1. 1-Chloroheptane, $C_7H_{15}Cl$
2. Ethyl butanoate, $C_6H_{12}O_2$

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): Matos, J. S.; Ortega, J. (Universidad Politécnica de Las Palmas, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Garcia, M. V.

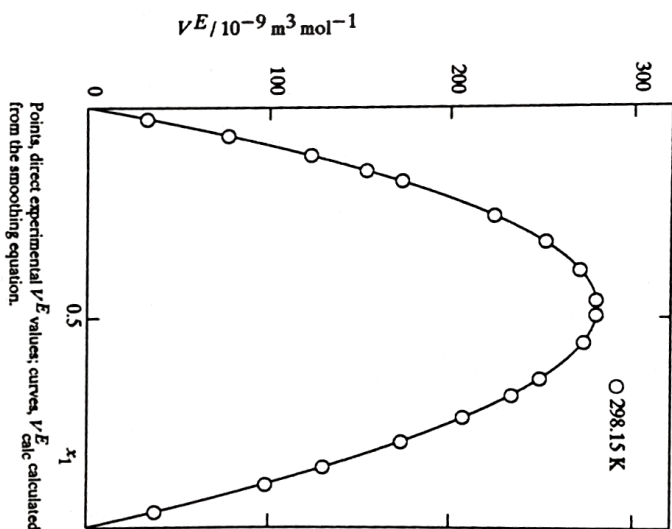
Edited by: Grolier, J.-P. E. (Laboratoire de Thermodynamique et Cinétique Chimique, UA CNRS 434, Université Blaise Pascal Clermont-Ferrand, 63170 Aubière, France)

Matos, J. S.; Ortega, J.; Garcia, M. V. (Polytechnic University of Canarias, Canary Islands, Spain); ref. 2

SOURCE OF DATA

DIRECT EXPERIMENTAL VALUES

Notes: P , atm.				
$T/K = 298.15$				
x_1	$V^E/10^{-9}$ $m^3 \text{ mol}^{-1}$			
0.02724	32.0			
0.06699	76.8			
0.11526	122.5			
0.15157	153.4			
0.17618	173.2			
0.25963	224.2			
0.32078	252.3			
0.38862	271.0			
0.45998	279.6			
0.49575	279.9			
0.56052	273.1			
0.64737	249.3			
0.68741	233.8			
0.73945	207.4			
0.79701	173.2			
0.85709	129.9			
0.89850	98.2			
0.96432	37.2			



SMOOTHING EQUATION

$$V^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

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

T/K	a_1	a_2	a_3	a_4	a_5	σ_a	δ_m
	$10^{-9} m^3 \text{ mol}^{-1}$						
298.15	1119.3 (1.2)	-98.0 (4.0)	8 (12)	14.9 (9.6)	35 (21)	0.6	0.9

The std. deviations σ_{a_i} of the coeffs. a_i are given in parentheses
 $\delta_m = \max |V^E_{\text{calc}} - V^E|$; $\sigma_a = [\sum (V^E_{\text{calc}} - V^E)^2 / (N - n)]^{1/2}$
 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 60 equipped with a cell model 602 (Anton Paar, Graz, Austria). Temp. was controlled to within 0.01 K with a Heio thermostat and was measured by means of a calibrated Pt resistance thermometer.

Procedure: Density, ρ , was calcd. from period of vibration, τ , $\rho = a + b\tau^2$. Coeffs. a and b were detd. by calibrating the app. (ref. 3) with doubly dist. and degassed H_2O , $\rho(298.15 \text{ K})/kg \text{ m}^{-3} = 997.043$ (ref. 4) and nonane (Fluka AG, Buchs, Switzerland, purum; Lot No. 74252, of stated purity > 99 mole %), $\rho(298.15 \text{ K})/kg \text{ m}^{-3} = 713.855$ (ref. 5). Mixts. were prepd. by weighing. V^E was calcd. from $V^E = V - (x_1 V^*_1 + x_2 V^*_2)$, where $V = (x_1 M_1 + x_2 M_2)/\rho$ is the molar vol. of the mixt. and $V^*_i = 1$ and M_i are, resp., the molar vol. and the molar mass of component i .

Materials: 1. ALFA Products (Danvers, MA, USA) material, of stated purity > 99 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) (from Fluka) and used without further purification; $\rho_1(298.15 \text{ K})/kg \text{ m}^{-3} = 870.56$; $n(D, 298.15 \text{ K}) = 1.4232$, $M_1/10^{-3} kg \text{ mol}^{-1} = 134.6488$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) "purum" grade material, of stated purity > 98 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho_2(298.15 \text{ K})/kg \text{ m}^{-3} = 872.73$; $n(D, 298.15 \text{ K}) = 1.3896$, $M_2/10^{-3} kg \text{ mol}^{-1} = 116.16008$.
 δT (reproducibility)/K < 0.01; δT (PTS-68)/K = 0.01; δx_1 < 0.0001; $\delta(V^E/10^{-9} m^3 \text{ mol}^{-1})$ < 3.

Errors:

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 2c*, 1979.
2. Matos, J. S.; Ortega, J.; Garcia, M. V. *J. Chem. Eng. Data* 1988, 33, 260.
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5. *Anton Paar Information Bull. No. 6*, March 1982.

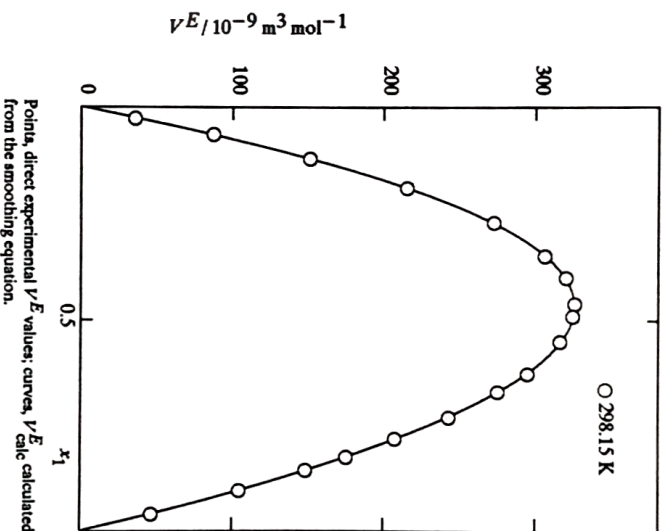
Component: 1. 1-Chlorooctane, $C_8H_{17}Cl$
2. Ethyl butanoate, $C_6H_{12}O_2$
State: Binary system, single-phase liquid; pure components, both liquid
Variables: V^E , molar excess volume
 x_i , mole fraction of component i
Parameters: T , temperature
Constants: P , pressure
Method: Calculation of V^E from density measurements at constant T and P and variable x_i ; ref. 1

Author(s): Matos, J. S.; Ortega, J. (Universidad Politécnica de Las Palmas, Escuela Superior de Ingenieros Industriales, Cátedra de Termodinámica y Fisicoquímica, Las Palmas de Gran Canaria, Islas Canarias, Spain); Garcia, M. V.
Edited by: Grolier, J.-P. E. (Laboratoire de Thermodynamique et Cinétique Chimique, U.A. CNRS 434, Université Blaise Pascal Clermont-Ferrand, 63170 Aubière, France)

SOURCE OF DATA
Matos, J. S.; Ortega, J.; Garcia, M. V. (Polytechnic University of Canarias, Canary Islands, Spain); ref. 2

Notes: P , atm.
DIRECT EXPERIMENTAL VALUES

T/K	$V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1}$								
298.15									
x_1									
0.02590	35.1								
0.06381	86.8								
0.12074	151.0								
0.19011	215.3								
0.27192	272.8								
0.35010	306.1								
0.40143	319.9								
0.46163	325.7								
0.49110	324.3								
0.55111	316.3								
0.62816	294.9								
0.67165	275.1								
0.73382	242.9								
0.78390	207.2								
0.82646	175.1								
0.85766	148.3								
0.90580	104.4								
0.96086	46.4								



SMOOTHING EQUATION

$$V^E_{\text{calc}} = x_1 x_2 \sum_{i=1}^n a_i (x_1 - x_2)^{i-1}$$

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

T/K	a_1	a_2	a_3	a_4	a_5	σ_a	δ_m
298.15	1297.0 (1.4)	-159.6 (5.5)	41.6 (6.2)	44 (14)		0.8	15

The std. deviations σ_{a_i} of the coeffs. a_i are given in parentheses
 $\delta_m = \max |V^E_{\text{calc}} - V^E|$; $\sigma_d = [\sum (V^E_{\text{calc}} - V^E)^2 / (N - n)]^{1/2}$
 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 60 equipped with a cell model 602 (Anton Paar, Graz, Austria). Temp. was controlled to within 0.01 K with a Heio thermostat and was measured by means of a calibrated Pt resistance thermometer.

Procedure: Density, ρ , was calcd. from period of vibration, τ : $\rho = a + b\tau^2$. Consts. a and b were detd. by calibrating the app. (ref. 3) with doubly dist. and degassed H_2O , $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 997.043$ (ref. 4) and nonane (Fluka AG, Buchs, Switzerland, 'purum', Lot No. 74252, of stated purity > 99 mole %), $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 713.855$ (ref. 5). Mixts. were prepd. by weighing. V^E was calcd. from $V^E = V - (x_1 V_1 + x_2 V_2)$, where $V = (x_1 M_1 + x_2 M_2)/\rho$ is the molar vol. of the mixt. and $V_i = V(x_i = 1)$ and M_i are, resp., the molar vol. and the molar mass of component i .
Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland) 'purum' grade material, of stated purity > 98 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 868.65$; $n(D, 298.15 \text{ K}) = 1.4280$; $M_1/10^{-3} \text{ kg mol}^{-1} = 148.67568$.
2. Fluka AG (Buchs, St. Gallen, Switzerland) 'purum' grade material, of stated purity > 98 mole %, was degassed in vacuo and dried over mol. sieve Type 4A (from Fluka) and used without further purification; $\rho(298.15 \text{ K})/\text{kg m}^{-3} = 872.73$; $n(D, 298.15 \text{ K}) = 1.3896$; $M_2/10^{-3} \text{ kg mol}^{-1} = 116.16008$.

Errors: δT (reproducibility)/K < 0.01; δT (TPS-68)/K = 0.01; δx_1 < 0.0001; $\delta V^E/10^{-9} \text{ m}^3 \text{ mol}^{-1}$ < 3.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 2c*, 1979.
2. Matos, J. S.; Ortega, J.; Garcia, M. V. *J. Chem. Eng. Data* 1988, 33, 260.
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4. Riddick, J. A.; Bunger, W. B. *Organic Solvents, II*, in *Techniques of Chemistry*, Weissberger, A., Editor, Wiley-Interscience, New York, 1970.
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