

SELECTED DATA ON MIXTURES

International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

Components: 1. Hexane, C₆H₁₄ [110-54-3]
2. Methyl undecanoate, C₁₂H₂₄O₂ [1731-86-8]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)
Edited by: Skrzecz, A.; Mączyski, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

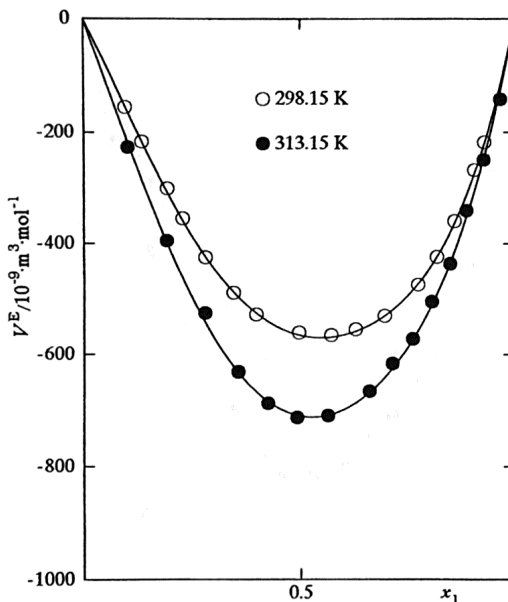
SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P = 101.32 kPa

T/K = 298.15		T/K = 313.15					
x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹	x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹				
0.0961	-154	0.1014	-226				
0.1335	-216	0.1911	-395				
0.1927	-301	0.2786	-525				
0.2275	-355	0.3553	-630				
0.2793	-424	0.4253	-687				
0.3448	-488	0.4930	-712				
0.3971	-527	0.5639	-708				
0.4968	-559	0.6620	-665				
0.5719	-564	0.7149	-615				
0.6298	-554	0.7633	-571				
0.6963	-530	0.8073	-505				
0.7755	-474	0.8514	-436				
0.8199	-423	0.8899	-341				
0.8623	-359	0.9294	-249				
0.9079	-268	0.9674	-141				
0.9315	-217						



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d, and maximum deviation δ_m determined by least-squares analysis.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ ·mol ⁻¹						
298.15	-2251.2 (6.1)	-353 (22)	-370 (25)	-864 (55)		3.2	6.0
313.15	-2828.0 (17.1)	-283 (64)	-241 (77)	-766 (163)		8.8	17.1

The standard deviations σ(a_i) of the coefficients 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, number of direct experimental values; n, number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ±0.02 kg·m⁻³. The temperature was controlled at ±0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm³ glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.3725, n(D, 313.15 K) = 1.3650, ρ(298.15 K)/kg·m⁻³ = 654.92, ρ(313.15 K)/kg·m⁻³ = 640.98.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss p.a." grade material; purity > 99.8 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4265, n(D, 313.15 K) = 1.4210, ρ(298.15 K)/kg·m⁻³ = 866.86, ρ(313.15 K)/kg·m⁻³ = 854.80.

Errors: δT/K = 0.02; δx₁ = 0.0005; δV^E/10⁻⁹·m³·mol⁻¹ < 8.

REFERENCES

- Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1).
- Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

SELECTED DATA ON MIXTURES

International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

Components: 1. Hexane, C_6H_{14} [110-54-3]
2. Methyl dodecanoate, $C_{13}H_{26}O_2$ [111-82-0]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)
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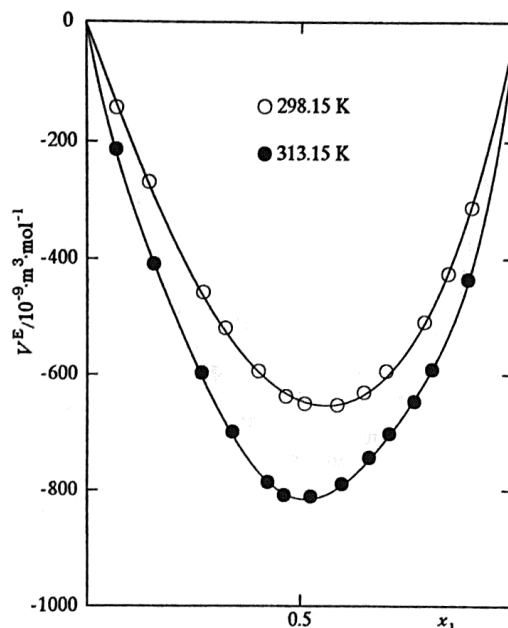
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DIRECT EXPERIMENTAL VALUES

Notes: $P = 101.32$ kPa

T/K = 298.15		T/K = 313.15					
x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$	x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$				
0.0695	-142	0.0675	-213				
0.1444	-268	0.1553	-408				
0.2715	-457	0.2675	-596				
0.3235	-518	0.3395	-698				
0.4015	-593	0.4235	-785				
0.4657	-636	0.4619	-808				
0.5115	-649	0.5250	-810				
0.5875	-651	0.5985	-788				
0.6507	-629	0.6635	-742				
0.7028	-593	0.7111	-701				
0.7925	-508	0.7695	-645				
0.8479	-424	0.8102	-590				
0.9011	-311	0.8945	-435				



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d , and maximum deviation δ_m determined by least-squares analysis.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$10^{-9} m^3 \cdot mol^{-1}$						
298.15	-2566.1 (10.6)	-569 (43)	-334 (52)	-410 (112)		5.8	8.4
313.15	-3249.7 (7.9)	-210 (27)	469 (90)	-1102 (75)	-2502 (162)	3.6	5.1

The standard deviations $\sigma(a_i)$ of the coefficients 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 , number of direct experimental values; n , number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ± 0.02 $kg \cdot m^{-3}$. The temperature was controlled at ± 0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm^3 glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; $n(D, 298.15$ K) = 1.3725, $n(D, 313.15$ K) = 1.3650, $\rho(298.15$ K)/ $kg \cdot m^{-3}$ = 654.92, $\rho(313.15$ K)/ $kg \cdot m^{-3}$ = 640.98.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; $n(D, 298.15$ K) = 1.4298, $n(D, 313.15$ K) = 1.4241, $\rho(298.15$ K)/ $kg \cdot m^{-3}$ = 865.25, $\rho(313.15$ K)/ $kg \cdot m^{-3}$ = 853.36.

Errors: $\delta T/K = 0.02$; $\delta x_1 = 0.0005$; $\delta V^E/10^{-9} m^3 \cdot mol^{-1} < 4$.

REFERENCES

1. Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1).
2. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

0147-1503/4/02-77\$4.00

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Int. DATA Ser., Ser. A Data Mixtures, Ser. A 2004, 32(2), 76-87

SELECTED DATA ON MIXTURES
International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

Components: 1. Hexane, C₆H₁₄ [110-54-3]
2. Methyl tridecanoate, C₁₄H₂₈O₂ [1731-88-0]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)
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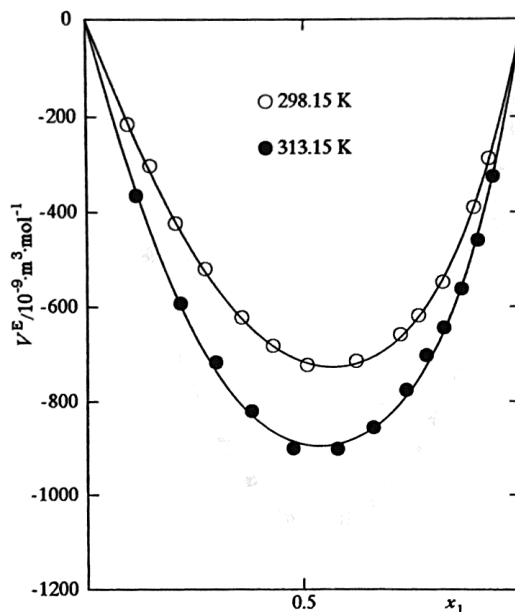
SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P = 101.32 kPa

T/K = 298.15		T/K = 313.15					
x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹	x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹				
0.0947	-214	0.1142	-364				
0.1454	-301	0.2155	-592				
0.2048	-421	0.2972	-717				
0.2729	-517	0.3806	-819				
0.3573	-621	0.4771	-899				
0.4292	-681	0.5805	-901				
0.5088	-722	0.6625	-855				
0.6225	-714	0.7384	-776				
0.7243	-658	0.7845	-703				
0.7659	-618	0.8245	-644				
0.8218	-546	0.8649	-562				
0.8917	-388	0.9019	-459				
0.9260	-286	0.9355	-324				



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d, and maximum deviation δ_m determined by least-squares analysis.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ ·mol ⁻¹						
298.15	-2854 (12)	-639 (45)	-601 (50)	-611 (112)		5.8	7.8
313.15	-3553 (31)	-390 (112)	-1049 (135)	-881 (288)		14.3	20.0

The standard deviations σ(a_i) of the coefficients 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, number of direct experimental values; n, number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ±0.02 kg·m⁻³. The temperature was controlled at ±0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm³ glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.3725, n(D, 313.15 K) = 1.3650, ρ(298.15 K)/kg·m⁻³ = 654.92, ρ(313.15 K)/kg·m⁻³ = 640.98.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 98.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4328, n(D, 313.15 K) = 1.4272, ρ(298.15 K)/kg·m⁻³ = 863.94, ρ(313.15 K)/kg·m⁻³ = 853.19.

Errors: δT/K = 0.02; δx₁ = 0.0005; δV^E/10⁻⁹·m³·mol⁻¹ < 8.

REFERENCES

- Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1).
- Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

0147-1503/4A02-7854.00

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Int. DATA Ser., Sel. Data Mixtures, Ser. A 2004, 32 (2), 76-87

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2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

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Components: 1. Hexane, C₆H₁₄ [110-54-3]
2. Methyl pentadecanoate, C₁₆H₃₂O₂ [7132-64-1]
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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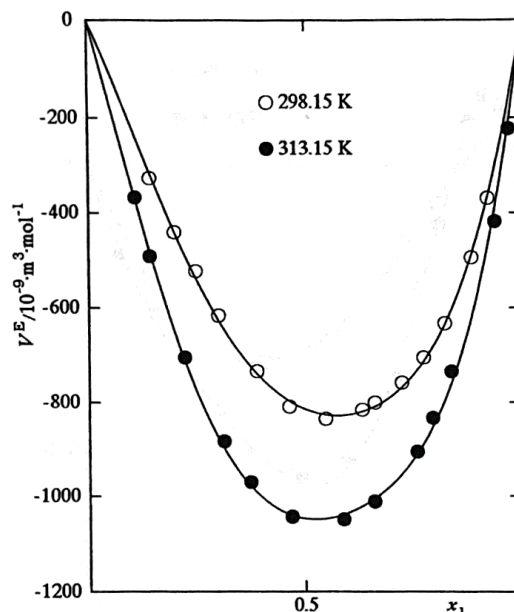
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DIRECT EXPERIMENTAL VALUES

Notes: P = 101.32 kPa

T/K = 298.15		T/K = 313.15					
x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹	x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹				
0.1411	-325	0.1080	-367				
0.1986	-439	0.1411	-490				
0.2475	-522	0.2209	-704				
0.3006	-615	0.3129	-883				
0.3897	-733	0.3738	-969				
0.4644	-809	0.4691	-1042				
0.5493	-835	0.5888	-1048				
0.6332	-815	0.6620	-1011				
0.6629	-801	0.7608	-905				
0.7269	-758	0.7991	-833				
0.7769	-704	0.8413	-735				
0.8257	-632	0.9421	-417				
0.8877	-493	0.9719	-222				
0.9240	-368						



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d, and maximum deviation δ_m determined by least-squares analysis.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ ·mol ⁻¹						
298.15	-3245 (20)	-756 (74)	-684 (91)	-1316 (205)		10.0	14.4
313.15	-4173 (41)	-255 (148)	-1416 (169)	-2116 (373)		18.7	36.9

The standard deviations σ(a_i) of the coefficients 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, number of direct experimental values; n, number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ±0.02 kg·m⁻³. The temperature was controlled at ±0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm³ glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.3725, n(D, 313.15 K) = 1.3650, ρ(298.15 K)/kg·m⁻³ = 654.92, ρ(313.15 K)/kg·m⁻³ = 640.98.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4369, n(D, 313.15 K) = 1.4309, ρ(298.15 K)/kg·m⁻³ = 862.24, ρ(313.15 K)/kg·m⁻³ = 851.01.

Errors: δT/K = 0.02; δx₁ = 0.0005; δV^E/10⁻⁹·m³·mol⁻¹ < 10.

REFERENCES

1. Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1).
2. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. J. Chem. Thermodyn., 1985, 17, 1127.

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Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1)

SELECTED DATA ON MIXTURES

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2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

0147-1503/4/02-80\$4.00

Components: 1. Octane, C₈H₁₈ [111-65-9]
 2. Methyl undecanoate, C₁₂H₂₄O₂ [1731-86-8]
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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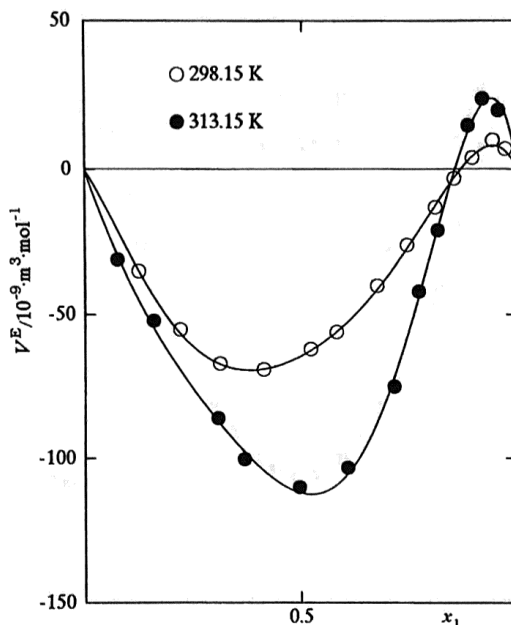
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DIRECT EXPERIMENTAL VALUES

Notes: P = 101.32 kPa

T/K = 298.15		T/K = 313.15			
x ₁	V ^E /10 ⁻⁹ m ³ .mol ⁻¹	x ₁	V ^E /10 ⁻⁹ m ³ .mol ⁻¹		
0.1243	-35	0.0756	-31		
0.2196	-55	0.1591	-52		
0.3116	-67	0.3075	-86		
0.4139	-69	0.3699	-100		
0.5231	-62	0.4970	-110		
0.5832	-56	0.6094	-103		
0.6766	-40	0.7169	-75		
0.7465	-26	0.7739	-42		
0.8113	-13	0.8164	-21		
0.8545	-3	0.8849	15		
0.8948	4	0.9174	24		
0.9417	10	0.9542	20		
0.9707	7				



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d, and maximum deviation δ_m determined by least-squares analysis.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ .mol ⁻¹						
298.15	-256.1 (2.6)	157.2 (8.8)	31 (26)	112 (23)	277 (46)	1.0	1.6
313.15	-446.2 (7.8)	-77.5 (22.3)	292 (74)	723 (52)	379 (115)	2.7	3.5

The standard deviations σ(a_i) of the coefficients 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, number of direct experimental values; n, number of coefficients a_i
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AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ±0.02 kg·m⁻³. The temperature was controlled at ±0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm³ glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "purum" grade material; purity > 99.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.3955, n(D, 313.15 K) = 1.3885, ρ(298.15 K)/kg·m⁻³ = 698.59, ρ(313.15 K)/kg·m⁻³ = 686.17.
 2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss p.a." grade material; purity > 99.8 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4265, n(D, 313.15 K) = 1.4210, ρ(298.15 K)/kg·m⁻³ = 866.86, ρ(313.15 K)/kg·m⁻³ = 854.80.

Errors: δT/K = 0.02; δx₁ = 0.0005; δV^E/10⁻⁹.m³.mol⁻¹ < 4.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 3b*, 1994, 22(1).
2. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

SELECTED DATA ON MIXTURES
International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305 - 3328

Compiled by Thermodynamics Research Center

Components: 1. Octane, C₈H₁₈ [111-65-9]
2. Methyl dodecanoate, C₁₃H₂₆O₂ [111-82-0]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)

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

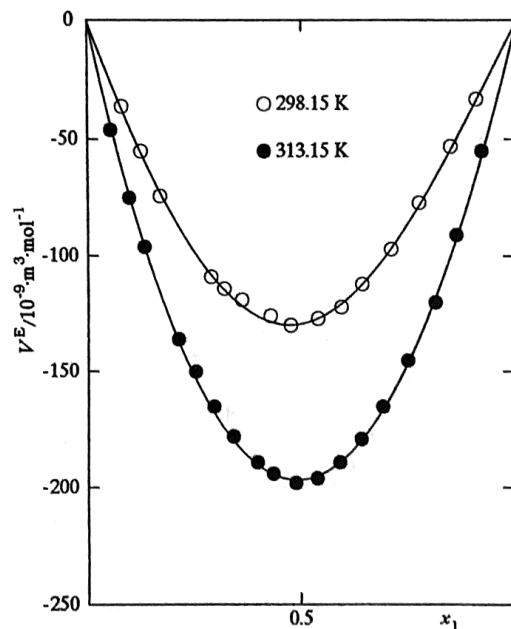
SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P = 101.32 kPa

T/K = 298.15		T/K = 313.15					
x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹	x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹				
0.0800	-36	0.0533	-46				
0.1251	-55	0.0971	-75				
0.1687	-74	0.1319	-96				
0.2891	-109	0.2119	-136				
0.3198	-114	0.2521	-150				
0.3612	-119	0.2957	-165				
0.4289	-126	0.3414	-178				
0.4775	-130	0.3984	-189				
0.5420	-127	0.4352	-194				
0.5966	-122	0.4897	-198				
0.6458	-112	0.5407	-196				
0.7135	-97	0.5932	-189				
0.7792	-77	0.6452	-179				
0.8512	-53	0.6954	-165				
0.9089	-33	0.7546	-145				
		0.8179	-120				
		0.8657	-91				
		0.9235	-55				



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d, and maximum deviation δ_m determined by least-squares analysis.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ ·mol ⁻¹						
298.15	-515.7 (2.2)	61.2 (4.7)	97.5 (10.5)			1.3	2.2
313.15	-784.2 (2.8)	22.3 (5.7)	-51.8 (13.1)			1.7	2.3

The standard deviations σ(a_i) of the coefficients 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, number of direct experimental values; n, number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ±0.02 kg·m⁻³. The temperature was controlled at ±0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm³ glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "purum" grade material; purity > 99.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.3955, n(D, 313.15 K) = 1.3885, ρ(298.15 K)/kg·m⁻³ = 698.59, ρ(313.15 K)/kg·m⁻³ = 686.17.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4298, n(D, 313.15 K) = 1.4241, ρ(298.15 K)/kg·m⁻³ = 865.25, ρ(313.15 K)/kg·m⁻³ = 853.36.

Errors: δT/K = 0.02; δx₁ = 0.0005; δV^E/10⁻⁹·m³·mol⁻¹ < 4.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 3b*, 1994, 22(1).
2. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

0147-1503/04/02-81-87

81

Int. DATA Ser., Sel. Data Mixtures, Ser. A 2004, 32(2), 76-87

SELECTED DATA ON MIXTURES

International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

Components: 1. Octane, C₈H₁₈ [111-65-9]
2. Methyl tridecanoate, C₁₄H₂₈O₂ [1731-88-0]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)
Edited by: Skrzecz, A.; Mączynski, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

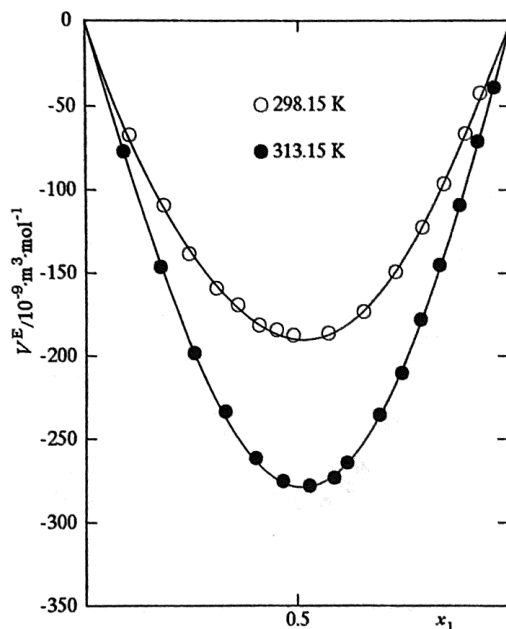
SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P = 101.32 kPa

T/K = 298.15		T/K = 313.15					
x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹	x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹				
0.1036	-67	0.0899	-77				
0.1836	-109	0.1761	-146				
0.2432	-138	0.2559	-198				
0.3074	-159	0.3295	-233				
0.3591	-169	0.4020	-261				
0.4086	-181	0.4658	-275				
0.4502	-184	0.5292	-278				
0.4905	-187	0.5877	-273				
0.5732	-186	0.6177	-264				
0.6565	-173	0.6954	-235				
0.7329	-149	0.7482	-210				
0.7953	-122	0.7922	-178				
0.8463	-96	0.8373	-145				
0.8950	-66	0.8825	-109				
0.9294	-42	0.9239	-71				
		0.9611	-39				



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d, and maximum deviation δ_m determined by least-squares analysis.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ ·mol ⁻¹						
298.15	-755.9 (3.5)	-51.0 (14.3)	48.2 (16.5)	120 (37)		2.0	3.1
313.15	-1111.8 (3.0)	-66.5 (6.1)	182.2 (13.5)			1.7	2.9

The standard deviations σ(a_i) of the coefficients 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, number of direct experimental values; n, number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ±0.02 kg·m⁻³. The temperature was controlled at ±0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm³ glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "purum" grade material; purity > 99.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.3955, n(D, 313.15 K) = 1.3885, ρ(298.15 K)/kg·m⁻³ = 698.59, ρ(313.15 K)/kg·m⁻³ = 686.17.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 98.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4328, n(D, 313.15 K) = 1.4272, ρ(298.15 K)/kg·m⁻³ = 863.94, ρ(313.15 K)/kg·m⁻³ = 853.19.

Errors: δT/K = 0.02; δx₁ = 0.0005; δV^E/10⁻⁹·m³·mol⁻¹ < 4.

REFERENCES

1. *Int. DATA Ser., Ser. A, Guideline 3b*, 1994, 22(1).
2. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

0147-1503/04/02-82-87

82

Int. DATA Ser., Sel. Data Mixtures, Ser. A 2004, 32 (2), 76-87

SELECTED DATA ON MIXTURES

International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

Components: 1. Octane, C₈H₁₈ [111-65-9]
2. Methyl pentadecanoate, C₁₆H₃₂O₂ [7132-64-1]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)

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

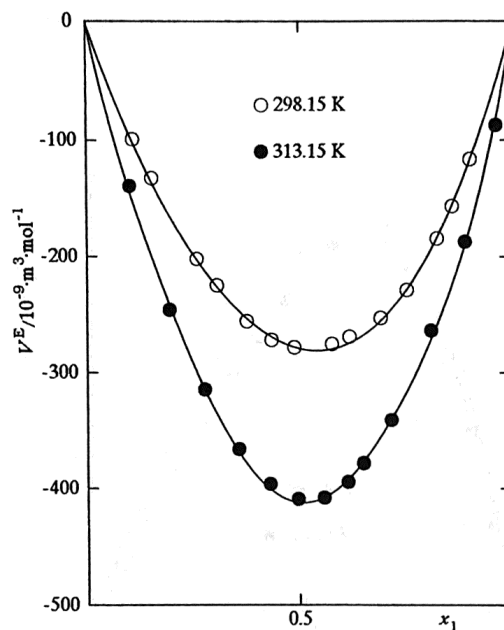
SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P = 101.32 kPa

T/K = 298.15		T/K = 313.15					
x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹	x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹				
0.1087	-99	0.1021	-139				
0.1538	-132	0.1957	-246				
0.2597	-202	0.2784	-314				
0.3075	-225	0.3585	-366				
0.3779	-256	0.4320	-396				
0.4375	-272	0.4982	-409				
0.4908	-278	0.5599	-408				
0.5793	-275	0.6167	-394				
0.6221	-269	0.6534	-378				
0.6948	-253	0.7202	-341				
0.7576	-229	0.8145	-264				
0.8279	-184	0.8938	-187				
0.8627	-156	0.9651	-87				
0.9052	-116						



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d, and maximum deviation δ_m determined by least-squares analysis.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ ·mol ⁻¹						
298.15	-1111.7 (5.1)	-185.0 (10.3)	-113 (24)			2.8	4.6
313.15	-1644.1 (11.0)	-82.9 (37.7)	267 (128)	-306 (102)	-769 (225)	5.0	9.1

The standard deviations σ(a_i) of the coefficients 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, number of direct experimental values; n, number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ±0.02 kg·m⁻³. The temperature was controlled at ±0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm³ glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "purum" grade material; purity > 99.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.3955, n(D, 313.15 K) = 1.3885, ρ(298.15 K)/kg·m⁻³ = 698.59, ρ(313.15 K)/kg·m⁻³ = 686.17.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4369, n(D, 313.15 K) = 1.4309, ρ(298.15 K)/kg·m⁻³ = 862.24, ρ(313.15 K)/kg·m⁻³ = 851.01.

Errors: δT/K = 0.02; δx₁ = 0.0005; δV^E/10⁻⁹·m³·mol⁻¹ < 4.

REFERENCES

- Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1).
- Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

0147-1503/4/02-83\$4.00

83

Int. DATA Ser., Sel. Data Mixtures, Ser. A 2004, 32(2), 76-87

SELECTED DATA ON MIXTURES
International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

Components: 1. Decane, $C_{10}H_{22}$ [124-18-5]
2. Methyl undecanoate, $C_{12}H_{24}O_2$ [1731-86-8]
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) Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)
Edited by: Skrzecz, A.; Mącznyński, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

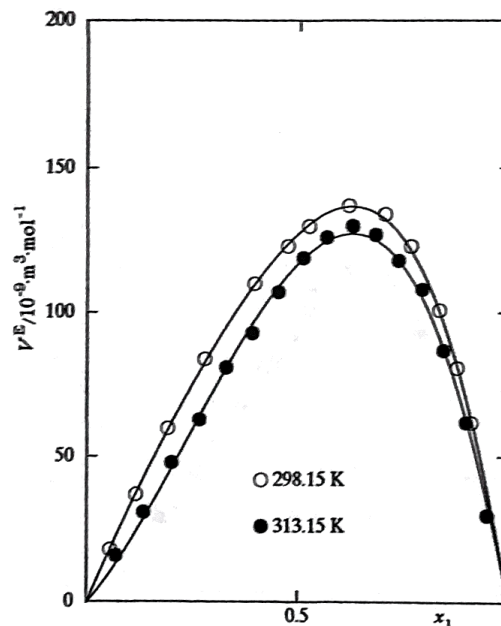
DIRECT EXPERIMENTAL VALUES

Notes: $P = 101.32$ kPa

T/K = 298.15

T/K = 313.15

x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$	x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$
0.0556	18	0.0689	16
0.1162	37	0.1352	31
0.1925	60	0.2017	48
0.2807	84	0.2672	63
0.3971	110	0.3307	81
0.4748	123	0.3919	93
0.5254	130	0.4535	107
0.6198	137	0.5123	119
0.7069	134	0.5681	126
0.7678	123	0.6291	130
0.8374	101	0.6833	127
0.8793	81	0.7386	118
0.9135	62	0.7950	108
		0.8478	87
		0.9022	62
		0.9502	30



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d , and maximum deviation δ_m determined by least-squares analysis.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	10^{-9} $m^3 \cdot mol^{-1}$						
298.15	510.8 (2.0)	269.8 (3.8)	101.1 (8.2)			1.0	1.5
313.15	469.1 (3.0)	302.8 (8.0)				2.3	5.1

The standard deviations $\sigma(a_i)$ of the coefficients 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 , number of direct experimental values; n , number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ± 0.02 $kg \cdot m^{-3}$. The temperature was controlled at ± 0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm^3 glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "purum" grade material; purity > 98.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; $n(D, 298.15$ K) = 1.4095, $n(D, 313.15$ K) = 1.4030, $\rho(298.15$ K)/ $kg \cdot m^{-3}$ = 726.21, $\rho(313.15$ K)/ $kg \cdot m^{-3}$ = 714.75.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss p.a." grade material; purity > 99.8 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; $n(D, 298.15$ K) = 1.4265, $n(D, 313.15$ K) = 1.4210, $\rho(298.15$ K)/ $kg \cdot m^{-3}$ = 866.86, $\rho(313.15$ K)/ $kg \cdot m^{-3}$ = 854.80.

Errors: $\delta T/K = 0.02$; $\delta x_1 = 0.0005$; $\delta V^E/10^{-9} m^3 \cdot mol^{-1} < 4$.

REFERENCES

- Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1).
- Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

0147-1503/4/02-84-84,00

84

Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1)

Received: March 15, 2004

*Ser. A. Thermodynamic Properties of Non-reacting Binary Systems

Published: April 30, 2004

SELECTED DATA ON MIXTURES

International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305 - 3328

Compiled by Thermodynamics Research Center

Components: 1. Decane, $C_{10}H_{22}$ [124-18-5]
2. Methyl dodecanoate, $C_{13}H_{26}O_2$ [111-82-0]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)

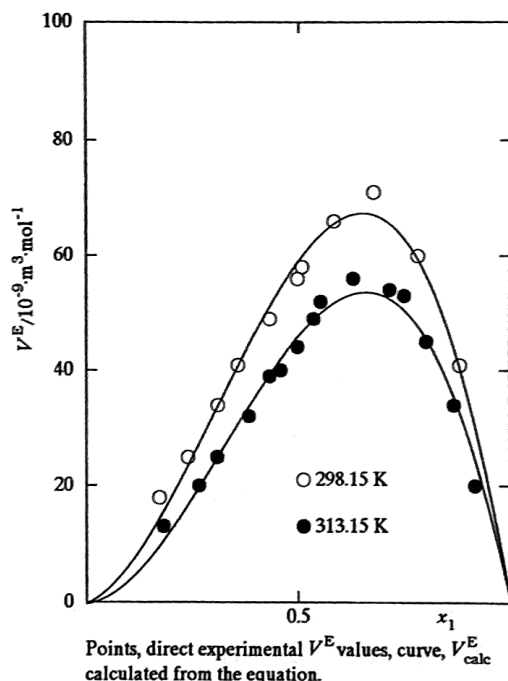
Edited by: Skrzecz, A.; Mączynski, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES
Notes: $P = 101.32$ kPa

T/K = 298.15		T/K = 313.15					
x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$	x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$				
0.1723	18	0.1808	13				
0.2401	25	0.2667	20				
0.3101	34	0.3092	25				
0.3591	41	0.3843	32				
0.4340	49	0.4332	39				
0.5003	56	0.4602	40				
0.5101	58	0.5004	44				
0.5862	66	0.5381	49				
0.6801	71	0.5547	52				
0.7842	60	0.6321	56				
0.8835	41	0.7191	54				
		0.7521	53				
		0.8041	45				
		0.8698	34				
		0.9186	20				



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

Coefficients a_i in the smoothing equation, standard deviation σ_d , and maximum deviation δ_m determined by least-squares analysis.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$10^{-9} m^3 \cdot mol^{-1}$						
298.15	235.7 (3.3)	204.1 (9.9)				2.3	3.7
313.15	183.6 (2.7)	174.9 (8.1)				2.1	4.7

The standard deviations $\sigma(a_i)$ of the coefficients 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 , number of direct experimental values; n , number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ± 0.02 $kg \cdot m^{-3}$. The temperature was controlled at ± 0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm^3 glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "purum" grade material; purity > 98.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; $n(D, 298.15 K) = 1.4095$, $n(D, 313.15 K) = 1.4030$, $\rho(298.15 K)/kg \cdot m^{-3} = 726.21$, $\rho(313.15 K)/kg \cdot m^{-3} = 714.75$.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; $n(D, 298.15 K) = 1.4298$, $n(D, 313.15 K) = 1.4241$, $\rho(298.15 K)/kg \cdot m^{-3} = 865.25$, $\rho(313.15 K)/kg \cdot m^{-3} = 853.36$.

Errors: $\delta T/K = 0.02$; $\delta x_1 = 0.0005$; $\delta V^E/10^{-9} m^3 \cdot mol^{-1} < 4$.

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2. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

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Int. DATA Ser., Sel. Data Mixtures, Ser. A 2004, 32 (2), 76-87

SELECTED DATA ON MIXTURES
International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

Components: 1. Decane, $C_{10}H_{22}$ [124-18-5]
2. Methyl tridecanoate, $C_{14}H_{28}O_2$ [1731-88-0]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)
Edited by: Skrzecz, A.; Mączyński, A. (Instytut Chemii Fizycznej, Polska Akademia Nauk, ul. Kasprzaka 44/52, 01-224 Warszawa, Poland)

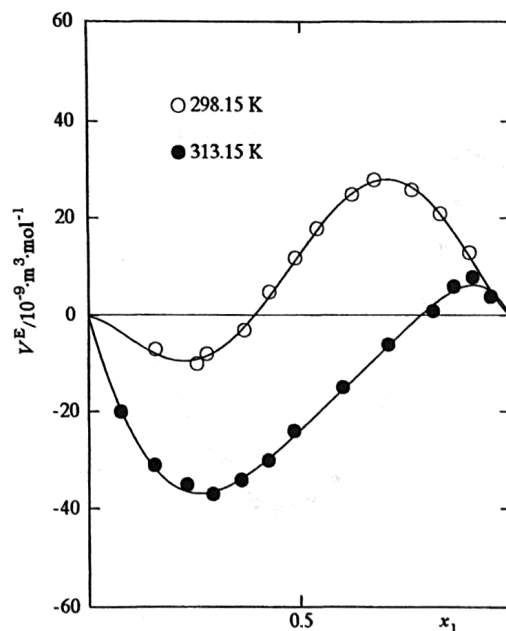
SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: $P = 101.32$ kPa

T/K = 298.15		T/K = 313.15					
x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$	x_1	$V^E/10^{-9}$ $m^3 \cdot mol^{-1}$				
0.1573	-7	0.0755	-20				
0.2549	-10	0.1538	-31				
0.2777	-8	0.2302	-35				
0.3684	-3	0.2929	-37				
0.4279	5	0.3597	-34				
0.4899	12	0.4250	-30				
0.5417	18	0.4857	-24				
0.6245	25	0.6037	-15				
0.6763	28	0.7106	-6				
0.7657	26	0.8163	1				
0.8346	21	0.8657	6				
0.9036	13	0.9111	8				
		0.9546	4				



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d , and maximum deviation δ_m determined by least-squares analysis.

T/K	a_1	a_2	a_3	a_4	a_5	σ_d	δ_m
	$10^{-9} m^3 \cdot mol^{-1}$						
298.15	51.5 (1.4)	241.2 (6.0)	-9.9 (7.5)	-186.7 (17.9)		0.7	1.0
313.15	-94.8 (2.8)	159.8 (9.0)	-62.8 (28.3)	79.6 (21.6)	92.7 (46.6)	1.1	1.5

The standard deviations σa_i of the coefficients 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 , number of direct experimental values; n , number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ± 0.02 $kg \cdot m^{-3}$. The temperature was controlled at ± 0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm^3 glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "purum" grade material; purity > 98.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; $n(D, 298.15 K) = 1.4095$, $n(D, 313.15 K) = 1.4030$, $\rho(298.15 K)/kg \cdot m^{-3} = 726.21$, $\rho(313.15 K)/kg \cdot m^{-3} = 714.75$.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 98.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; $n(D, 298.15 K) = 1.4328$, $n(D, 313.15 K) = 1.4272$, $\rho(298.15 K)/kg \cdot m^{-3} = 863.94$, $\rho(313.15 K)/kg \cdot m^{-3} = 853.19$.

Errors: $\delta T/K = 0.02$; $\delta x_1 = 0.0005$; $\delta V^E/10^{-9} m^3 \cdot mol^{-1} < 4$.

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2. Ortega, J.; Matos, J. S.; Paz-Andrade, M. I.; Jiménez, E. *J. Chem. Thermodyn.*, 1985, 17, 1127.

0147-1503/4/02-86\$4.00

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Int. DATA Ser., Ser. A 2004, 32 (2), 76-87

SELECTED DATA ON MIXTURES
International DATA Series*

2c. EXCESS VOLUME

National Institute of Standards and Technology, Boulder, CO 80305-3328

Compiled by Thermodynamics Research Center

Components: 1. Decane, C₁₀H₂₂ [124-18-5]
2. Methyl pentadecanoate, C₁₆H₃₂O₂ [7132-64-1]
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: Ortega, J. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, 35071 Las Palmas de Gran Canaria, Canary Islands, Spain)

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

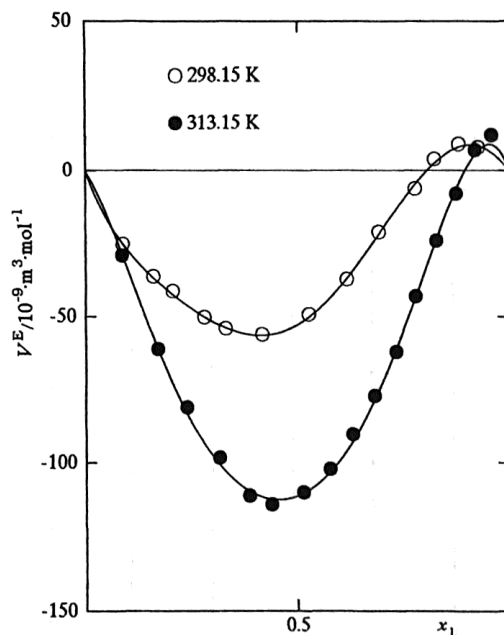
SOURCE OF DATA

Ortega, J.; Sabater, G.; Dieppa, R.; Navas, A.; Marrero, E.; Espiau, F. (Laboratorio de Termodinámica y Fisicoquímica, Escuela Superior de Ingenieros Industriales, Universidad de Las Palmas de Gran Canaria, Canary Islands, Spain); FIRST PUBLISHED RESULTS

DIRECT EXPERIMENTAL VALUES

Notes: P = 101.32 kPa

T/K = 298.15		T/K = 313.15					
x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹	x ₁	V ^E /10 ⁻⁹ m ³ ·mol ⁻¹				
0.0870	-25	0.0865	-29				
0.1595	-36	0.1713	-61				
0.2061	-41	0.2399	-81				
0.2823	-50	0.3162	-98				
0.3317	-54	0.3878	-111				
0.4185	-56	0.4398	-114				
0.5297	-49	0.5161	-110				
0.6179	-37	0.5778	-102				
0.6933	-21	0.6319	-90				
0.7787	-6	0.6849	-77				
0.8237	4	0.7357	-62				
0.8794	9	0.7818	-43				
0.9261	8	0.8285	-24				
		0.8761	-8				
		0.9189	7				
		0.9575	12				



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

SMOOTHING EQUATION

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

Coefficients a_i in the smoothing equation, standard deviation σ_d, and maximum deviation δ_m determined by least-squares analysis.

T/K	a ₁	a ₂	a ₃	a ₄	a ₅	σ _d	δ _m
	10 ⁻⁹ m ³ ·mol ⁻¹						
298.15	-210.3 (2.6)	163.0 (7.6)	282 (26)	135 (19)	-170 (44)	1.0	1.7
313.15	-443.5 (4.0)	107.2 (13.1)	185 (42)	211 (34)	361 (72)	1.9	2.8

The standard deviations σ(a_i) of the coefficients 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, number of direct experimental values; n, number of coefficients a_i
All direct experimental values equally weighted

AUXILIARY INFORMATION

Apparatus: The density was determined by an Anton Paar Model DMA-58 vibrating-tube digital densimeter with a precision of ±0.02 kg·m⁻³. The temperature was controlled at ±0.01 K with a Heto ultrathermostat.

Procedure: The procedure was described in ref. 2. Mixtures were prepared by weighing in hermetically sealed 2.5 cm³ glass vials. The apparatus was calibrated with doubly distilled and degassed water and nonane.

Materials: 1. Fluka AG (Buchs, St. Gallen, Switzerland), "purum" grade material; purity > 98.0 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4095, n(D, 313.15 K) = 1.4030, ρ(298.15 K)/kg·m⁻³ = 726.21, ρ(313.15 K)/kg·m⁻³ = 714.75.
2. Fluka AG (Buchs, St. Gallen, Switzerland), "puriss" grade material; purity > 99.5 mole % by glc; degassed ultrasonically, dried over molecular sieves 3A; n(D, 298.15 K) = 1.4369, n(D, 313.15 K) = 1.4309, ρ(298.15 K)/kg·m⁻³ = 862.24, ρ(313.15 K)/kg·m⁻³ = 851.01.

Errors: δT/K = 0.02; δx₁ = 0.0005; δV^E/10⁻⁹·m³·mol⁻¹ < 4.

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Int. DATA Ser., Ser. A, Guideline 3b, 1994, 22(1)