COMPONENTS:

1. Methane; CH_4; [74-82-8]
2. Alkanes (C_{16}-C_{32})

EVALUATOR:

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February 1986.

CRITICAL EVALUATION:

Hexadecane; $C_{16}H_{34}$; [544-76-3]

There is surprising little experimental data for the systems methane + higher alkanes at elevated pressures. For the system methane + hexadecane the data of Sultanov et al. (1) are substantially in agreement with the data of Lin et al. (2) for the liquid phase compositions in the overlapping range of temperature but there are significant discrepancies between the vapor phase compositions. The vapor compositions for the Lin et al data are probably more precise in the lower pressure region and are also probably more accurate. The data of Glaser et al.(3) cover a different temperature range and detailed comparison between the data and those of ref. (1) and (2) is impossible. Glaser et al. data which is classified as tentative can be used to derive pressure-composition sections as given in the table below.

T/K	290.0	300.0	310.0	320.0	330.0	340.0	350.0	360.0
				p/MPa				
0.977		63.075	61.087	59.352	57.727	56.211	54.804	
0.942		66.714	64.566	62.702	61.051	59.491	58.033	56.685
0.952		67.859	65.680	63.803	62.104	60.556	59.104	57.759
0.927	70.346	67.848	65.709	63.849	62.208	60.681	59.313	
0.887		66.999	64.960	63.204	61.659	60.241	58.939	
0.824	59.082	57.485	56.267	55.081	54.111	53.275	52.374	51.604
0.703		36.769	36.619	36.515	36.448	36.372	36.310	36.198
0.600		23.310	23.608	24.029	24.378	24.593	24.839	25.060
0.497		16.026	16.497	16.691	17.344	17.707		
0.342		8.548	8.863	9.183	9.470	9.736	9.988	
0.295	6.478	6.856	7.130	7.406	7.650	7.888	8.071	
0.184		4.141	4.313	4.490	4.632	4.770	4.905	
0.889		2.151	2.245	2.335	2.418	2.500	2.568	

Eicosane; $C_{20}H_{42}$; [112-95-8]

The system eicosane + methane has been investigated by Puri and Kohn (4). The data when extrapolated to 1 atmosphere pressure gives a solubility which is about 15 per cent lower than that which would be expected from the data of Chappelow and Prausnitz (5) and therefore should be regarded with caution.

Dotriacontane; $C_{32}H_{66}$; [544-85-4]

The system methane + dotriacontane has been studied by Cordeiro et al.(6) The solubility extrapolated to 1 atmosphere pressure is about 5 per cent smaller than might be expected from extrapolation from the data of Lin and Parcher (7) on other similar alkanes. Within the combined uncertainty of the two extrapolations this agreement is satisfactory and the data classified as tentative.

References.

1. Lin, H.-M.; Sebastian, H. M.; Chao, K.-C.
J. Chem. Eng. Data, 1980, *25*, 252-257.
2. Sultanov, R. G.; Skripka, V. G.; Namoit, A. Yu.
Gazov. Delo. 1972, *10*, 43.
3. Glaser, M.; Peters, C. J.; Van der Kooi, H. J.; Lichtenthaler, R. N.;
J. Chem. Thermodyn., 1985, *17*, 803.
4. Puri, S.; Kohn, J. P.;
J. Chem. Eng. Data, 1970, *15*, 372.
5. Chappelow, C. C.; Prausnitz, J. M.;
Am. Inst. Chem. Engnrs. J., 1974, *20*, 1097.
6. Cordeiro, D. J.; Luks, K. D.; Kohn, J. P.;
Ind. Eng. Chem. Process. Des. Develop. 1973, *12*, 47.
7. Lin, P. J.; Parcher, J. F.;
J. Chromatog. Sci., 1982, *20*, 33.

COMPONENTS:

1. Methane; CH_4; [74-82-8]

2. Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Sultanov, R. G.; Skripka, V. G.; Namiot, A. Yu.
Gazov. Delo. 1972, *10*, 43-6.

VARIABLES:

Temperature, pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of methane in liquid, x_{CH_4}	in gas, y_{CH_4}	T/K	P/MPa	Mole fraction of methane in liquid, x_{CH_4}	in gas, y_{CH_4}
373.15	4.9	0.181	-	473.15	29.4	0.6370	0.9860
	9.8	0.321	-		39.2	0.7700	0.9725
	19.6	0.508	-		44.1	0.8600	0.9360
	29.4	0.637	-		45.1	0.9020	0.9020
	39.2	0.733	0.9990	523.15	4.9	0.1840	0.8400
	49.0	0.8125	0.9950		9.8	0.3180	0.8880
	53.9	0.8575	0.9835		19.6	0.5240	0.8810
	56.4	0.8980	0.9770		29.4	0.6800	0.9540
423.15	4.9	0.1750	0.9992		36.8	0.8070	0.9160
	9.8	0.3075	0.9980		38.2	0.8620	0.8620
	19.6	0.4940	0.9975	573.15	4.9	0.1880	0.9530
	29.4	0.6250	0.9920		9.8	0.3250	0.9620
	39.2	0.7360	0.9865		19.6	0.0555(+)	0.9550
	49.0	0.8560	0.9700		29.4	0.7550	0.8820
	51.6	0.8950	0.9450		30.4	0.8200	0.8200
	52.4	0.9275	0.9275	623.15	4.9	0.2030	0.9890
473.15	4.9	0.1760	0.9960		9.8	0.3640	0.8900
	9.8	0.3210	0.9960		19.6	0.6640	0.9862
	19.6	0.5000	0.9930		21.2	0.7825	0.7825

+ This composition is obviously a typographical error.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Static equilibrium cell fitted with magnetic stirrer, details in ref. (1). Samples of coexisting phases analysed by freezing out hexadecane and estimating methane volumetrically.

SOURCE AND PURITY OF MATERIALS:

1. Purity 99.9 mole per cent.

2. "Pure sample", boiling point 286.3-287.3 °C.

ESTIMATED ERROR:

$\delta T/K = \pm 0.3$; $\delta P/MPa = \pm 0.1$;
δx_{CH_4}, $\delta y_{CH_4} = \pm 0.002$ (estimated by compiler).

REFERENCES:

1. Sultanov, R. G.; Skripka, V. G.; Namiot, A. Yu.
Gazov. Prom. 1971, *16* (4), 6.

COMPONENTS:

1. Methane; CH_4; [74-82-8]
2. Hexadecane; $C_{16}H_{34}$; [544-76-3]

ORIGINAL MEASUREMENTS:

Lin, H.-M.; Sebastian, H.M.; Chao, K.-C.

J. Chem. Engng. Data. 1980, *25*, 252-257.

VARIABLES:

Temperature, pressure

PREPARED BY:

C.L. Young

EXPERIMENTAL VALUES:

T/K	P/atm	P/MPa	Mole fraction in liquid, x_{CH_4}	Mole fraction in vapor, y_{CH_4}
462.45	20.02	2.029	0.0801	0.99544
	30.71	3.112	0.1187	0.99658
	49.8	5.046	0.1824	0.99722
	100.0	10.13	0.3207	0.99718
	149.9	15.19	0.4326	0.99636
	200.9	20.36	0.5193	0.99467
	249.3	25.26	0.5958	0.99206
542.65	20.50	2.077	0.0831	0.9580
	30.23	3.063	0.1208	0.9687
	50.0	5.07	0.1884	0.9765
	99.5	10.08	0.3322	0.9808
	149.9	15.19	0.4539	0.9798
	200.6	20.33	0.5512	0.9754
	222.5	22.54	0.6229	0.9719
623.15	20.71	2.098	0.0836	0.7930
	31.39	3.181	0.1265	0.8453
	50.0	5.07	0.2032	0.8865
	99.7	10.10	0.3716	0.9132
	150.3	15.23	0.5178	0.9097
	176.1	17.84	0.5968	0.8970
	201.3	20.40	0.7371	0.8733
703.55	20.87	2.115	0.0697	0.3097
	30.77	3.118	0.1363	0.4632
	49.8	5.046	0.2822	0.5099

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Flow apparatus with both liquid and gas components continually passing into a mixing tube and then into a cell in which phases separated under gravity. Liquid sample removed from bottom of cell and vapor sample from top of cell. Composition of samples found by stripping out gas and estimating amount of solute volumetrically and solvent gravimetrically. Temperature measured with thermocouple and pressure with Bourdon gauge. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Matheson sample, purity better than 99 mole per cent.
2. Matheson, Coleman and Bell sample, purity better than 99 mole per cent.

ESTIMATED ERROR:

$\delta T/K = \pm 0.1$; $\delta P/MPa = \pm 0.01$; δx_{CH_4}, $\delta y_{CH_4} > \pm 1.0\%$ (estimated by compiler).

REFERENCES:

1. Simnick, J.J.; Lawson, C.C.; Lin, H.M.; Chao, K.C. *Am. Inst. Chem. Engnrs. J.* 1977, *23*, 469.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4 ; [74-82-8] 2. Hexadecane; $C_{16}H_{34}$;[544-76-3]	Glaser, M.; Peters, C. J.; Van der Kooi, H. J.; Lichtenthaler, R. N. *J. Chem. Thermodyn.* 1985, *17*, 803-815.
VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

Experimentally determined two-phase boundaries
(x, mole fraction of methane)

T/K	P/MPa	T/K	P/Mpa	T/K	P/Mpa	T/K	P/Mpa
			x = 0.977 (l+g)				
293.20	64.56	307.35	61.58	322.08	59.00	336.62	56.70
297.49	63.60	312.30	60.68	326.95	58.20	341.65	55.98
302.62	62.54	317.15	59.84	331.86	57.44	346.49	55.30
						351.30	54.62
			x = 0.977 (s+g)				
285.84	70.10	285.83	72.10	285.82	74.10	285.75	80.10
						285.74	84.10
			x = 0.962 (l+g)				
293.27	68.36	312.30	64.12	327.01	61.52	346.62	58.44
297.91	67.22	317.26	63.18	331.92	60.74	351.33	57.88
303.42	65.92	322.25	62.32	336.40	59.98	356.28	57.20
				341.62	59.26	361.07	56.54
			x = 0.962 (s+g)				
286.28	72.60	286.35	76.10	286.44	80.10	286.54	83.60
						286.61	86.80

cont.

AUXILIARY INFORMATION

METHOD APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
Cailletet apparatus used up to pressures of 20 MPa and an autoclave with two sapphire windows was used at higher pressures. Both systems provided with magnetic stirring facility. Pressure measured with pressure balance and temperatures measured with platinum resistance thermometer. Details of Cailletet apparatus given in ref (1),(2) and source; details of autoclave given in ref (1),(3) and source.	1. Matheson Research Grade sample, purity checked using gas chromatography. 2. Merck sample, purity at least 99.9 mole per cent, checked by gas chromatography.
	ESTIMATED ERROR:

REFERENCES:

1. Van der Kooi, H. J.; PhD. thesis, Delft. Univ. Tech., 1981.
2. De Loos, Th. W.; Van der Kooi, H. J.; Poot, W.; Ott, P. L. *Delft. Progr.Rep*, 1983, *8*, 200.
3. Van Wilie, G. S. A.; Diepen, G. A. M., *Rec.Trav.Chim.Pays Bas.*, (1961), *80*, 659.

COMPONENTS:

1. Methane; CH_4 ; [74-82-8]
2. Hexadecane; $C_{16}H_{34}$;[544-76-3]

ORIGINAL MEASUREMENTS:

Glaser, M.; Peters, C. J.; Van der Kooi, H. J.; Lichtenthaler, R. N.
J. Chem. Thermodyn.
1985, *17*, 803-815.

EXPERIMENTAL VALUES:

T/K	P/MPa	T/K	P/MPa	T/K	P/MPa	T/K	P/MPa
			x = 0.952 (l+g)				
292.16	69.82	312.34	65.22	391.92	61.80	351.41	58.91
297.04	68.57	317.27	64.39	336.91	61.02	356.72	58.20
301.81	67.44	322.19	63.42	341.60	60.32	361.47	57.56
307.45	66.20	327,07	62.58	346.44	59.61		
			x = 0.952 (s+g)				
286.23	72.90	286.33	75.60	286.53	80.10		
			x = 0.927 (l+g)				
289.05	70.58	307.98	66.12	327.51	62.60	347.05	59.72
292.82	69.64	312.78	65.16	332.42	61.84	351.84	59.06
297.68	68.40	317.61	64.26	337.33	61.10	356.78	58.44
303.03	67.16	322.63	63.41	341.88	60.40		
			x = 0.927 (s+g)				
286.43	72.60	286.50	73.10	286.56	74.10	286.69	76.40
						286.83	78.10
			x = 0.887 (l+g)				
292.23	68.84	307.59	65.42	322.21	62.84	336.96	60.66
297.01	67.68	312.40	64.52	327.10	62.08	341.72	60.01
302.58	66.44	317.31	63.66	331.95	61.38	346.69	59.36
						351.42	58.76
			x = 0.887 (s+l)				
286.98	76.60	287.00	76.90	287.17	78.20	287.41	80.90
				287.29	79.70	287.64	83.30
			x = 0.824 (l+g)				
287.74	59.48	307.49	56.60	327.13	54.38	346.54	52.68
295.22	58.20	312.34	55.95	331.83	53.94	351.29	52.27
297.47	57.85	317.25	55.38	336.85	53.50	356.11	51.90
302.62	57.15	322.21	54.85	341.99	53.12	361.36	51.56
			x = 0.824 (s+l)				
285.84	62.10	286.11	64.00	286.58	67.50	286.84	71.00
			x = 0.703 (l+g)				
292.72	36.94	312.08	36.59	331.68	36.44	351.95	36.30
297.49	36.82	316.99	36.54	336.58	36.40	356.83	36.24
302.31	36.73	321.82	36.50	341.45	36.36	361.44	36.18
307.21	36.66	326.79	36.46	346.36	36.32		
			x = 0.703 (s+l)				
285.26	40.10	285.62	42.10	285.78	43.00	286.15	45.00
			x = 0.600 (l+g)				
293.19	23.10	312.17	23.76	331.91	24.44	352.39	24.90
297.90	23.22	317.18	23.94	336.77	24.52	354.44	24.98
302.66	23.40	322.11	24.10	341.63	24.64	361.46	25.06
307.58	23.46	326.96	24.26	346.56	24.78		

cont.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4 ; [74-82-8] 2. Hexadecane; $C_{16}H_{34}$;[544-76-3]	Glaser, M.; Peters, C. J.; Van der Kooi, H. J.; Lichtenthaler, R. N. *J. Chem. Thermodyn.* 1985, *17*, 803-815.

EXPERIMENTAL VALUES:

T/K	P/MPa	T/K	P/MPa	T/K	P/MPa	T/K	P/MPa
			x = 0.600 (s+l)				
286.61	26.30	285.92	27.80	286.03	28.10	286.32	29.30
			x = 0.497 (l+g)				
293.32	15.69	308.05	16.41	322.77	17.08	337.36	17.61
297.93	15.92	312.94	16.63	327.64	17.26	342.36	17.79
303.03	16.18	317.83	16.86	332.38	17.43	347.37	17.94
			x = 0.497 (s+l)				
285.86	16.24	285.97	16.63	286.14	17.51	286.26	17.90
						286.37	18.39
			x = 0.342 (l+g)				
290.89	8.19	307.92	8.79	327.70	9.41	347.33	9.92
293.43	8.29	313.02	8.97	332.68	9.54	352.61	10.05
298.09	8.48	317.65	9.11	337.47	9.67	357.38	10.14
303.26	8.65	322.76	9.27	342.53	9.80		
			x = 0.296 (l+g)				
288.86	6.48	303.24	6.94	322.78	7.48	342.52	7.94
290.56	6.55	308.05	7.07	327.76	7.60	347.53	8.02
293.27	6.63	312.98	7.22	332.68	7.71	352.47	8.13
298.07	6.79	317.90	7.35	337.59	7.83		
			x = 0.296 (s+l)				
288.21	7.46	288.48	8.58	288.74	9.76	289.37	12.21
				288.86	10.15	289.47	12.56
			x = 0.184 (l+g)				
298.17	4.106	313.09	4.366	327.74	4.597	342.77	4.805
303.52	4.205	318.41	4.465	332.71	4.675	347.64	4.877
308.13	4.283	323.12	4.533	337.65	4.742	352.56	4.935
						356.33	4.994
			x = 0.184 (s+l)				
290.21	8.441	290.41	9.317	290.69	10.500	291.31	12.954
				291.01	11.771	291.60	13.984
			x = 0.111 (l+g)				
290.27	2.061	308.20	2.228	328.23	2.399	343.26	2.522
292.17	2.087	313.21	2.277	333.26	2.453	348.24	2.556
293.22	2.093	318.20	2.320	338.25	2.488	363.23	2.659
303.25	2.184	323.27	2.360				
			x = 0.111 (s+l)				
290.27	3.189	290.68	4.955	291.52	8.339	292.22	11.086
290.67	4.906	291.07	6.574	291.93	9.958	293.38	11.920

COMPONENTS:

1. Methane; CH_4; [74-82-8]
2. Eicosane; $C_{20}H_{42}$; [112-95-8]

ORIGINAL MEASUREMENTS:

Puri, S.; Kohn, J. P.;

J. Chem. Eng. Data, 1970, *15*, 372-374.

VARIABLES:

Pressure

PREPARED BY:

C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of methane, x
313.15	0.51	0.0179
	1.01	0.0510
	1.52	0.0785
	2.03	0.0785
	2.53	0.1268
	3.04	0.1490
	3.55	0.1701
	4.05	0.1910
	4.56	0.2108
	5.07	0.2300
	5.57	0.2489
	6.08	0.2677
solid-liquid-gas equilibrium		
319.15	0.684	0.0348
308.95	0.897	0.0465
308.75	1.177	0.0620
308.55	1.479	0.0775
308.35	1.864	0.0961
308.15	2.260	0.1145
307.95	2.746	0.1360
307.75	3.294	0.1592
307.55	3.921	0.1860
307.35	4.603	0.2142
307.15	5.352	0.2450

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:

Borosilicate glass cell. Temperature measured with platinum resistance thermometer. Pressure measured with Bourdon gauge. Samples of methane added to eicosane and equilibriated. Liquid phase composition estimated fromn known overall composition and volume of both phases. Details in ref. (1).

SOURCE AND PURITY OF MATERIALS:

1. Matheson pure grade, further purified by distillation and absorption. Final purity better than 99.5 mole per cent.
2. Humphrey Wilkinson sample, minimum purity 99 mole per cent

ESTIMATED ERROR:

$\partial T/K = \pm 0.25$; $\partial P/MPa = \pm 0.05$; $\partial x = \pm 0.002$

REFERENCES:

1. Lee, K. H.; Kohn, J. P.; *J. Chem. Eng. Data*, 1969, *14* 292.

COMPONENTS:	ORIGINAL MEASUREMENTS:
1. Methane; CH_4; [74-82-8] 2. Dotriacontane; $C_{32}H_{66}$; [544-85-4]	Cordeiro, D. J.; Luks, K. D.; Kohn, J. P. *Ind. Eng. Chem. Process. Des. Develop.* 1973, *12*, 47-51.
VARIABLES:	PREPARED BY:
Temperature, pressure	C. L. Young

EXPERIMENTAL VALUES:

T/K	P/MPa	Mole fraction of methane in liquid, x_{CH_4}
343.15	1.585	0.1000
	2.025	0.1250
	2.475	0.1500
	2.960	0.1750
	3.480	0.2000
	4.040	0.2250
	4.630	0.2500
	5.250	0.2750
	5.900	0.3000
	6.550	0.3250

Molar volume data in source.

AUXILIARY INFORMATION

METHOD/APPARATUS/PROCEDURE:	SOURCE AND PURITY OF MATERIALS:
A known amount of gas added to a known amount of solvent in a 10 cm^3 glass equilibrium cell. Liquid phase composition determined from overall composition and volume of both phases. Details in source.	1. Phillips Petroleum pure grade samples, purity better than 99 mole per cent. 2. Humphrey Chemical Co. sample, minimum purity 97 mole per cent.
	ESTIMATED ERROR: $\delta T/K = \pm 0.02$; $\delta P/MPa = \pm 0.007$; $\delta x_{CH_4} = \pm 0.001$ (estimated by compiler).
	REFERENCES: