

**J. Gmehling  
U. Onken  
J. R. Rarey-Nies**

# **VAPOR-LIQUID EQUILIBRIUM DATA COLLECTION**

**Aqueous Systems  
(Supplement 2)**



**Chemistry Data Series**

**Vol. I, Part 1b**

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**Editors: Dieter Behrens, Reiner Eckermann**

# Vapor-Liquid Equilibrium Data Collection

**1b**

**Aqueous Systems  
(Supplement 2)**

Tables and diagrams of data for binary and  
multicomponent mixtures up to moderate pressures.  
Constants of correlation equations.

**J. Gmehling, U. Onken, J. R. Rarey-Nies**

Lehrstuhl Technische Chemie B  
(Prof. Dr. U. Onken)  
Universität Dortmund

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**1b**

**Aqueous Systems  
(Supplement 2)**

**Systems with:**

**Deuterium oxide**

**Water**

## SUBJECTS OF VOLUME I

The table lists the parts of Volume I already published or in preparation.

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Supplement 1	1a (1981)
Supplement 2	1b (1988)
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Alcohols	2a (1977)
Alcohols and Phenols	2b (1978)
Supplement 1	2c (1982)
Supplement 2	2d (1982)
Supplement 3	2e (1988)
Supplement 4	2f (in prep.)
Aldehydes, Ketones, Ethers	3/4 (1979)
Supplement 1, Aldehydes, Ketones	3a (in prep.)
Supplement 1, Ethers	4a (in prep.)
Carboxylic Acids, Anhydrides, Esters	5 (1982)
Supplement 1	5a (in prep.)
Aliphatic Hydrocarbons C <sub>4</sub> -C <sub>6</sub>	6a (1980)
Aliphatic Hydrocarbons C <sub>7</sub> -C <sub>18</sub>	6b (1980)
Supplement 1	6c (1984)
Supplement 2	6d (in prep.)
Aromatic Hydrocarbons	7 (1980)
Supplement 1	7a (in prep.)
Halogen, Nitrogen, Sulfur and other Compounds	8 (1984)
Supplement 1	8a (in prep.)

## AUTHORS' PREFACE

Since 1984, when the two last volumes of our Vapor-Liquid Equilibrium Data Collection were published, a large quantity of new experimental data have been reported in the literature. These data were added to our Dortmund Data Bank (DDB). At the same time we extended our data bank to other thermodynamic mixture properties, i. e. liquid-liquid equilibria and heats of mixing, in collaboration with the group of Prof. A. Fredenslund (Lyngby, Denmark), and built up new data files for gas solubilities in collaboration with the group of Prof. H. Knapp (Berlin, Germany), excess heat capacities and activity coefficients at infinite dilution (this latter data file has been developed in collaboration with the groups of Prof. A. G. Medina (Porto, Portugal) and Prof. P. Alessi and Prof. I. Kikić (Trieste, Italy)).

All these activities are aimed at supplying the basis for the improvement and development of thermodynamic models of mixtures. Of course, we are also aware of the interest of users in industry and research who do not have access to the data in our data bank by network or in-house version. Therefore we are now starting the publication of a new series of supplements to the VLE Data Collection.

The present work will cover data for mixtures containing water, which were added to our data bank in the period from 1979, when Part 1a (first supplement to Part 1) was finished, up to 1987. Because of their great practical importance we have decided to include systems containing HCl, H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, NH<sub>3</sub> and N<sub>2</sub>H<sub>4</sub> in this part. Apart from this, we have made a few minor changes in the data tables. For example, for binary systems the activity coefficients at infinite dilution are given for each model equation. Recommended parameter values are now also given for systems containing carboxylic acids, taking into account vapor-phase non-ideality via the chemical theory. As for systems with more than two components, in general we refrained from tabulating the values of model parameters obtained by a fit to experimental multicomponent data. On the basis of our experience, parameters from binary and ternary data should be used in these cases.

On this occasion, we should like to thank all the colleagues who have sent us reprints and reports of new VLE data. We are also grateful to Dr. R. Eckermann and Mr. M. Groves from DECHEMA (Frankfurt/M) for their efforts in starting this new series of supplements.

From our team, the following members helped in the preparation of this supplement volume: Mrs. L. Kunzner, who was responsible for the input to the computer, Mrs. A. Nies, who did all the sorting, Mr. cand. ing. R. Treckmann, Mr. cand. chem. A. Thimm and Mrs. cand. ing. B. Urbanski. We should like to thank them for their diligence and enthusiasm.

Dortmund, October 1987

J. Gmehling

U. Onken

J. R. Rarey-Nies

## PREFACE OF EDITORS

The DECHEMA Chemistry Data Series is concerned with the physical and thermodynamic property data of chemical compounds and their mixtures in the fluid state, in particular PVT and phase equilibrium data, heat capacity, enthalpy and entropy data and transport and interfacial tension data.

Thermophysical property information is required by those engaged in process design and development. Chemical engineering calculations demand accurate data and appropriate correlation methods which are often difficult to locate in the open literature. There is thus a pressing need for classified, critically evaluated and comprehensive experimental data, a need which this Series aims to meet.

DECHEMA gives authors, especially from universities, the opportunity to publish not only their theoretical results, but also their measured or compiled data, often a large amount, which would otherwise have never been published.

The research work of Prof. Gmehling, Prof. Onken and co-workers on vapor-liquid equilibria, which was partly supported by the Federal Ministry of Research and Technology and by DECHEMA, has been very fruitful; in particular, it led to an extension of the UNIFAC method. The authors have produced what is probably the largest collection of vapor-liquid equilibrium data available today. This data collection is being published as Volume 1 of the DECHEMA Chemistry Data Series. The appearance of Part 8 in 1984 marked the completion of Volume 1 for the time being. Since then, further data has become available, and will be published over the next few years.

We hope that this volume will give all those whose work involves vapor-liquid equilibrium a useful tool to help them solve their problems more easily and quickly than before.

Frankfurt/Main, July 1988

Dieter Behrens  
Reiner Eckermann

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## Formula Index of Systems

R = RECOMMENDED VALUES

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
=====			
D2O	Deuterium oxide		
CH3DO	o-Deuteromethanol		1
CH4O	Methanol		2
C2H5DO	o-Deuteroethanol		3- 4
C2H6O	Ethanol		5
=====			
H2O	Water		
BrH	Hydrogen bromide		6- 9
		C1H	Hydrogen chloride 422
CHN	Hydrogen cyanide	C3H5Cl	3-Chloro-1-propene 423
CH2O	Formaldehyde		10- 14
CH2O2	Formic acid		15- 18 19 1
		C2H6O	Ethanol
		C3H6O2	Ethyl formate 563-565
		C3H6O2	Ethyl formate
		C2H6O	Ethanol 563-565
		C5H4O2	Furfural 424-426
CH3DO	o-Deuteromethanol		20
CH3NO2	Nitromethane		21
		C3H8O	2-Propanol 427
CH4O	Methanol		22- 33 34- 35 F
		C2H4O	Acetaldehyde
		C4H10O2	1,1-Dimethoxyethane 566
		C2H4O2	Acetic acid 428
		C2H4O2	Acetic acid
		C3H6O2	Methyl acetate 567-568
		C2H6O	Ethanol
		C4H10O	1-Butanol 569
		C2H6O2	1,2-Ethanediol
		C4H10O3	Diethylene glycol 570
		C3H6O	Acetone 429
		C3H6O	Propionic aldehyde 430

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
CH4O	Methanol	C3H6O2 Methyl acetate C2H4O2 Acetic acid	567-568
		C3H8O3 Glycerol	431
		C4H6O2 Vinyl acetate	432
		C4H8O2 1,4-Dioxane	433-435
		C4H10O 1-Butanol C2H6O Ethanol	569
		C4H10O2 1,1-Dimethoxyethane C2H4O Acetaldehyde	566
		C4H10O3 Diethylene glycol C2H6O2 1,2-Ethanediol	570
		C5H10O2 Valeric acid	436
		C6H6 Benzene	437-438
		C6H12O2 Butyl acetate	439
		C8H16O2 Octanoic acid	440
C2H3N	Acetonitrile		36- 37
C2H4O	Acetaldehyde		38- 40
		CH4O Methanol C4H10O2 1,1-Dimethoxyethane	566
		C2H6O Ethanol	441-442
		C3H6O2 Methyl acetate	443
		C4H6O2 Vinyl acetate	444
		C4H10O2 1,1-Dimethoxyethane CH4O Methanol	566
C2H4O	Ethylene oxide		41- 42
C2H4O2	Acetic acid		43- 78 79- 81 R
		CH4O Methanol	428
		CH4O Methanol C3H6O2 Methyl acetate	567-568
		C3H6O2 Methyl acetate	445-446
		C3H6O2 Methyl acetate CH4O Methanol	567-568
		C4H8O2 Ethyl acetate	447-448

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C2H4O2	Acetic acid	C4H8O2 Methyl propionate	449-450
		C4H10O2 2-Ethoxyethanol	
		C6H12O3 1,2-Ethanediol-monoacetate- monoethylether	571
		C5H5N Pyridine	451
		C5H8O2 Vinyl propionate	452
		C6H4Cl2 o-Dichlorobenzene	453
		C6H12O2 Propyl propionate	454
		C6H12O3 1,2-Ethanediol-monoacetate-mono- ethylether	
		C4H10O2 2-Ethoxyethanol	571
		C7H12O4 Diethyl malonate	455
		C7H14O2 Butyl propionate	456
		C8H15N Caprylonitrile	457
		C9H10O2 Benzyl acetate	458
C2H5DO	o-Deuteroethanol		82
C2H6O	Ethanol		83-111 112-114 R
		CH2O2 Formic acid	
		C3H6O2 Ethyl formate	563-565
		CH4O Methanol	
		C4H10O 1-Butanol	569
		C2H4O Acetaldehyde	441-442
		C2H6O2 1,2-Ethanediol	459-460
		C2H7NO Ethanolamine	461-463
		C3H6O Propionic aldehyde	464
		C3H6O2 Ethyl formate	
		CH2O2 Formic acid	563-565
		C3H8O 1-Propanol	465-470
		C3H8O 1-Propanol	
		C4H10O 1-Butanol	572-573
		C3H8O 2-Propanol	471-472
		C4H6O2 Vinyl acetate	473
		C4H8O2 Ethyl acetate	474-478

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C2H6O	Ethanol	C4H100 1-Butanol	479-484
		C4H100 1-Butanol CH40 Methanol	569
		C4H100 1-Butanol C3H80 1-Propanol	572-573
		C4H100 Diethyl ether	485-486
		C4H100 2-Methyl-1-propanol	487-491
		C5H6O2 Furfuryl alcohol	492
		C5H120 3-Methyl-1-butanol	493
		C5H120 1-Pentanol	494
		C6H6 Benzene	495-497
		C6H12 Cyclohexane	498-499
		C6H1202 Butyl acetate	500
		C7H1402 Isopentyl acetate	501-505
C2H6OS	Dimethylsulfoxide		115-118 119 R
C2H6O2	1,2-Ethanediol		120-127
		CH40 Methanol C4H1003 Diethylene glycol	570
		C2H6O Ethanol	459-460
		C4H1003 Diethylene glycol	506
		C4H1003 Diethylene glycol CH40 Methanol	570
C2H7N	Ethylamine		128
C2H7NO	Ethanolamine		129-133
		C2H6O Ethanol	461-463
C2H8N2	Ethylenediamine		134
C3H4O	Acrolein		135-137
C3H4O2	Acrylic acid		138
C3H5C1	3-Chloro-1-propene	CHN Hydrogen cyanide	423

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C3H6O	Acetone		139-152 153 R
		CH40 Methanol	429
		C4H6O Croton aldehyde	507
		C4H6O2 Vinyl acetate	508
		C4H8O2 1,4-Dioxane	509-510
		C5H6O2 Furfuryl alcohol	511
		C6H12O2 Butyl acetate	512
		C6H14 Hexane	513
		C9H12O 1-Phenyl-2-propanol	514
C3H6O	Allyl alcohol	C3H8O 1-Propanol C3H8O 2-Propanol	574
		C3H8O 2-Propanol C3H8O 1-Propanol	574
		C4H5N Allylcyanide	515
C3H6O	Propionic aldehyde	CH40 Methanol	430
		C2H6O Ethanol	464
C3H6O2	Ethyl formate	CH2O2 Formic acid C2H6O Ethanol	563-565
		C2H6O Ethanol CH2O2 Formic acid	563-565
C3H6O2	Methyl acetate		154-155
		CH40 Methanol C2H4O2 Acetic acid	567-568
		C2H4O Acetaldehyde	443
		C2H4O2 Acetic acid	445-446
		C2H4O2 Acetic acid CH40 Methanol	567-568
		C4H6O2 Vinyl acetate	516
C3H6O2	Propionic acid		156 R
C3H6O3	1,3,5-Trioxane		157
C3H7NO	N,N-Dimethylformamide		158-164
C3H7NO	N-Methylacetamide		165-168

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
-----			
H2O	Water		
-----			
C3H8O	1-Propanol	C2H6O Ethanol	465-470
-----			
		C2H6O Ethanol	
		C4H10O 1-Butanol	572-573
-----			
		C3H6O Allyl alcohol	
		C3H8O 2-Propanol	574
-----			
		C3H8O 2-Propanol	
		C3H6O Allyl alcohol	574
-----			
		C3H9NO 3-Amino-1-propanol	517-519
-----			
		C4H10O 1-Butanol	
		C2H6O Ethanol	572-573
-----			
		C5H10O2 Propyl acetate	520-523
-----			
		C6H6 Benzene	524-525
-----			
		C6H12 1-Hexene	526-527
-----			
		C7H14 1-Heptene	528
-----			
		C8H18 Octane	529
-----			
C3H8O	2-Propanol		169-178 179-180 R
-----			
		CH3NO2 Nitromethane	427
-----			
		C2H6O Ethanol	471-472
-----			
		C3H6O Allyl alcohol	
		C3H8O 1-Propanol	574
-----			
		C3H8O 1-Propanol	
		C3H6O Allyl alcohol	574
-----			
		C6H6 Benzene	530
-----			
		C6H6O Phenol	531-536
-----			
C3H8O2	1,2-Propanediol		181
-----			
C3H8O3	Glycerol		182-188
-----			
		CH4O Methanol	431
-----			
C3H9N	Isopropylamine		189
-----			
C3H9N	Propylamine		190
-----			
C3H9NO	3-Amino-1-propanol	C3H8O 1-Propanol	517-519
-----			
C4H5N	Allyl cyanide		191
-----			
		C3H6O Allyl alcohol	515
-----			

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C4H5N	Crotonitrile (cis)		192
C4H5N	Crotonitrile (trans)		193
C4H6O	Croton aldehyde		194-195
		C3H6O Acetone	507
		C4H8O 2-Butanone	537
		C4H8O Butyraldehyde	538
C4H6O2	Methacrylic acid		196-197
C4H6O2	Vinyl acetate	CH4O Methanol	432
		C2H4O Acetaldehyde	444
		C2H6O Ethanol	473
		C3H6O Acetone	508
		C3H6O2 Methyl acetate	516
C4H6O3	Acetic anhydride		198
C4H6O3	Propylene carbonate		199-203
C4H8O	2-Butanone		204-210 211 R
		C4H6O Croton aldehyde	537
		C5H6O2 Furfuryl alcohol	539
C4H8O	Butyraldehyde		212-218
		C4H6O Croton aldehyde	538
C4H8O	Isobutyraldehyde	C4H10O 2-Methyl-1-propanol	540-541
C4H8O	Tetrahydrofuran		219-221
C4H8O2	1,4-Dioxane		222-229
		CH4O Methanol	433-435
		C3H6O Acetone	509-510
C4H8O2	Ethyl acetate		230-237
		C2H4O2 Acetic acid	447-448
		C2H6O Ethanol	474-478
C4H8O2	Methyl propionate	C2H4O2 Acetic acid	449-450
C4H9NO	N,N-Dimethylacetamide		238-240

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C4H9NO	Morpholine		241-244
C4H10O	1-Butanol		245-253 254 R
		CH4O C2H6O	Methanol Ethanol 569
		C2H6O	Ethanol 479-484
		C2H6O CH4O	Ethanol Methanol 569
		C2H6O C3H8O	Ethanol 1-Propanol 572-573
		C3H8O C2H6O	1-Propanol Ethanol 572-573
		C4H10O	tert-Butanol 542
		C6H12O2	Butyl acetate 543
		C8H16O2	Butyl butyrate 544
C4H10O	2-Butanol		255-256
		C5H10O2	Propyl acetate 545-546
		C9H12	Isopropylbenzene 547
C4H10O	tert-Butanol	C4H10O	1-Butanol 542
		C10H22	Decane 548
C4H10O	Diethyl ether		257
		C2H6O	Ethanol 485-486
C4H10O	2-Methyl-1-propanol		258-259
		C2H6O	Ethanol 487-491
		C4H8O	Isobutyraldehyde 540-541
		C5H10O	3-Methylbutyraldehyde 549
C4H10O2	1,4-Butanediol		260
C4H10O2	2,3-Butanediol		261-271 272 R
C4H10O2	1,1-Dimethoxyethane	CH4O C2H4O	Methanol Acetaldehyde 566
		C2H4O CH4O	Acetaldehyde Methanol 566



## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C4H10O2	2-Ethoxyethanol		273-275
		C2H4O2 Acetic acid	
		C6H12O3 1,2-Ethanediol-monoacetate-mono-ethylether	571
		C6H12O3 1,2-Ethanediol-monoacetate-mono-ethylether	
		C2H4O2 Acetic acid	571
C4H10O3	Diethylene glycol		276-278
		CH4O Methanol	
		C2H6O2 1,2-Ethanediol	570
		C2H6O2 1,2-Ethanediol	506
		C2H6O2 1,2-Ethanediol	
		CH4O Methanol	570
		C6H6O Phenol	550
C4H11NO	2-(Dimethylamino)ethanol		279-280
C5H4O2	Furfural	CH2O2 Formic acid	424-426
C5H5N	Pyridine		281-283 284 R
		C2H4O2 Acetic acid	451
		C6H6 Benzene	551
C5H6O2	Furfuryl alcohol		285-286
		C2H6O Ethanol	492
		C3H6O Acetone	511
		C4H8O 2-Butanone	539
C5H8O2	Vinyl propionate	C2H4O2 Acetic acid	452
C5H9NO	N-Methylpyrrolidone(2)		287-291
C5H10O	3-Methyl-3-buten-1-ol		292-293
		C6H12O2 4,4-Dimethyl-1,3-dioxane	552-553
C5H10O	3-Methylbutyraldehyde	C4H10O 2-Methyl-1-propanol	549
C5H10O	Valeraldehyde		294
C5H10O2	2-(Hydroxymethyl)-tetrahydrofuran		295-297

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C5H10O2	Propyl acetate		298-304
		C3H8O 1-Propanol	520-523
		C4H10O 2-Butanol	545-546
C5H10O2	Valeric acid	CH4O Methanol	436
C5H11N	Piperidine		305-306
C5H12O	3-Methyl-1-butanol		307-308
		C2H6O Ethanol	493
C5H12O	1-Pentanol		309-310
		C2H6O Ethanol	494
C5H12O	2-Pentanol		311-313
C6H4Cl2	o-Dichlorobenzene		314
		C2H4O2 Acetic acid	453
C6H6	Benzene	CH4O Methanol	437-438
		C2H6O Ethanol	495-497
		C3H8O 1-Propanol	524-525
		C3H8O 2-Propanol	530
		C5H5N Pyridine	551
		C6H7N 2-Methylpyridine	554
		C6H12O2 Butyl acetate	555
C6H6ClN	m-Chloroaniline		315
C6H6O	Phenol		316-319
		C3H8O 2-Propanol	531-536
		C4H10O3 Diethylene glycol	550
		ClH Hydrogen chloride	556-559
C6H7N	Aniline		320
C6H7N	2-Methylpyridine		321-322
		C6H6 Benzene	554
C6H7N	3-Methylpyridine		323
C6H7N	4-Methylpyridine		324-327

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C6H100	Cyclohexanone		328-330
		C6H11N02 Nitrocyclohexane	560
C6H100	Methyldihydropyran	C6H1202 4,4-Dimethyl-1,3-dioxane	561-562
C6H11N0	6-Caprolactam		331-334
C6H11N02	Nitrocyclohexane	C6H100 Cyclohexanone	560
C6H12	Cyclohexane	C2H60 Ethanol	498-499
C6H12	1-Hexene	C3H80 1-Propanol	526-527
C6H120	4-Methyl-2-pentanone		335-337
C6H1202	Butyl acetate		338-339
		CH40 Methanol	439
		C2H60 Ethanol	500
		C3H60 Acetone	512
		C4H100 1-Butanol	543
		C6H6 Benzene	555
C6H1202	4,4-Dimethyl-1,3-dioxane		340
		C5H100 3-Methyl-3-buten-1-ol	552-553
		C6H100 Methyldihydropyran	561-562
C6H1202	Propyl propionate	C2H402 Acetic acid	454
C6H1203	1,2-Ethanediol-monoacetate- monoethylether	C2H402 Acetic acid C4H1002 2-Ethoxyethanol	571
		C4H1002 2-Ethoxyethanol C2H402 Acetic acid	571
C6H13N	2-Methylpiperidine		341-342
C6H14	Hexane	C3H60 Acetone	513
C6H140	1-Hexanol		343
C6H140	4-Methyl-2-pentanol		344
C6H19N	Triethylamine		345-347
C7H9N	2,6-Dimethylpyridine		348
C7H1204	Diethyl malonate	C2H402 Acetic acid	455
C7H14	1-Heptene	C3H80 1-Propanol	528

## Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
H2O	Water		
C7H14O2	Butyl propionate	C2H4O2	Acetic acid 456
C7H14O2	Isopentyl acetate	C2H6O	Ethanol 501-505
C8H15N	Caprylonitrile	C2H4O2	Acetic acid 457
C8H16O2	Butyl butyrate	C4H10O	1-Butanol 544
C8H16O2	Octanoic acid	CH4O	Methanol 440
C8H18	Octane	C3H8O	1-Propanol 529
C8H18O	2-Ethyl-1-hexanol		349-350
C8H18O	1-Octanol		351
C9H10O2	Benzyl acetate	C2H4O2	Acetic acid 458
C9H12	Isopropylbenzene		352
		C4H10O	2-Butanol 547
C9H12O	1-Phenyl-2-propanol	C3H6O	Acetone 514
C10H14N2	Nicotine		353
C10H22	Decane	C4H10O	tert-Butanol 548
C1H	Hydrogen chloride		354-362
		BrH	Hydrogen bromide 422
		C6H6O	Phenol 556-559
FH	Hydrogen fluoride		363-372
HI	Hydrogen iodide		373
HNO3	Nitric acid		374-398
H2O2	Hydrogen peroxide		399-404 405 R
H3N	Ammonia		406
H4N2	Hydrazine		407-420 421 R

## Alphabetical Index of Systems

R = RECOMMENDED VALUES

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Deuterium oxide	D2O		
o-Deuteroethanol	C2H5DO		3- 4
o-Deuteromethanol	CH3DO		1
Ethanol	C2H6O		5
Methanol	CH4O		2
Water	H2O		
Acetaldehyde	C2H4O		38- 40
		1,1-Dimethoxyethane Methanol	C4H10O2 CH4O 566
		Ethanol	C2H6O 441-442
		Methanol	CH4O
		1,1-Dimethoxyethane	C4H10O2 566
		Methyl acetate	C3H6O2 443
		Vinyl acetate	C4H6O2 444
Acetic acid	C2H4O2		43- 78 79- 81 R
		Benzyl acetate	C9H10O2 458
		Butyl propionate	C7H14O2 456
		Caprylonitrile	C8H15N 457
		o-Dichlorobenzene	C6H4Cl2 453
		Diethyl malonate	C7H12O4 455
		1,2-Ethanediol-monoacetate- monoethylether	C6H12O3
		2-Ethoxyethanol	C4H10O2 571
		2-Ethoxyethanol	C4H10O2
		1,2-Ethanediol-monoacetate- monoethylether	C6H12O3 571
		Ethyl acetate	C4H8O2 447-448
		Methanol	CH4O 428
		Methanol	CH4O
		Methyl acetate	C3H6O2 567-568
		Methyl acetate	C3H6O2 445-446

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
Acetic acid	C2H4O2	Methyl acetate Methanol	C3H6O2 CH4O 567-568
		Methyl propionate	C4H8O2 449-450
		Propyl propionate	C6H12O2 454
		Pyridine	C5H5N 451
		Vinyl propionate	C5H8O2 452
Acetic anhydride	C4H6O3		198
Acetone	C3H6O		139-152 153 R
		Butyl acetate	C6H12O2 512
		Croton aldehyde	C4H6O 507
		1,4-Dioxane	C4H8O2 509-510
		Furfuryl alcohol	C5H6O2 511
		Hexane	C6H14 513
		Methanol	CH4O 429
		1-Phenyl-2-propanol	C9H12O 514
		Vinyl acetate	C4H6O2 508
Acetonitrile	C2H3N		36- 37
Acrolein	C3H4O		135-137
Acrylic acid	C3H4O2		138
Allyl alcohol	C3H6O	Allylcyanide	C4H5N 515
		1-Propanol	C3H8O
		2-Propanol	C3H8O 574
		2-Propanol	C3H8O
		1-Propanol	C3H8O 574
Allylcyanide	C4H5N		191
		Allyl alcohol	C3H6O 515
3-Amino-1-propanol	C3H9NO	1-Propanol	C3H8O 517-519
Ammonia	H3N		406
Aniline	C6H7N		320

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
Benzene	C6H6	Butyl acetate	C6H12O2 555
		Ethanol	C2H6O 495-497
		Methanol	CH4O 437-438
		2-Methylpyridine	C6H7N 554
		1-Propanol	C3H8O 524-525
		2-Propanol	C3H8O 530
		Pyridine	C5H5N 551
Benzyl acetate	C9H10O2	Acetic acid	C2H4O2 458
1,4-Butanediol	C4H10O2		260
2,3-Butanediol	C4H10O2		261-271 272 R
1-Butanol	C4H10O		245-253 254 R
		tert-Butanol	C4H10O 542
		Butyl acetate	C6H12O2 543
		Butyl butyrate	C8H16O2 544
		Ethanol	C2H6O 479-484
		Ethanol	C2H6O
		Methanol	CH4O 569
		Ethanol	C2H6O
		1-Propanol	C3H8O 572-573
		Methanol	CH4O
		Ethanol	C2H6O 569
		1-Propanol	C3H8O
		Ethanol	C2H6O 572-573
2-Butanol	C4H10O		255-256
		Isopropylbenzene	C9H12 547
		Propyl acetate	C5H10O2 545-546
tert-Butanol	C4H10O	1-Butanol	C4H10O 542
		Decane	C10H22 548
2-Butanone	C4H8O		204-210 211 R
		Croton aldehyde	C4H6O 537
		Furfuryl alcohol	C5H6O2 539

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
Butyl acetate	C6H12O2		338-339
		Acetone	C3H6O 512
		Benzene	C6H6 555
		1-Butanol	C4H10O 543
		Ethanol	C2H6O 500
		Methanol	CH4O 439
Butyl butyrate	C8H16O2	1-Butanol	C4H10O 544
Butyl propionate	C7H14O2	Acetic acid	C2H4O2 456
Butyraldehyde	C4H8O		212-218
		Croton aldehyde	C4H6O 538
6-Caprolactam	C6H11NO		331-334
Caprylonitrile	C8H15N	Acetic acid	C2H4O2 457
m-Chloroaniline	C6H6ClN		315
3-Chloro-1-propene	C3H5Cl	Hydrogen cyanide	CHN 423
Croton aldehyde	C4H6O		194-195
		Acetone	C3H6O 507
		2-Butanone	C4H8O 537
		Butyraldehyde	C4H8O 538
Crotonitrile (cis)	C4H5N		192
Crotonitrile (trans)	C4H5N		193
Cyclohexane	C6H12	Ethanol	C2H6O 498-499
Cyclohexanone	C6H10O		328-330
		Nitrocyclohexane	C6H11NO2 560
Decane	C10H22	tert-Butanol	C4H10O 548
o-Deuteroethanol	C2H5DO		82
o-Deuteromethanol	CH3DO		20
o-Dichlorobenzene	C6H4Cl2		314
		Acetic acid	C2H4O2 453



## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
Diethylene glycol	C4H10O3		276-278
		1,2-Ethanediol	C2H6O2 506
		1,2-Ethanediol Methanol	C2H6O2 CH4O 570
		Methanol 1,2-Ethanediol	CH4O C2H6O2 570
		Phenol	C6H6O 550
Diethyl ether	C4H10O		257
		Ethanol	C2H6O 485-486
Diethyl malonate	C7H12O4	Acetic acid	C2H4O2 455
1,1-Dimethoxyethane	C4H10O2	Acetaldehyde Methanol	C2H4O CH4O 566
		Methanol Acetaldehyde	CH4O C2H4O 566
N,N-Dimethylacetamide	C4H9NO		238-240
2-(Dimethylamino)ethanol	C4H11NO		279-280
4,4-Dimethyl-1,3-dioxane	C6H12O2		340
		3-Methyl-3-buten-1-ol	C5H10O 552-553
		Methyl-dihydropyran	C6H10O 561-562
N,N-Dimethylformamide	C3H7NO		158-164
2,6-Dimethylpyridine	C7H9N		348
Dimethylsulfoxide	C2H6OS		115-118 119 R
1,4-Dioxane	C4H8O2		222-229
		Acetone	C3H6O 509-510
		Methanol	CH4O 433-435
1,2-Ethanediol	C2H6O2		120-127
		Diethylene glycol	C4H10O3 506
		Diethylene glycol Methanol	C4H10O3 CH4O 506 570
		Ethanol	C2H6O 459-460
		Methanol Diethylene glycol	CH4O C4H10O3 570

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
1,2-Ethanediol-monoacetate-mono-ethylether	C6H12O3	Acetic acid 2-Ethoxyethanol	C2H4O2 C4H10O2 571
		2-Ethoxyethanol Acetic acid	C4H10O2 C2H4O2 571
Ethanol	C2H6O		83-111 112-114 R
		Acetaldehyde	C2H4O 441-442
		Benzene	C6H6 495-497
		1-Butanol	C4H10O 479-484
		1-Butanol Methanol	C4H10O CH4O 569
		1-Butanol 1-Propanol	C4H10O C3H8O 572-573
		Butyl acetate	C6H12O2 500
		Cyclohexane	C6H12 498-499
		Diethyl ether	C4H10O 485-486
		1,2-Ethanediol	C2H6O2 459-460
		Ethanolamine	C2H7NO 461-463
		Ethyl acetate	C4H8O2 474-478
		Ethyl formate Formic acid	C3H6O2 CH2O2 563-565
		Formic acid Ethyl formate	CH2O2 C3H6O2 563-565
		Furfuryl alcohol	C5H6O2 492
		Isopentyl acetate	C7H14O2 501-505
		Methanol	CH4O
		1-Butanol	C4H10O 569
		3-Methyl-1-butanol	C5H12O 493
		2-Methyl-1-propanol	C4H10O 487-491
		1-Pentanol	C5H12O 494
		1-Propanol	C3H8O 465-470
		1-Propanol 1-Butanol	C3H8O C4H10O 572-573
		2-Propanol	C3H8O 471-472

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
Ethanol	C2H6O	Propionic aldehyde	C3H6O 464
		Vinyl acetate	C4H6O2 473
Ethanolamine	C2H7NO		129-133
		Ethanol	C2H6O 461-463
2-Ethoxyethanol	C4H10O2		273-275
		Acetic acid	C2H4O2
		1,2-Ethanediol-monoacetate- monoethylether	C6H12O3 571
		1,2-Ethanediol-monoacetate- monoethylether	C6H12O3
		Acetic acid	C2H4O2 571
Ethyl acetate	C4H8O2		230-237
		Acetic acid	C2H4O2 447-448
		Ethanol	C2H6O 474-478
Ethylamine	C2H7N		128
Ethylenediamine	C2H8N2		134
Ethylene oxide	C2H4O		41- 42
Ethyl formate	C3H6O2	Ethanol	C2H6O
		Formic acid	CH2O2 563-565
		Formic acid	CH2O2
		Ethanol	C2H6O 563-565
2-Ethyl-1-hexanol	C8H18O		349-350
Formaldehyde	CH2O		10- 14
Formic acid	CH2O2		15- 18 19
		Ethanol	C2H6O
		Ethyl formate	C3H6O2 563-565
		Ethyl formate	C3H6O2
		Ethanol	C2H6O 563-565
		Furfural	C5H4O2 424-426
Furfural	C5H4O2	Formic acid	CH2O2 424-426
Furfuryl alcohol	C5H6O2		285-286
		Acetone	C3H6O 511
		2-Butanone	C4H8O 539
		Ethanol	C2H6O 492

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
Glycerol	C3H8O3		182-188
		Methanol	CH4O 431
1-Heptene	C7H14	1-Propanol	C3H8O 528
Hexane	C6H14	Acetone	C3H6O 513
1-Hexanol	C6H14O		343
1-Hexene	C6H12	1-Propanol	C3H8O 526-527
Hydrazine	H4N2		407-420 421 R
Hydrogen bromide	BrH		6- 9
		Hydrogen chloride	ClH 422
Hydrogen chloride	ClH		354-362
		Hydrogen bromide	BrH 422
		Phenol	C6H6O 556-559
Hydrogen cyanide	CHN	3-Chloro-1-propene	C3H5Cl 423
Hydrogen fluoride	FH		363-372
Hydrogen iodide	HI		373
Hydrogen peroxide	H2O2		399-404 405 R
2-(Hydroxymethyl)-tetrahydro- furan	C5H10O2		295-297
Isobutyraldehyde	C4H8O	2-Methyl-1-propanol	C4H10O 540-541
Isopentyl acetate	C7H14O2	Ethanol	C2H6O 501-505
Isopropylamine	C3H9N		189
Isopropylbenzene	C9H12		352
		2-Butanol	C4H10O 547
Methacrylic acid	C4H6O2		196-197
Methanol	CH4O		22- 33 34- 35 R
		Acetaldehyde	C2H4O
		1,1-Dimethoxyethane	C4H10O2 566
		Acetic acid	C2H4O2 428
		Acetic acid	C2H4O2
		Methyl acetate	C3H6O2 567-568

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
Methanol	CH4O	Acetone C3H6O	429
		Benzene C6H6	437-438
		1-Butanol Ethanol C4H10O C2H6O	569
		Butyl acetate C6H12O2	439
		Diethylene glycol 1,2-Ethanediol C4H10O3 C2H6O2	570
		1,1-Dimethoxyethane Acetaldehyde C4H10O2 C2H4O	566
		1,4-Dioxane C4H8O2	433-435
		1,2-Ethanediol Diethylene glycol C2H6O2 C4H10O3	570
		Ethanol 1-Butanol C2H6O C4H10O	569
		Glycerol C3H8O3	431
		Methyl acetate Acetic acid C3H6O2 C2H4O2	567-568
		Octanoic acid C8H16O2	440
		Propionic aldehyde C3H6O	430
		Valeric acid C5H10O2	436
		Vinyl acetate C4H6O2	432
N-Methylacetamide	C3H7NO		165-168
Methyl acetate	C3H6O2		154-155
		Acetaldehyde C2H4O	443
		Acetic acid C2H4O2	445-446
		Acetic acid Methanol C2H4O2 CH4O	567-568
		Methanol Acetic acid CH4O C2H4O2	567-568
		Vinyl acetate C4H6O2	516
3-Methyl-1-butanol	C5H12O		307-308
		Ethanol C2H6O	493
3-Methyl-3-buten-1-ol	C5H10O		292-293
		4,4-Dimethyl-1,3-dioxane C6H12O2	552-553

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
3-Methylbutyraldehyde	C5H10O	2-Methyl-1-propanol	C4H10O 549
Methyl-dihydropyran	C6H10O	4,4-Dimethyl-1,3-dioxane	C6H12O2 561-562
4-Methyl-2-pentanol	C6H14O		344
4-Methyl-2-pentanone	C6H12O		335-337
2-Methylpiperidine	C6H13N		341-342
2-Methyl-1-propanol	C4H10O		258-259
		Ethanol	C2H6O 487-491
		Isobutyraldehyde	C4H8O 540-541
		3-Methylbutyraldehyde	C5H10O 549
Methyl propionate	C4H8O2	Acetic acid	C2H4O2 449-450
2-Methylpyridine	C6H7N		321-322
		Benzene	C6H6 554
3-Methylpyridine	C6H7N		323
4-Methylpyridine	C6H7N		324-327
N-Methylpyrrolidone(2)	C5H9NO		287-291
Morpholine	C4H9NO		241-244
Nicotine	C10H14N2		353
Nitric acid	HNO3		374-398
Nitrocyclohexane	C6H11NO2	Cyclohexanone	C6H10O 560
Nitromethane	CH3NO2		21
		2-Propanol	C3H8O 427
Octane	C8H18	1-Propanol	C3H8O 529
Octanoic acid	C8H16O2	Methanol	CH4O 440
1-Octanol	C8H18O		351
1-Pentanol	C5H12O		309-310
		Ethanol	C2H6O 494
2-Pentanol	C5H12O		311-313
Phenol	C6H6O		316-319
		Diethylene glycol	C4H10O3 550
		Hydrogen chloride	ClH 556-559

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE		
Water	H2O				
	Phenol	C6H6O	2-Propanol	C3H8O	531-536
	1-Phenyl-2-propanol	C9H12O	Acetone	C3H6O	514
	Piperidine	C5H11N			305-306
	1,2-Propanediol	C3H8O2			181
	1-Propanol	C3H8O	Allyl alcohol	C3H6O	
			2-Propanol	C3H8O	574
			3-Amino-1-propanol	C3H9NO	517-519
			Benzene	C6H6	524-525
			1-Butanol	C4H10O	
			Ethanol	C2H6O	572-573
			Ethanol	C2H6O	465-470
			Ethanol	C2H6O	
			1-Butanol	C4H10O	572-573
			1-Heptene	C7H14	528
			1-Hexene	C6H12	526-527
			Octane	C8H18	529
			2-Propanol	C3H8O	
			Allyl alcohol	C3H6O	574
	1-Propanol	C3H8O	Propyl acetate	C5H10O2	520-523
	2-Propanol	C3H8O			169-178 179-180 R
			Allyl alcohol	C3H6O	
			1-Propanol	C3H8O	574
			Benzene	C6H6	530
			Ethanol	C2H6O	471-472
			Nitromethane	CH3NO2	427
			Phenol	C6H6O	531-536
			1-Propanol	C3H8O	
			Allyl alcohol	C3H6O	574
	Propionic acid	C3H6O2			156 R
	Propionic aldehyde	C3H6O	Ethanol	C2H6O	464
			Methanol	CH4O	430

## Alphabetical Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
Water	H2O		
Propyl acetate	C5H10O2		298-304
		2-Butanol	C4H10O 545-546
		1-Propanol	C3H8O 520-523
Propylamine	C3H9N		190
Propylene carbonate	C4H6O3		199-203
Propyl propionate	C6H12O2	Acetic acid	C2H4O2 454
Pyridine	C5H5N		281-283 284 R
		Acetic acid	C2H4O2 451
		Benzene	C6H6 551
Tetrahydrofuran	C4H8O		219-221
Triethylamine	C6H15N		345-347
1,3,5-Trioxane	C3H6O3		157
Valeraldehyde	C5H10O		294
Valeric acid	C5H10O2	Methanol	CH4O 436
Vinyl acetate	C4H6O2	Acetaldehyde	C2H4O 444
		Acetone	C3H6O 508
		Ethanol	C2H6O 473
		Methanol	CH4O 432
		Methyl acetate	C3H6O2 516
Vinyl propionate	C5H8O2	Acetic acid	C2H4O2 452