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VAPOR-LIQUID EQUILIBRIUM DATA COLLECTION

Aldehydes and Ketones

Ethers



Chemistry Data Series

Vol. I, Parts 3 + 4

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Editors: Dieter Behrens, Reiner Eckermann

Vapor-Liquid Equilibrium Data Collection

3 + 4

**Aldehydes and Ketones
Ethers**

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

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Aldehydes and Ketones

Systems with:

Aldehydes:

Acetaldehyde
Acrolein
Propionic Aldehyde
Crotonaldehyde

Butyraldehyde
Isobutyraldehyde
Furfural
Benzaldehyde

Ketones:

Acetone
Methyl Vinyl Ketone
2,3-Butanedione
2-Butanone
N-Methylpyrrolidone
Methyl Isopropyl Ketone
2-Pentanone

3-Pentanone
Cyclohexanone
3-Hexanone
4-Methyl-2-pentanone
1-Methyl-2-cyclohexanone
2-Heptanone
4-Heptanone

4

Ethers

Systems with:

Propylene Oxide
1,3,5-Trioxane
Dimethoxymethane
Bis(2-Chloroethyl) Ether
Tetrahydrofuran
1,4-Dioxane
Morpholine
Diethyl Ether

Dimethoxyethane
Ethyl Propyl Ether
Methyl Butyl Ether
Diisopropyl Ether
Dipropyl Ether
Ethyl Butyl Ether
Dibutyl Ether
Diethylene Glycol Butyl Ether

SUBJECTS OF VOLUME I

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

Subtitle	Vol. I, Part
Aqueous-Organic Systems Supplement 1	1 published 1a in prep.
Organic Hydroxy Compounds Alcohols Alcohols and Phenols Supplement 1	2a published 2b published 2c in prep.
Aldehydes, Ketones, Ethers	3/4 published
Esters and Carboxylic Acids	5 in prep.
Aliphatic Hydrocarbons	6a in prep. 6b in prep.
Aromatic Hydrocarbons	7 in prep.
Halogen, Nitrogen, Sulfur and other Compounds	8 in prep.

AUTHORS' PREFACE

With this, parts 3 + 4 of our Vapor-Liquid Equilibrium Data Collection we have extended the data sheets by adding recommended parameters for those systems for which at least two data sets exist fulfilling both the point and the integral consistency test according to our standardized procedure. With these optimized parameters for the Wilson, the NRTL, and the UNIQUAC equation, it is possible to perform VLE calculations for ranges of temperature and pressure. We have thus taken up a suggestion of many users of our collection. Again we should like to point out, that parameters should be used with judgement. This applies to the recommended values of VLE parameters, too, especially when calculations are to be performed for temperatures beyond the range in which the parameters have been evaluated. Recommended values for the systems of parts 1, 2a and 2b will be given in the first supplement.

Concerning constants of the van Laar equation, these will not be listed in the tables if unreasonable values result from the optimization procedure, e.g. different signs of the two constants, as occasionally happens.

We should like to express our thanks to Dr. M. Schönberg (Hoechst AG, Frankfurt/M) for supplying vapor pressure data from his collection, and again to Dr. H. Stage (Köln-Niehl) for making available to us VLE data which were hard to obtain otherwise. Special thanks are due to Dipl.-Phys. H. Preusch (computer center of the University of Dortmund) for giving constant help so readily. On this occasion we should also like to acknowledge with gratitude the efforts of the editors, especially of Dr. R. Eckermann. From our team the following members were engaged in the preparation of this part: Mrs. L. Kunzner, Mrs. U. Arlt, Miss B. Gabor, Dipl.-Ing. P. Grenzheuser, Miss G. Hennig, Dipl.-Ing. B. Kolbe.

Dortmund, February 1979

Ulfert Onken

Jürgen Gmehling

Wolfgang Arlt

University of Dortmund

PREFACE OF EDITORS

Subjects of this series are the physical and thermodynamic property data of chemical compounds and mixtures essentially for the fluid state covering PVT data, heat capacity, enthalpy, and entropy data, phase equilibrium data, transport and interfacial tension data.

The main purpose is to provide chemists and engineers with data for process design and development. For computer based calculations in process design appropriate correlation methods and accurate data must be used. These are only in some cases available in the open literature. For that reason the most urgent requirement regarding the publication of data is to offer classified and critically evaluated data, thus giving an impression which of them are reliable or not. This will be the goal of the series.

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

The work of Dr. Gmehling, Prof. Onken and Dipl.-Chem. Arlt on vapor-liquid equilibria which was supported by the Federal Ministry of Research and Technology and 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 that is today available with evaluation programs and experimental data.

We present the evaluation of this material in several parts of the first volume of the series. We hope that this gives particularly the users an instrument that will allow them to solve their problems considerably more easily and quickly than before.

Frankfurt/Main, February 1979

Dieter Behrens
Reiner Eckermann

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Morpholine	482
Diethyl Ether	483
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1,2-Dimethoxyethane	522
Ethyl Propyl Ether	523
Methyl Butyl Ether	527
Diisopropyl Ether	529
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Aldehydes

Formula Index of Systems

R=RECOMMENDED VALUES

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT	4TH COMPONENT	PAGE
=====				
C2H4O	ACETALDEHYDE			
C2H4O	ETHYLENE OXIDE			1- 2
C4H4O2	ACETIC ACID			3
C2H4O2	METHYL FORMATE			4
C3H6O	PROPYLENE OXIDE			5- 6
C4H6O2	VINYL ACETATE			7
C6H6	BENZENE			8
C7H8	TOLUENE			9
=====				
C3H4O	ACROLEIN			
C3H3N	ACRYLONITRILE			10- 12
C3H6O	ACETONE			13
=====				
C3H6O	PROPIONIC ALDEHYDE			
C3H6Cl2	1,2-DICHLOROPROPANE			14- 15
C3H6O	ACETONE			16
		C3H6O	PROPYLENE OXIDE	64
C3H6O	PROPYLENE OXIDE			17
C4H8O	2-BUTANONE			18
C6H12	CYCLOHEXANE			19
=====				
C4H6O	CROTONALDEHYDE			
C2H4O2	ACETIC ACID			20- 23
C3H6O	ACETONE			24- 26
C4H6O2	VINYL ACETATE			27- 30
=====				
C4H8O	BUTYRALDEHYDE			
C4H8O	ISOBUTYRALDEHYDE			31- 32
C7H8	TOLUENE			33
=====				
C4H8O	ISOBUTYRALDEHYDE			
C7H8	TOLUENE			34
=====				
C5H4O2	FURFURAL			
CCL4	TETRACHLOROETHANE			35
		C6H6	BENZENE	65
CHCL3	CHLOROFORM			36
C2HCL3	TRICHLORETHYLENE			37
C4H8	1-BUTENE			38- 39
C4H8	2-BUTENE (CIS)			40

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE	
=====				
C5H4O2	FURFURAL			
C4H10	2-METHYLPENTANE		41	
C5H6O	2-METHYLFURAN		42	
C6H6	BENZENE		43 = 44	
		C6H12	CYCLOHEXANE	66
		C7H16	2,4-DIMETHYLPENTANE	67
C6H12	CYCLOHEXANE		45	
C6H12O2	BUTYL ACETATE		46	
C7H8	TOLUENE		47 = 48	
		C7H14	METHYLCYCLOHEXANE	68 = 69
		C7H16	HEPTANE	70 = 71
		C8H18	2,2,4-TRIMETHYLPENTANE	72
C7H14	METHYLCYCLOHEXANE		49	
C7H16	HEPTANE		50	
C8H10	ETHYLBENZENE		51	
C8H10	P-XYLENE		52	
C8H16O2	OCTANOIC ACID		53 = 54	
C8H18	2,2,4-TRIMETHYLPENTANE		55	
C9H18O2	METHYL OCTANOATE		56 = 57	
C10H20O2	DECANOIC ACID		58	
C10H22	DECANE		59	
C11H22O2	METHYL DECANOATE		60 = 61	
=====				
C7H6O	BENZALDEHYDE			
C7H8	TOLUENE		62	
C9H10O2	BENZYL ACETATE		63	

Ketones

Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT	4TH COMPONENT	PAGE
C3H6O	ACETONE			
CCL3D	DEUTERIOCHLOROFORM			75-79 79 R
CCL4	TETRACHLOROETHANE			80-86 86 R
		C6H6	BENZENE	361-362
CHCL3	CHLOROFORM			87-128 127-128 R
		CS2	CARBON DISULFIDE	363-364
		C2CL4	TETRACHLOROETHYLENE	365-366
		C3H8O2	DIMETHOXYMETHANE	367-368
		C6H12O	4-METHYL-2-PENTANONE	369-370
		C6H14	2,3-DIMETHYLBUTANE	371
		C6H14	HEXANE	372-379
		C7H8	TOLUENE	380-381
CH3I	METHYL IODIDE	CS2	CARBON DISULFIDE	382
CS2	CARBON DISULFIDE			129-139 139 R
C2H2CL2	CIS-1,2-DICHLOROETHYLENE			140
C2H2CL2	TRANS-1,2-DICHLOROETHYLENE			141
C2H3CL3	1,1,2-TRICHLOROETHANE			142
C2H3N	ACETONITRILE			143
C2H4CL2	1,2-DICHLOROETHANE			144-146
		C6H6	BENZENE	383-385
C2H4O2	ACETIC ACID			147-152
C2H5I	ETHYL IODIDE			153
C2H6OS	DIMETHYLSULFOXIDE			154
C3H6O	PROPYLENE OXIDE			155-157
C3H6O2	ETHYL FORMATE			158
C3H6O2	METHYL ACETATE			159-163
		C3H6O2	ETHYL FORMATE	386
		C4H8O	2-BUTANONE	387
		C4H8O2	ETHYL ACETATE	388
C2H7NO	N,N-DIMETHYLFORMAMIDE			164
C3H8O2	DIMETHOXYMETHANE			165
C4H6O2	VINYL ACETATE			166-170 170 R
C4H6O3	ACETIC ANHYDRIDE			171-172
C4H8O	2-BUTANONE			173-175
		C4H8O2	ETHYL ACETATE	389
		C6H12	CYCLOHEXANE	390-391
C4H8O2	ETHYL ACETATE			176

Formula Index of Systems

Ketones

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
C3H6O	ACETONE		
C4H10O	DIETHYL ETHER		177-180
C5H5N	PYRIDINE		181
C5H8	ISOPRENE		182
		C5H12 2-METHYLBUTANE	392
C5H10	2-METHYL-1-BUTENE		183
C5H10	2-METHYL-2-BUTENE		184
C5H10O2	PROPYL ACETATE		185
C5H12	2-METHYLBUTANE		186
C5H12	PENTANE		187-191 191 R
C6H5Cl	CHLOROBENZENE		192-193
		C6H6 BENZENE	393-394
C6H6	BENZENE		194-209 209 R
		C6H12 CYCLOHEXANE	395-396
C6H12	CYCLOHEXANE		210-217 217 R
C6H12	1-HEXENE		218
C6H12O2	BUTYL ACETATE		219
C6H14	2,3-DIMETHYLBUTANE		220-221
C6H14	HEXANE		222-231 231 R
C7H8	TOLUENE		232-238 238 R
C7H16	HEPTANE		239-243 243 R
C8H20Si	TETRAETHYLSILANE		244-245
C10H22	DECANE		246-248 248 R
C12H26	DODECANE		249-250
C14H30	TETRADECANE		251-252
C4H6O	METHYL VINYL KETONE		
C4H5Cl	2-CHLORO-1,3-BUTADIENE		253
C4H6Cl2	1,3-DICHLORO-2-BUTENE		254
C4H6O2	2,3-BUTANEDIONE		
C2H4O2	ACETIC ACID		255
C7H8	TOLUENE		256
C7H14	METHYLCYCLOHEXANE		257

Ketones

Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
C4H8O	2-BUTANONE		
CCL4	TETRACHLOROMETHANE		258-259
		C2HCL3 TRICHLOROETHYLENE	397-398
		C6H12 CYCLOHEXANE	399-400
CHCL3	CHLOROFORM		260
		C6H6 BENZENE	401-402
CH2CL2	DICHLOROMETHANE		261
C2HCL3	TRICHLOROETHYLENE		262-264
C2H2CL2	CIS-1,2-DICHLOROETHYLENE		265
C2H2CL2	TRANS-1,2-DICHLOROETHYLENE		266
C2H4O2	ACETIC ACID		267-269
C3H6O	PROPYLENE OXIDE		270
C3H6O2	METHYL ACETATE		271
C3H6O2	PROPIONIC ACID		272-273
C3H7CL	1-CHLOROPROPANE		274-275
C4H8O2	BUTYRIC ACID		276-277
C4H8O2	ETHYL ACETATE		278
C5H6O	2-METHYLFURAN		279
C5H10	2-METHYL-2-BUTENE		280
C5H10O	3-PENTANONE		281
		C6H12O 4-METHYL-2-PENTANONE	403-404
C5H12	2-METHYLBUTANE		282
C6H5CL	CHLOROBENZENE		283
C6H6	BENZENE		284-295
			295 R
		C6H12 CYCLOHEXANE	405-408
C6H12	CYCLOHEXANE		296-298
			298 R
C6H12	1-HEXENE		299
C6H12O	4-METHYL-2-PENTANONE		300
C6H14	HEXANE		301-303
			303 R
C7H8	TOLUENE		304-308
C7H16	HEPTANE		309-312
			312 R
C6H10	ETHYLBENZENE		313-316
C8H18	OCTANE		317
C5H9NC	N-METHYLPIRROLIDONE		
C4H4S	THIOPHENE		318

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
=====			
C5H10C	METHYL ISOPROPYL KETONE		
=====			
C5H8	ISOPRENE		319
C5H10	2-METHYL-2-BUTENE		320
C5H12	2-METHYLBUTANE		321
=====			
C5H10O	2-PENTANONE		
=====			
C7H8	TOLUENE		322
C7H16	HEPTANE		323
=====			
C5H10O	3-PENTANONE		
=====			
C2H4O2	ACETIC ACID		324
C3H6O2	METHYL ACETATE		325
C3H6O2	PROPIONIC ACID		326
C4H8O2	BUTYRIC ACID		327
C4H8O2	ETHYL ACETATE		328
C6H12O	3-HEXANONE		329
C6H12O	4-METHYL-2-PENTANONE		330
C6H14	HEXANE		331
C7H14O	4-HEPTANONE		332
C7H16	HEPTANE		333-336
			336 R
=====			
C6H10O	CYCLOHEXANONE		
=====			
C6H12	CYCLOHEXANE		337-338
C7H8	TOLUENE		339
=====			
C6H12O	3-HEXANONE		
=====			
C3H6O2	PROPIONIC ACID		340
C4H8O2	BUTYRIC ACID		341
C7H14O	4-HEPTANONE		342
=====			
C6H12O	4-METHYL-2-PENTANONE		
=====			
CHCl3	CHLOROFORM		343-344
C2H4O2	ACETIC ACID		345
C3H4O2	ACRYLIC ACID		346
C3H6O2	PROPIONIC ACID		347
C7H6	BENZENE		348-351
			C6H12 CYCLOHEXANE 409-410
C6H12	CYCLOHEXANE		352-355
			355 R
C7H8	TOLUENE		356
=====			

Ketones

Formula Index of Systems

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
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	C2H4O2	ACETIC ACID	357
C7H14O	2-HEPTANONE		
	C2H4O2	ACETIC ACID	358
C7H14O	4-HEPTANONE		
	C3H6O2	PROPIONIC ACID	359
	C4H8O2	BUTYRIC ACID	360

Formula Index of Systems

Ethers

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
C3H6O	PROPYLENE OXIDE		
C7H8	TOLUENE		413
C3H6O3	1,3,5-TRIOXANE		
CH2CL2	DICHLOROMETHANE		414
C6H6	BENZENE		415
C3H8O2	DIMETHOXYETHANE		
CHCL3	CHLOROFORM		416-418 418 R
CS2	CARBON DISULFIDE		419-422
C2H2CL2	CIS-1,2-DICHLOROETHYLENE		423
C2H2CL2	TRANS-1,2-DICHLOROETHYLENE		424
C4H10O	DIETHYL ETHER		425
C6H6	BENZENE		426
C4H8CL2O	BIS(2-CHLOROETHYL) ETHER		
C2H4CL2	1,2-DICHLOROETHANE		427-428
C4H8O	TETRAHYDROFURAN		
CCL4	TETRACHLOROMETHANE		429-430
C2H2CL2	CIS-1,2-DICHLOROETHYLENE		431
C2H2CL2	TRANS-1,2-DICHLOROETHYLENE		432
C2H6OS	DIMETHYLSULFOXIDE		433-434
C3H9RO2	METHYL BORATE		435
C4H4O	FURAN		436
C5H6O	2-METHYLFURAN		437
C4H8O2	1,4-DIOXANE		
CCL4	TETRACHLOROMETHANE		438-440
CHCL3	CHLOROFORM		441
CH3NO2	NITROMETHANE		442-445
CS2	CARBON DISULFIDE		446
C2H4CL2	1,2-DICHLOROETHANE		447
C2H4O2	ACETIC ACID		448
C2H6OS	DIMETHYLSULFOXIDE		449-450
C3H7NO	N,N-DIMETHYLFORMAMIDE		451-454
C4H8O2	ETHYL ACETATE		455-456
C4H10O	DIETHYL ETHER		457
C5H10	1-PENTENE		458
C6H6	BENZENE		459-467

Ethers

Formula Index of Systems

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C4H9O2	1,4-DIOXANE		
C6H12	CYCLOHEXANE		468
C6H12	1-HEXENE		469-470
C6H14	HEXANE		471-472
C7H8	TOLUENE		473-477
C7H16	HEPTANE		478
C8H16	1-OCTENE		479
C8H18	OCTANE		480
C9H20	NONANE		481
C4H9NO	MORPHOLINE		
C6H10	ETHYLBENZENE		482
C4H10O	DIETHYL ETHER		
CHCl3	CHLOROFORM		483-491 491 R
CH2Cl2	DICHLOROMETHANE		492
CH3I	METHYL IODIDE		493
CH3NO2	NITROMETHANE		494
CS2	CARBON DISULFIDE		495
C2HBrClF3	HALOTHANE		496-498 498 R
C2H3N	ACETONITRILE		499
C2H4O2	ACETIC ACID		500-502
C2H5Cl	ETHYL CHLORIDE		503-509 509 R
C4H6	BUTADIENE		510
C4H8O2	ETHYL ACETATE		511-513
C6F6	HEXAFLUOROBENZENE		514-515
C6H6	BENZENE		516-520
C4H10O2	1,1-DIMETHOXYETHANE		
C3H6O2	METHYL ACETATE		521
C4H10O2	1,2-DIMETHOXYETHANE		
CH2O2	FORMIC ACID		522
C5H12O	ETHYL PROPYL ETHER		
CHCl3	CHLOROFORM		523-526 526 R
C5H12O	METHYL BUTYL ETHER		
CH2O2	FORMIC ACID		527
C2H4O2	ACETIC ACID		528

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
=====			
C6H14O	DIISOPROPYL ETHER		
CCL4	TETRACHLOROETHANE		529-533 533 R
CHCL3	CHLOROFORM		534-539 539 R
CH2O2	FORMIC ACID		540-541
C2H2CL2	CIS-1,2-DICHLOROETHYLENE		542
C2H2CL2	TRANS-1,2-DICHLOROETHYLENE		543
C2H4O2	ACETIC ACID		544-545
C3H4O2	ACRYLIC ACID		546
C4H6O2	ACETIC ANHYDRIDE		547
C6F6	HEXAFLUOROENZENE		548-549
C6H6	BENZENE		550-554 554 R
C6H12	CYCLOHEXANE		555
C7H8	TOLUENE		556-558
C7H16	HEPTANE		559-560
C8H10	ETHYLBENZENE		561-563
=====			
C6H14O	DIPROPYL ETHER		
CHCL3	CHLOROFORM		564-569 569 R
CH2O2	FORMIC ACID		570
C2HCL3	TRICHLOROETHYLENE		571
C2H4O2	ACETIC ACID		572
C6H6	BENZENE		573-576
C7H8	TOLUENE		577-579
C7H16	HEPTANE		580
C8H10	ETHYLBENZENE		581-583
C8H18	OCTANE		584
C9H20	NONANE		585
=====			
C6H14O	ETHYL BUTYL ETHER		
CHCL3	CHLOROFORM		586-587
CH2O2	FORMIC ACID		588
C2H4O2	ACETIC ACID		589
=====			
C8H18O	DIBUTYL ETHER		
CHCL3	CHLOROFORM		590-591
C7H16	HEPTANE		592
=====			
C8H18O2	DIETHYLENE GLYCOL BUTYL ETHER		
C10H8	NAPHTHALENE		593
C12H26	DODECANE		594

Aldehydes

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R=RECOMMENDED VALUES

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
ACETALDEHYDE		C2H4O	
	ACETIC ACID	C2H4O2	3
	BENZENE	C6H6	8
	ETHYLENE OXIDE	C2H4O	1- 2
	METHYL FORMATE	C2H4O2	4
	PROPYLENE OXIDE	C3H6O	5- 6
	TOLUENE	C7H8	9
	VINYL ACETATE	C4H6O2	7
ACROLEIN		C3H4O	
	ACETONE	C3H6O	13
	ACRYLONITRILE	C3H3N	10- 12
BENZALDEHYDE		C7H6O	
	BENZYL ACETATE	C9H10O2	63
	TOLUENE	C7H8	62
BUTYRALDEHYDE		C4H8O	
	ISOBUTYRALDEHYDE	C4H8O	31- 32
	TOLUENE	C7H8	33
CROTONALDEHYDE		C4H6O	
	ACETIC ACID	C2H4O2	20- 23
	ACETONE	C3H6O	24- 26
	VINYL ACETATE	C4H6O2	27- 30
			30 R
FURFURAL		C5H4O2	
	BENZENE	C6H6	43- 44
		CYCLOHEXANE	C6H12 66
		2,4-DIMETHYLPENTANE	C7H16 67
	1-BUTENE	C4H8	38- 39
	2-BUTENE(CIS)	C4H8	40
	BUTYL ACETATE	C6H12O2	46
	CHLOROFORM	CHCl3	36
	CYCLOHEXANE	C6H12	45
	DECANE	C10H22	59
	DECANOIC ACID	C10H20O2	58
	ETHYLBENZENE	C8H10	51
	HEPTANE	C7H16	50

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
FURFURAL	C5H4O2		
METHYLCYCLOHEXANE	C7H14		49
METHYL DECANOATE	C11H22O2		60- 61
2-METHYLFURAN	C5H6O		42
METHYL OCTANOATE	C9H18O2		56- 57
2-METHYLPROPANE	C4H10		41
OCTANOIC ACID	C8H16O2		53- 54
TETRACHLOROMETHANE	CCL4		35
		BENZENE	C6H6 65
TOLUENE	C7H8		47- 48
		HEPTANE	C7H16 70- 71
		METHYLCYCLOHEXANE	C7H14 68- 69
		2,2,4-TRIMETHYLPENTANE	C8H18 72
TRICHLOROETHYLENE	C2HCL3		37
2,2,4-TRIMETHYLPENTANE	C8H18		55
P-XYLENE	C8H10		52
ISOBUTYRALDEHYDE	C4H8O		
TOLUENE	C7H8		34
PROPIONIC ALDEHYDE	C3H6O		
ACETONE	C3H6O		16
		PROPYLENE OXIDE	C3H6O 64
2-BUTANONE	C4H8O		18
CYCLOHEXANE	C6H12		19
1,2-DICHLOROPROPANE	C3H6CL2		14- 15
PROPYLENE OXIDE	C3H6O		17

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1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
ACETONL	C3H6O		
ACETIC ACID	C2H4O2		147-152
ACETIC ANHYDRIDE	C4H6O3		171-172
ACETONITRILE	C2H3N		143
BENZENE	C6H6		194-209 209 R
		CYCLOHEXANE	C6H12 395-396
2-BUTANONE	C4H8O		173-175
		CYCLOHEXANE	C6H12 390-391
		ETHYL ACETATE	C4H8O2 389
BUTYL ACETATE	C6H12O2		219
CARBON DISULFIDE	CS2		129-139 139 R
CHLOROBENZENE	C6H5CL		192-193
		BENZENE	C6H6 393-394
CHLOROFORM	CHCL3		87-128 127-128 R
		CARBON DISULFIDE	CS2 363-364
		DIMETHOXYMETHANE	C3H8O2 367-368
		2,3-DIMETHYLBUTANE	C6H14 371
		HEXANE	C6H14 372-379
		4-METHYL-2-PENTANONE	C6H12O 369-370
		TETRACHLOROETHYLENE	C2CL4 365-366
		TOLUENE	C7H8 380-381
CYCLOHEXANE	C6H12		210-217 217 R
DECANE	C10H22		246-248 248 R
DEUTEROCHLOROFORM	CCL3D		75-79 79 R
1,2-DICHLOROETHANE	C2H4CL2		144-146
		BENZENE	C6H6 383-385
CIS-1,2-DICHLOROETHYLENE	C2H2CL2		140
TRANS-1,2-DICHLOROETHYLENE	C2H2CL2		141
DIETHYL ETHER	C4H10O		177-180
DIMETHOXYMETHANE	C3H8O2		165
2,3-DIMETHYLBUTANE	C6H14		220-221
N,N-DIMETHYLFORMAMIDE	C2H7NO		164
DIMETHYLSULFOXIDE	C2H6OS		154
DODECANE	C12H26		249-250
ETHYL ACETATE	C4H8O2		176
ETHYL FORMATE	C3H6O2		158

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ETHYL IODIDE	C2H5I		153
HEPTANE	C7H16		239=243 243 R
HEXANE	C6H14		222=231 231 R
1-HEXENE	C6H12		218
ISOPRENE	C5H8		182
		2-METHYLBUTANE C5H12	392
METHYL ACETATE	C3H6O2		159=163
		2-BUTANONE C4H8O	387
		ETHYL ACETATE C4H8O2	388
		ETHYL FORMATE C3H6O2	386
2-METHYLBUTANE	C5H12		186
2-METHYL-1-BUTENE	C5H10		183
2-METHYL-2-BUTENE	C5H10		184
METHYL IODIDE	CH3I	CARBON DISULFIDE CS2	382
PENTANE	C5H12		187=191 191 R
PROPYL ACETATE	C5H10O2		185
PROPYLENE OXIDE	C3H6O		155=157
PYRIDINE	C5H5N		181
TETRACHLOROMETHANE	CCL4		80= 86 86 R
		BENZENE C6H6	361=362
TETRADECANE	C14H30		251=252
TETRAETHYLSILANE	C8H20SI		244=245
TOLUENE	C7H8		232=238 238 R
1,1,2-TRICHLOROETHANE	C2H3CL3		142
VINYL ACETATE	C4H6O2		166=170 170 R
2,3-DIACETONE	C4H6O2		
ACETIC ACID	C2H4O2		255
METHYLCYCLOHEXANE	C7H14		257
TOLUENE	C7H8		256
2-BUTANONE	C4H8O		
ACETIC ACID	C2H4O2		267=269
BENZENE	C6H6		284=295 295 R
		CYCLOHEXANE C6H12	405=408
BUTYRIC ACID	C4H8O2		276=277
CHLOROBENZENE	C6H5CL		283

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1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
2-BUTANONE	C4H8O		
	CHLOROFORM	CHCL3	260
		BENZENE	C6H6 401-402
	1-CHLOROPROPANE	C3H7CL	274-275
	CYCLOHEXANE	C6H12	296-298 298 R
	CIS-1,2-DICHLOROETHYLENE	C2H2CL2	265
	TRA-1,2-DICHLOROETHYLENE	C2H2CL2	266
	DICHLOROMETHANE	CH2CL2	261
	ETHYL ACETATE	C4H8O2	278
	ETHYLBENZENE	C8H10	313-316
	HEPTANE	C7H16	309-312 312 R
	HEXANE	C6H14	301-303 303 R
	1-HEXENE	C6H12	299
	METHYL ACETATE	C3H6O2	271
	2-METHYLBUTANE	C5H12	282
	2-METHYL-2-BUTENE	C5H10	280
	2-METHYLFURAN	C5H6O	279
	4-METHYL-2-PENTANONE	C6H12O	300
	OCTANE	C8H18	317
	3-PENTANONE	C5H10O	281
		4-METHYL-2-PENTANONE	C6H12O 403-404
	PROPIONIC ACID	C3H6O2	272-273
	PROPYLENE OXIDE	C3H6O	270
	TETRACHLOROMETHANE	CCl4	258-259
		CYCLOHEXANE	C6H12 399-400
		TRICHLOROETHYLENE	C2HCL3 397-398
	TOLUENE	C7H8	304-308
	TRICHLOROETHYLENE	C2HCL3	262-264
CYCLOHEXANONE	C6H10O		
	CYCLOHEXANE	C6H12	337-338
	TOLUENE	C7H8	339
2-HEPTANONE	C7H14O		
	ACETIC ACID	C2H4O2	358
4-HEPTANONE	C7H14O		
	BUTYRIC ACID	C4H8O2	360
	PROPIONIC ACID	C3H6O2	359

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE	
3-HEXANONE		C6H12O		
	BUTYRIC ACID	C4H8O2	341	
4-HEPTANONE		C7H14O	342	
	PROPIONIC ACID	C3H6O2	340	
1-METHYL-2-CYCLOHEXANONE		C7H12O		
	ACETIC ACID	C2H4O2	357	
METHYL ISOPROPYL KETONE		C5H10O		
	ISOPRENE	C5H8	319	
	2-METHYLBJTANE	C5H12	321	
	2-METHYL-2-BUTENE	C5H10	320	
4-METHYL-2-PENTANONE		C6H12O		
	ACETIC ACID	C2H4O2	345	
	ACRYLIC ACID	C3H4O2	346	
	BENZENE	C6H6	348-351	
		CYCLOHEXANE	C6H12	409-410
	CHLOROFORM	CHCL3	343-344	
	CYCLOHEXANE	C6H12	352-355 355 R	
	PROPIONIC ACID	C3H6O2	347	
	TOLUENE	C7H8	356	
N-METHYLPYRROLIDONE		C5H9NO		
	THIOPHENE	C4H4S	318	
METHYL VINYL KETONE		C4H6O		
	2-CHLORO-1,3-BUTADIENE	C4H5CL	253	
	1,3-DICHLORO-2-BUTENE	C4H6CL2	254	
2-PENTANONE		C5H10O		
	HEPTANE	C7H16	323	
	TOLUENE	C7H8	322	
3-PENTANONE		C5H10O		
	ACETIC ACID	C2H4O2	324	
	BUTYRIC ACID	C4H8O2	327	
	ETHYL ACETATE	C4H8O2	328	
	HEPTANE	C7H16	333-336 336 R	

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3-PENTANONE		C ₅ H ₁₀ O	
4-HEPTANONE		C ₇ H ₁₄ O	332
HEXANE		C ₆ H ₁₄	331
3-HEXANONE		C ₆ H ₁₂ O	329
METHYL ACETATE		C ₃ H ₆ O ₂	325
4-METHYL-2-PENTANONE		C ₆ H ₁₂ O	330
PROPIONIC ACID		C ₃ H ₆ O ₂	326

1ST COMPONENT	2ND COMPONENT	3RD COMPONENT 4TH COMPONENT	PAGE
BIS(2-CHLOROETHYL)ETHER		C4H8CL2O	
	1,2-DICHLOROETHANE	C2H4CL2	427-428
DIBUTYL ETHER		C8H18O	
	CHLOROFORM	CHCL3	590-591
	HEPTANE	C7H16	592
DIETHYLENE GLYCOL BUTYL ETHER		C8H18O3	
	DODECANE	C12H26	594
	NAPHTHALENE	C10H8	593
DILTHYL ETHER		C4H10O	
	ACETIC ACID	C2H4O2	500-502
	ACETONITRILE	C2H3N	499
	BENZENE	C6H6	516-520
	BUTADIENE	C4H6	510
	CARBON DISULFIDE	CS2	495
	CHLOROFORM	CHCL3	483-491 491 R
	DICHLOROMETHANE	CH2CL2	492
	ETHYL ACETATE	C4H8O2	511-513
	ETHYL CHLORIDE	C2H5CL	503-509 509 R
	HALOTHANE	C2HBRCLF3	496-498 498 R
	HEXAFLUOROBENZENE	C6F6	514-515
	METHYL IODIDE	CH3I	493
	NITROMETHANE	CH3NO2	494
DIISOPROPYL ETHER		C6H14O	
	ACETIC ACID	C2H4O2	544-545
	ACETIC ANHYDRIDE	C4H6O3	547
	ACRYLIC ACID	C3H4O2	546
	BENZENE	C6H6	550-554 554 R
	CHLOROFORM	CHCL3	534-539 539 R
	CYCLOHEXANE	C6H12	555
	CIS-1,2-DICHLOROETHYLENE	C2H2CL2	542
	TRANS-1,2-DICHLOROETHYLENE	C2H2CL2	543
	ETHYLBENZENE	C8H10	561-563
	FORMIC ACID	CH2O2	540-541

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	HEPTANE	C7H16	559-560
	HEXAFLUOROBENZENE	C6F6	548-549
	TETRACHLOROETHYLENE	CCL4	529-533 533
	TOLUENE	C7H8	556-558
1,1-DIMETHOXYETHANE		C4H10O2	
	METHYL ACETATE	C3H6O2	521
1,2-DIMETHOXYETHANE		C4H10O2	
	FORMIC ACID	CH2O2	522
DIMETHOXYMETHANE		C3H8O2	
	BENZENE	C6H6	426
	CARBON DISULFIDE	CS2	419-422
	CHLOROFORM	CHCL3	416-418 418
	CIS-1,2-DICHLOROETHYLENE	C2H2CL2	423
	TRANS-1,2-DICHLOROETHYLENE	C2H2CL2	424
	DIETHYL ETHER	C4H10O	425
1,4-DIOXANE		C4H8O2	
	ACETIC ACID	C2H4O2	448
	BENZENE	C6H6	459-467
	CARBON DISULFIDE	CS2	446
	CHLOROFORM	CHCL3	441
	CYCLOHEXANE	C6H12	468
	1,2-DICHLOROETHANE	C2H4CL2	447
	DIETHYLAMINE	C4H11N	457
	N,N-DIMETHYLFORMAMIDE	C3H7NO	451-454
	DIMETHYLSULFIDE	C2H6S	449-450
	ETHYL ACETATE	C4H8O2	455-456
	HEPTANE	C7H16	478
	HEXANE	C6H14	471-472
	1-HEXENE	C6H12	469-470
	NITROMETHANE	CH3NO2	442-445
	NONANE	C9H20	481
	OCTANE	C8H18	480
	1-OCTENE	C8H16	479
	1-PENTENE	C5H10	458
	TETRACHLOROETHYLENE	CCL4	438-440
	TOLUENE	C7H8	473-477

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	ACETIC ACID	C2H4O2	572
	BENZENE	C6H6	573-576
	CHLOROFORM	CHCl3	564-569 569 R
	ETHYLBENZENE	C8H10	581-583
	FORMIC ACID	CH2O2	570
	HEPTANE	C7H16	580
	NONANE	C9H20	585
	OCTANE	C8H18	584
	TOLUENE	C7H8	577-579
	TRICHLOROETHYLENE	C2HCl3	571
ETHYL BUTYL ETHER		C6H14O	
	ACETIC ACID	C2H4O2	589
	CHLOROFORM	CHCl3	586-587
	FORMIC ACID	CH2O2	588
ETHYL ISOPROPYL ETHER		C5H12O	
	CHLOROFORM	CHCl3	523-526 526 R
METHYL BUTYL ETHER		C5H12O	
	ACETIC ACID	C2H4O2	528
	FORMIC ACID	CH2O2	527
MORPHOLINE		C4H9NO	
	ETHYLBENZENE	C8H10	482
PROPYLENE OXIDE		C3H6O	
	TOLUENE	C7H8	413
Tetrahydrofuran		C4H8O	
	CIS-1,2-DICHLOROETHYLENE	C2H2Cl2	431
	TRANS-1,2-DICHLOROETHYLENE	C2H2Cl2	432
	DIMETHYLSULFIDE	C2H6OS	433-434
	FURAN	C4H4O	436
	METHYL BORATE	C3H9BO3	435
	Z-METHYLFURAN	C5H6O	437
	TETRACHLOROMETHANE	CCl4	429-430
1,3,5-TRIOXANE		C3H6O3	
	BENZENE	C6H6	415
	DICHLOROMETHANE	CH2Cl2	414