J. Gmehling
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VAPOR-LIQUID EQUILIBRIUM DATA COLLECTION

Carboxylic Acids, Anhydrides
Supplement 1

Chemistry Data Series

Vol. I, Part 5a

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Vapor-Liquid Equilibrium Data Collection

5a

Carboxylic Acids, Anhydrides

Supplement 1

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

J. Gmehling, U. Onken

Technische Chemie
Universität Oldenburg

5a

Carboxylic Acids, Anhydrides

Systems with:
Aliphatic and aromatic carboxylic acids

Acetic Acid
Acrylic Acid
Benzoic Acid
Butyric Acid
Chloroacetic Acid
Dichloroacetic Acid
Formic Acid
Hexanoic Acid
Isobutyric Acid
Lauric Acid
Methacrylic Acid
Z-9-Octadecenoic Acid
3-Pentenoic Acid (isomer not specified)
Propionic Acid
Trichloroacetic Acid
Trifluoroacetic Acid
Valeric Acid

Anhydrides

Acetic Anhydride
Maleic Anhydride

AUTHORS' PREFACE

With this volume we have pleasure in publishing a new supplement of the Vapor-Liquid Equilibrium Data Collection for carboxylic acids and anhydrides as DECHEMA Chemistry Data Series Volume I Part 5a.

The data in this book are taken from the Dortmund Data Bank and are available in electronic form. The Dortmund Data Bank covers a wide range of properties in addition to the VLE, h^E, $\gamma\infty$, for example: data bases of the vapor-liquid equilibria of low boiling substances (HPV), azeotropic data (AZD), gas solubilities (GLE), solid-liquid equilibria (SLE) and a pure component property data base (PCP). Data in electronic form can be obtained from DDBST GmbH, Oldenburg, Germany or DECHEMA e.V., Frankfurt am Main. Data collections for inhouse use are available from DDBST GmbH; DECHEMA e.V.; FIZ Chemie GmbH, Berlin, Germany and Aspen Technology, Inc., Cambridge, Massachusetts, USA. DDBST GmbH can also supply a large program system well suited to handling the data in the data banks. Online versions of the database are hosted by STN International (Columbus, Ohio, USA; Karlsruhe, Germany and Tokyo, Japan) and DECHEMA e.V. (via the Internet).

We would like to thank J. Krafczyk and J. Menke for computer programming assistance in order to allow publication of data determined under non-isotherm and non-isobaric conditions. In addition we would like to sincerely thank all those colleagues who have both supported and continue to support the endeavours of the thermodynamic group at the University of Oldenburg by delivering VLE data from their research. At this juncture we would like to request other colleagues in this field to send us unpublished data and reprints of their publications on thermophysical properties.

Oldenburg, November 2002

J. Gmehling U. Onken

EXECUTIVE EDITOR'S PREFACE

The aim of DECHEMA e.V., The Society for Chemical Technology and Biotechnology when it was founded in 1926 was to improve cooperation between chemist and engineer. As the importance of mathematical modelling, computer simulation and optimisation became apparent in the mid-nineteen-seventies, this ideal resulted in the production and publication of collections of basic thermophysical data in both electronic and book form. This is not data that could have easily found a publisher outside the engineering societies, because of its sheer volume and limited circle of interest. By its sponsoring and publication of the DECHEMA Chemistry Data Series DECHEMA e.V. has been associated with these endevours for over a quarter of a century. Much of the original work to determine the values obtained was financed by the German Ministry of Research.

It is to be hoped that publication of this data collection by DECHEMA e.V. in the DECHEMA Chemistry Data Series will inspire other authors to consider publishing their collections of thermophysical data. DECHEMA e.V. is always pleased to assist colleagues from the thermophysical data community in preparing their results, their studies, their collections and their assessments for publication. DECHEMA e.V. is always prepared to enlarge the scope of the DECHEMA Chemistry Data Series and is thus pleased to hear from readers, designers, scientists and engineers of areas where thermophysical data is not available or scarce. We hope that the end user finds the data of utility and of interest.

Frankfurt am Main, November 2002 Gerhard Kreysa

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$C_4H_{10}O_2$	tert-Butylhydroperoxide	$C_4H_8O_2$	Isobutyric Acid	253

C_5H_5N	Pyridine	CH_2O_2	Formic Acid	18–19
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		$C_3H_6O_2$	Propionic Acid	189–190
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		$C_3H_6O_2$	Propionic Acid	205–208R
		$C_4H_8O_2$	Isobutyric Acid	254–255
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		$C_4H_8O_2$	Butyric Acid	245
	Propyl Butyrate	$C_4H_8O_2$	Butyric Acid	246
C_7H_{16}	Heptane	$C_2H_4O_2$	Acetic Acid	144–145
		$C_3H_4O_2$	Acrylic Acid	161
		$C_3H_6O_2$	Propionic Acid	214–218R
		$C_4H_6O_2$	Methacrylic Acid	224
		$C_4H_6O_3$	Acetic Anhydride	331
		$C_4H_8O_2$	Isobutyric Acid	258–259
C_8H_{10}	Ethylbenzene	$C_4H_6O_2$	Methacrylic Acid	225
	Xylene (isomer not specified)	$C_4H_2O_3$	Maleic Anhydride	311
	m-Xylene	$C_4H_6O_2$	Methacrylic Acid	226
	o-Xylene	$C_4H_2O_3$	Maleic Anhydride	310
		$C_4H_6O_3$	Acetic Anhydride	332

$C_8H_{14}O_2$	Butyl Methacrylate	$C_4H_6O_2$	Methacrylic Acid	227–228
$C_8H_{15}N$	Caprylonitrile	$C_2H_4O_2$	Acetic Acid	146
C_8H_{16}	1-Octene	$C_3H_4O_2$	Acrylic Acid	162
		$C_4H_6O_3$	Acetic Anhydride	333–335
$C_8H_{16}O_2$	Butyl Butyrate	$C_4H_8O_2$	Butyric Acid	247
C_8H_{18}	Octane	$C_2H_4O_2$	Acetic Acid	147–148
		$C_3H_4O_2$	Acrylic Acid	163
		$C_4H_6O_2$	Methacrylic Acid	229
		$C_4H_6O_3$	Acetic Anhydride	336–337
$C_9H_{10}O_2$	Benzyl Acetate	$C_2H_4O_2$	Acetic Acid	149
C_9H_{12}	Isopropylbenzene	$C_2H_4O_2$	Acetic Acid	150–151
		$C_4H_6O_2$	Methacrylic Acid	230
C_9H_{20}	Nonane	$C_2H_4O_2$	Acetic Acid	152
		$C_3H_4O_2$	Acrylic Acid	164
		$C_4H_6O_2$	Methacrylic Acid	231
		$C_4H_8O_2$	Butyric Acid	248
$C_{10}H_{16}$	Camphene	$C_2H_4O_2$	Acetic Acid	153
$C_{10}H_{22}$	Decane	$C_3H_4O_2$	Acrylic Acid	165
		$C_4H_6O_2$	Methacrylic Acid	232–233
		$C_5H_{10}O_2$	Valeric Acid	263
$C_{11}H_{24}$	N-Undecane	$C_4H_6O_2$	Methacrylic Acid	234
		$C_4H_8O_2$	Butyric Acid	249
		$C_5H_{10}O_2$	Valeric Acid	264
		$C_6H_{12}O_2$	Hexanoic Acid	267
$C_{12}H_{20}O_2$	Isobornyl Acetate	$C_2H_4O_2$	Acetic Acid	154
$C_{12}H_{24}O_2$	Lauric Acid	$C_{14}H_{28}O_2$	Myristic Acid	280–282

$C_{12}H_{26}$	Dodecane	$C_4H_6O_2$	Methacrylic Acid	235
		$C_5H_{10}O_2$	Valeric Acid	265
		$C_6H_{12}O_2$	Hexanoic Acid	268
$C_{13}H_{28}$	Tridecane	$C_5H_{10}O_2$	Valeric Acid	266
$C_{14}H_{12}O_2$	Benzyl Benzoate	$C_7H_6O_2$	Benzoic Acid	279
$C_{14}H_{28}O_2$	Myristic Acid	$C_{12}H_{24}O_2$	Lauric Acid	280–282
$C_{14}H_{30}$	Tetradecane	$C_6H_{12}O_2$	Hexanoic Acid	269
$C_{18}H_{34}O_2$	Z-9-Octadecenoic Acid	CS_2	Carbon Disulfide	283

CCl_4	Tetrachloromethane	$C_2H_4O_2$	Acetic Acid	$C_3H_6O_2$	Propionic Acid	289
				C_6H_6	Benzene	290–291
		$C_3H_4O_2$	Acrylic Acid	$C_2H_4O_2$	Acetic Acid	288
CH_2O_2	Formic Acid	$C_2H_4O_2$	Acetic Acid	$C_3H_6O_2$	Methyl Acetate	284
					Propionic Acid	285–286
		$C_5H_{10}O_2$	Butyl Formate	C_5H_5N	Pyridine	287
$C_2H_4O_2$	Acetic Acid	CCl_4	Tetrachloromethane	$C_3H_4O_2$	Acrylic Acid	288
		$C_3H_6O_2$	Methyl Acetate	CH_2O_2	Formic Acid	284
			Propionic Acid	CCl_4	Tetrachloromethane	289
				CH_2O_2	Formic Acid	285–286
				C_3H_7Br	Propyl Bromide	293–294
				$C_4H_8O_2$	Butyric Acid	295
					Ethyl Acetate	296
				C_6H_{12}	Cyclohexane	298–299
		$C_4H_8O_2$	Butyric Acid	$C_5H_{10}O_2$	Pentanoic Acid	300
			Ethyl Acetate	C_6H_{14}	Hexane	301
		C_6H_6	Benzene	CCl_4	Tetrachloromethane	290–291
				$C_3H_6O_2$	Propionic Acid	297
		C_7H_{16}	Heptane	$C_3H_4O_2$	Acrylic Acid	292
		C_8H_{10}	Ethylbenzene	C_8H_8	Styrene	302
$C_3H_4O_2$	Acrylic Acid	$C_2H_4O_2$	Acetic Acid	CCl_4	Tetrachloromethane	288
				C_7H_{16}	Heptane	292
$C_3H_6O_2$	Methyl Acetate	CH_2O_2	Formic Acid	$C_2H_4O_2$	Acetic Acid	284
	Propionic Acid	CCl_4	Tetrachloromethane	$C_2H_4O_2$	Acetic Acid	289
		CH_2O_2	Formic Acid	$C_2H_4O_2$	Acetic Acid	285–286
		$C_2H_4O_2$	Acetic Acid	C_6H_6	Benzene	297

		C_3H_7Br	Propyl Bromide	$C_2H_4O_2$	Acetic Acid	293–294
		$C_4H_8O_2$	Butyric Acid	$C_2H_4O_2$	Acetic Acid	295
			Ethyl Acetate	$C_2H_4O_2$	Acetic Acid	296
		C_6H_{12}	Cyclohexane	$C_2H_4O_2$	Acetic Acid	298–299
C_3H_7Br	Propyl Bromide	$C_2H_4O_2$	Acetic Acid	$C_3H_6O_2$	Propionic Acid	293–294
$C_4H_8O_2$	Butyric Acid	$C_2H_4O_2$	Acetic Acid	$C_3H_6O_2$	Propionic Acid	295
		$C_5H_{10}O_2$	Pentanoic Acid	$C_2H_4O_2$	Acetic Acid	300
	Ethyl Acetate	$C_2H_4O_2$	Acetic Acid	$C_3H_6O_2$	Propionic Acid	296
		C_6H_{14}	Hexane	$C_2H_4O_2$	Acetic Acid	301
C_5H_5N	Pyridine	CH_2O_2	Formic Acid	$C_5H_{10}O_2$	Butyl Formate	287
$C_5H_{10}O_2$	Butyl Formate	C_5H_5N	Pyridine	CH_2O_2	Formic Acid	287
	Pentanoic Acid	$C_2H_4O_2$	Acetic Acid	$C_4H_8O_2$	Butyric Acid	300
C_6H_6	Benzene	CCl_4	Tetrachloromethane	$C_2H_4O_2$	Acetic Acid	290–291
		$C_3H_6O_2$	Propionic Acid	$C_2H_4O_2$	Acetic Acid	297
C_6H_{12}	Cyclohexane	$C_2H_4O_2$	Acetic Acid	$C_3H_6O_2$	Propionic Acid	298–299
C_6H_{14}	Hexane	$C_2H_4O_2$	Acetic Acid	$C_4H_8O_2$	Ethyl Acetate	301
$C_7H_6O_2$	Benzoic Acid	$C_{12}H_{10}$	Biphenyl	C_7H_8	Toluene	303–304
C_7H_8	Toluene	$C_7H_6O_2$	Benzoic Acid	$C_{12}H_{10}$	Biphenyl	303–304
C_7H_{16}	Heptane	$C_3H_4O_2$	Acrylic Acid	$C_2H_4O_2$	Acetic Acid	292
C_8H_8	Styrene	$C_2H_4O_2$	Acetic Acid	C_8H_{10}	Ethylbenzene	302
C_8H_{10}	Ethylbenzene	C_8H_8	Styrene	$C_2H_4O_2$	Acetic Acid	302
$C_{12}H_{10}$	Biphenyl	C_7H_8	Toluene	$C_7H_6O_2$	Benzoic Acid	303–304

$C_2H_4O_2$	Acetic Acid	$C_4H_8O_2$	Butyric Acid	$C_5H_{10}O_2$	N-Pentanoic Acid	$C_6H_{12}O_2$	Isocaproic Acid (4-Methylpentanoic Acid)	305
$C_4H_8O_2$	Butyric Acid	$C_5H_{10}O_2$	N-Pentanoic Acid	$C_6H_{12}O_2$	Isocaproic Acid (4-Methylpentanoic Acid)	$C_2H_4O_2$	Acetic Acid	305
$C_5H_{10}O_2$	N-Pentanoic Acid	$C_6H_{12}O_2$	Isocaproic Acid (4-Methylpentanoic Acid)	$C_2H_4O_2$	Acetic Acid	$C_4H_8O_2$	Butyric Acid	305
$C_6H_{12}O_2$	Isocaproic Acid (4-Methylpentanoic Acid)	$C_2H_4O_2$	Acetic Acid	$C_4H_8O_2$	Butyric Acid	$C_5H_{10}O_2$	N-Pentanoic Acid	305

Acetaldehyde Diacetate	$C_6H_{10}O_4$	Acetic Acid	$C_2H_4O_2$	115–117
		Acetic Anhydride	$C_4H_6O_3$	326–328
Acetamide	C_2H_5NO	Acetic Acid	$C_2H_4O_2$	50–51
Acetic Acid	$C_2H_4O_2$	Acetaldehyde Diacetate	$C_6H_{10}O_4$	115–117
		Acetamide	C_2H_5NO	50–51
		Acetic Anhydride	$C_4H_6O_3$	76–79
		Acetonitrile	C_2H_3N	45–47
		Benzene	C_6H_6	107–112R
		Benzyl Acetate	$C_9H_{10}O_2$	149
		Butyl Acetate	$C_6H_{12}O_2$	125–126
		Butyric Acid	$C_4H_8O_2$	80–82
		Camphene	$C_{10}H_{16}$	153
		6-Caprolactam	$C_6H_{11}NO$	119
		Caprylonitrile	$C_8H_{15}N$	146
		3-Chloro-1-Propene	C_3H_5Cl	52–53
		Chlorobenzene	C_6H_5Cl	105–106
		Chloroform	$CHCl_3$	43
		Cyclohexane	C_6H_{12}	120–123
		o-Dichlorobenzene	$C_6H_4Cl_2$	104
		Diethyl Malonate	$C_7H_{12}O_4$	140
		N,N-Dimethylacetamide	C_4H_9NO	96
		N,N-Dimethylformamide (DMF)	C_3H_7NO	70–71
		Ethyl Acetate	$C_4H_8O_2$	83–95
		Ethyl Iodide	C_2H_5I	48–49
		Ethyl Trichloroacetate	$C_4H_5Cl_3O_2$	72
		Ethylene Glycol Diacetate	$C_6H_{10}O_4$	118

Formic Acid	CH_2O_2	2–7
Heptane	C_7H_{16}	144–145
Hexane	C_6H_{14}	130
1-Hexene	C_6H_{12}	124
Isobornyl Acetate	$C_{12}H_{20}O_2$	154
Isobutyl Acetate	$C_6H_{12}O_2$	127–129R
Isopropylbenzene	C_9H_{12}	150–151
Methacrolein	C_4H_6O	73
Methacrylic Acid	$C_4H_6O_2$	74
Methyl Acetate	$C_3H_6O_2$	54–57
Methyl Iodide	CH_3I	44
Nitric Acid	HNO_3	37
Nonane	C_9H_{20}	152
Octane	C_8H_{18}	147–148
Pentyl Acetate	$C_7H_{14}O_2$	141–143
Propionic Acid	$C_3H_6O_2$	58–64R
Propyl Acetate	$C_5H_{10}O_2$	103
Propyl Bromide	C_3H_7Br	65–69R
Pyridine	C_5H_5N	97–100
Sulfur Dioxide	O_2S	36
Tetrachloromethane	CCl_4	38–42R
Toluene	C_7H_8	139
Triethylamine	$C_6H_{15}N$	131–138
Trifluoroacetic Acid	$C_2HF_3O_2$	27
Vinyl Acetate	$C_4H_6O_2$	75
Vinyl Butyrate	$C_6H_{10}O_2$	113–114

		Vinyl Propionate	$C_5H_8O_2$	101–102
Acetic Anhydride	$C_4H_6O_3$	Acetaldehyde Diacetate	$C_6H_{10}O_4$	326–328
		Acetic Acid	$C_2H_4O_2$	76–79
		Butyric Acid	$C_4H_8O_2$	238
		Carbon Disulfide	CS_2	322
		Ethyl Acetate	$C_4H_8O_2$	323
		Heptane	C_7H_{16}	331
		Isobutyric Acid	$C_4H_8O_2$	252
		Isopropyl Acetate	$C_5H_{10}O_2$	324–325
		Methyl Chloride	CH_3Cl	320
		Methyl Iodide	CH_3I	321
		Octane	C_8H_{18}	336–337
		1-Octene	C_8H_{16}	333–335
		Propionic Acid	$C_3H_6O_2$	180–183
		Sulfur Dioxide	O_2S	312
		Tetrachloromethane	CCl_4	313–319R
		Toluene	C_7H_8	329–330
		o-Xylene	C_8H_{10}	332
Acetonitrile	C_2H_3N	Acetic Acid	$C_2H_4O_2$	45–47
		Formic Acid	CH_2O_2	1
		Isobutyric Acid	$C_4H_8O_2$	250–251
		Propionic Acid	$C_3H_6O_2$	173–174
Acrylic Acid	$C_3H_4O_2$	sec-Butylacrylate	$C_7H_{12}O_2$	160
		Decane	$C_{10}H_{22}$	165
		Ethyl Acrylate	$C_5H_8O_2$	159
		Heptane	C_7H_{16}	161

		Methyl Acrylate	$C_4H_6O_2$	155–158
		Nonane	C_9H_{20}	164
		Octane	C_8H_{18}	163
		1-Octene	C_8H_{16}	162
Aniline	C_6H_7N	Butyric Acid	$C_4H_8O_2$	242–243
		Propionic Acid	$C_3H_6O_2$	201–202
Benzene	C_6H_6	Acetic Acid	$C_2H_4O_2$	107–112R
		Benzoic Acid	$C_7H_6O_2$	270
		Butyric Acid	$C_4H_8O_2$	241
		Chloroacetic Acid	$C_2H_3ClO_2$	26
		Dichloroacetic Acid	$C_2H_2Cl_2O_2$	29
		Maleic Anhydride	$C_4H_2O_3$	309
		Propionic Acid	$C_3H_6O_2$	199–200R
Benzoic Acid	$C_7H_6O_2$	Benzene	C_6H_6	270
		Benzonitrile	C_7H_5N	271–272
		Benzyl Benzoate	$C_{14}H_{12}O_2$	279
		Toluene	C_7H_8	273–278
Benzonitrile	C_7H_5N	Benzoic Acid	$C_7H_6O_2$	271–272
Benzyl Acetate	$C_9H_{10}O_2$	Acetic Acid	$C_2H_4O_2$	149
Benzyl Benzoate	$C_{14}H_{12}O_2$	Benzoic Acid	$C_7H_6O_2$	279
Butyl Acetate	$C_6H_{12}O_2$	Acetic Acid	$C_2H_4O_2$	125–126
		Propionic Acid	$C_3H_6O_2$	210
Butyl Butyrate	$C_8H_{16}O_2$	Butyric Acid	$C_4H_8O_2$	247
Butyl Methacrylate	$C_8H_{14}O_2$	Methacrylic Acid	$C_4H_6O_2$	227–228
sec-Butylacrylate	$C_7H_{12}O_2$	Acrylic Acid	$C_3H_4O_2$	160
tert-Butylhydroperoxide	$C_4H_{10}O_2$	Isobutyric Acid	$C_4H_8O_2$	253

Butyric Acid	$C_4H_8O_2$	Acetic Acid	$C_2H_4O_2$	80–82
		Acetic Anhydride	$C_4H_6O_3$	238
		Aniline	C_6H_7N	242–243
		Benzene	C_6H_6	241
		Butyl Butyrate	$C_8H_{16}O_2$	247
		Carbon Disulfide	CS_2	236
		Methyl Acetate	$C_3H_6O_2$	237
		Nonane	C_9H_{20}	248
		Pentyl Acetate	$C_7H_{14}O_2$	245
		Propionic Acid	$C_3H_6O_2$	184–186
		Propyl Butyrate	$C_7H_{14}O_2$	246
		Pyridine	C_5H_5N	239–240
		Toluene	C_7H_8	244
		N-Undecane	$C_{11}H_{24}$	249
Camphene	$C_{10}H_{16}$	Acetic Acid	$C_2H_4O_2$	153
6-Caprolactam	$C_6H_{11}NO$	Acetic Acid	$C_2H_4O_2$	119
Caprylonitrile	$C_8H_{15}N$	Acetic Acid	$C_2H_4O_2$	146
Carbon Disulfide	CS_2	Acetic Anhydride	$C_4H_6O_3$	322
		Butyric Acid	$C_4H_8O_2$	236
		Z-9-Octadecenoic Acid	$C_{18}H_{34}O_2$	283
3-Chloro-1-Propene	C_3H_5Cl	Acetic Acid	$C_2H_4O_2$	52–53
		Formic Acid	CH_2O_2	12
Chloroacetic Acid	$C_2H_3ClO_2$	Benzene	C_6H_6	26
		Chloroform	$CHCl_3$	32
		Nitric Acid	HNO_3	30
		N-Pentanoic Acid	$C_5H_{10}O_2$	33–35
		Sulfuric Acid	H_2O_4S	31

Chlorobenzene	C_6H_5Cl	Acetic Acid	$C_2H_4O_2$	105–106
		Methacrylic Acid	$C_4H_6O_2$	222
Chloroform	$CHCl_3$	Acetic Acid	$C_2H_4O_2$	43
		Chloroacetic Acid	$C_2H_3ClO_2$	32
		Dichloroacetic Acid	$C_2H_2Cl_2O_2$	28
		Methacrylic Acid	$C_4H_6O_2$	219
		Trichloroacetic Acid	$C_2HCl_3O_2$	25
Cyclohexane	C_6H_{12}	Acetic Acid	$C_2H_4O_2$	120–123
		Isobutyric Acid	$C_4H_8O_2$	254–255
		Propionic Acid	$C_3H_6O_2$	205–208R
Decane	$C_{10}H_{22}$	Acrylic Acid	$C_3H_4O_2$	165
		Methacrylic Acid	$C_4H_6O_2$	232–233
		Valeric Acid	$C_5H_{10}O_2$	263
Dichloroacetic Acid	$C_2H_2Cl_2O_2$	Benzene	C_6H_6	29
		Chloroform	$CHCl_3$	28
o-Dichlorobenzene	$C_6H_4Cl_2$	Acetic Acid	$C_2H_4O_2$	104
1,2-Dichloroethane	$C_2H_4Cl_2$	Methacrylic Acid	$C_4H_6O_2$	220
Diethyl Malonate	$C_7H_{12}O_4$	Acetic Acid	$C_2H_4O_2$	140
N,N-Dimethylacetamide	C_4H_9NO	Acetic Acid	$C_2H_4O_2$	96
N,N-Dimethylformamide (DMF)	C_3H_7NO	Acetic Acid	$C_2H_4O_2$	70–71
		Formic Acid	CH_2O_2	17
Dodecane	$C_{12}H_{26}$	Hexanoic Acid	$C_6H_{12}O_2$	268
		Methacrylic Acid	$C_4H_6O_2$	235
		Valeric Acid	$C_5H_{10}O_2$	265
Ethyl Acetate	$C_4H_8O_2$	Acetic Acid	$C_2H_4O_2$	83–95
		Acetic Anhydride	$C_4H_6O_3$	323

		Maleic Anhydride	$C_4H_2O_3$	308
		Propionic Acid	$C_3H_6O_2$	187
Ethyl Acrylate	$C_5H_8O_2$	Acrylic Acid	$C_3H_4O_2$	159
Ethyl Iodide	C_2H_5I	Acetic Acid	$C_2H_4O_2$	48–49
Ethyl Propionate	$C_5H_{10}O_2$	Propionic Acid	$C_3H_6O_2$	191–198R
Ethyl Trichloroacetate	$C_4H_5Cl_3O_2$	Acetic Acid	$C_2H_4O_2$	72
Ethylbenzene	C_8H_{10}	Methacrylic Acid	$C_4H_6O_2$	225
Ethylene Glycol Diacetate	$C_6H_{10}O_4$	Acetic Acid	$C_2H_4O_2$	118
Formic Acid	CH_2O_2	Acetic Acid	$C_2H_4O_2$	2–7
		Acetonitrile	C_2H_3N	1
		3-Chloro-1-Propene	C_3H_5Cl	12
		N,N-Dimethylformamide (DMF)	C_3H_7NO	17
		Methyl Acetate	$C_3H_6O_2$	13
		Methyl Formate	$C_2H_4O_2$	8–11
		Propionic Acid	$C_3H_6O_2$	14–16
		Pyridine	C_5H_5N	18–19
		Valeric Acid	$C_5H_{10}O_2$	20
Heptane	C_7H_{16}	Acetic Acid	$C_2H_4O_2$	144–145
		Acetic Anhydride	$C_4H_6O_3$	331
		Acrylic Acid	$C_3H_4O_2$	161
		Isobutyric Acid	$C_4H_8O_2$	258–259
		Methacrylic Acid	$C_4H_6O_2$	224
		Propionic Acid	$C_3H_6O_2$	214–218R
Hexane	C_6H_{14}	Acetic Acid	$C_2H_4O_2$	130
		Methacrylic Acid	$C_4H_6O_2$	223
		Propionic Acid	$C_3H_6O_2$	211

Hexanoic Acid	$C_6H_{12}O_2$	Dodecane	$C_{12}H_{26}$	268
		Tetradecane	$C_{14}H_{30}$	269
		N-Undecane	$C_{11}H_{24}$	267
1-Hexene	C_6H_{12}	Acetic Acid	$C_2H_4O_2$	124
		Propionic Acid	$C_3H_6O_2$	209
Isobornyl Acetate	$C_{12}H_{20}O_2$	Acetic Acid	$C_2H_4O_2$	154
Isobutyl Acetate	$C_6H_{12}O_2$	Acetic Acid	$C_2H_4O_2$	127–129R
Isobutyric Acid	$C_4H_8O_2$	Acetic Anhydride	$C_4H_6O_3$	252
		Acetonitrile	C_2H_3N	250–251
		tert-Butylhydroperoxide	$C_4H_{10}O_2$	253
		Cyclohexane	C_6H_{12}	254–255
		Heptane	C_7H_{16}	258–259
		Methylcyclohexane	C_7H_{14}	257
		Propionic Acid	$C_3H_6O_2$	188
		Toluene	C_7H_8	256
Isopropyl Acetate	$C_5H_{10}O_2$	Acetic Anhydride	$C_4H_6O_3$	324–325
Isopropylbenzene	C_9H_{12}	Acetic Acid	$C_2H_4O_2$	150–151
		Methacrylic Acid	$C_4H_6O_2$	230
Lauric Acid	$C_{12}H_{24}O_2$	Myristic Acid	$C_{14}H_{28}O_2$	280–282
Maleic Anhydride	$C_4H_2O_3$	Benzene	C_6H_6	309
		Ethyl Acetate	$C_4H_8O_2$	308
		Methyl Acrylate	$C_4H_6O_2$	307
		Nitromethane	CH_3NO_2	306
		Xylene (isomer not specified)	C_8H_{10}	311
		o-Xylene	C_8H_{10}	310

Methacrolein	C_4H_6O	Acetic Acid	$C_2H_4O_2$	73
		Methacrylic Acid	$C_4H_6O_2$	221
Methacrylic Acid	$C_4H_6O_2$	Acetic Acid	$C_2H_4O_2$	74
		Butyl Methacrylate	$C_8H_{14}O_2$	227–228
		Chlorobenzene	C_6H_5Cl	222
		Chloroform	$CHCl_3$	219
		Decane	$C_{10}H_{22}$	232–233
		1,2-Dichloroethane	$C_2H_4Cl_2$	220
		Dodecane	$C_{12}H_{26}$	235
		Ethylbenzene	C_8H_{10}	225
		Heptane	C_7H_{16}	224
		Hexane	C_6H_{14}	223
		Isopropylbenzene	C_9H_{12}	230
		Methacrolein	C_4H_6O	221
		Nonane	C_9H_{20}	231
		Octane	C_8H_{18}	229
		N-Undecane	$C_{11}H_{24}$	234
		m-Xylene	C_8H_{10}	226
Methyl Acetate	$C_3H_6O_2$	Acetic Acid	$C_2H_4O_2$	54–57
		Butyric Acid	$C_4H_8O_2$	237
		Formic Acid	CH_2O_2	13
Methyl Acrylate	$C_4H_6O_2$	Acrylic Acid	$C_3H_4O_2$	155–158
		Maleic Anhydride	$C_4H_2O_3$	307
Methyl Chloride	CH_3Cl	Acetic Anhydride	$C_4H_6O_3$	320
Methyl Formate	$C_2H_4O_2$	Formic Acid	CH_2O_2	8–11
Methyl Iodide	CH_3I	Acetic Acid	$C_2H_4O_2$	44
		Acetic Anhydride	$C_4H_6O_3$	321

Methylcyclohexane	C_7H_{14}	Isobutyric Acid	$C_4H_8O_2$	257
Myristic Acid	$C_{14}H_{28}O_2$	Lauric Acid	$C_{12}H_{24}O_2$	280–282
Nitric Acid	HNO_3	Acetic Acid	$C_2H_4O_2$	37
		Chloroacetic Acid	$C_2H_3ClO_2$	30
		Trichloroacetic Acid	$C_2HCl_3O_2$	21–24
Nitromethane	CH_3NO_2	Maleic Anhydride	$C_4H_2O_3$	306
Nonane	C_9H_{20}	Acetic Acid	$C_2H_4O_2$	152
		Acrylic Acid	$C_3H_4O_2$	164
		Butyric Acid	$C_4H_8O_2$	248
		Methacrylic Acid	$C_4H_6O_2$	231
Z-9-Octadecenoic Acid	$C_{18}H_{34}O_2$	Carbon Disulfide	CS_2	283
Octane	C_8H_{18}	Acetic Acid	$C_2H_4O_2$	147–148
		Acetic Anhydride	$C_4H_6O_3$	336–337
		Acrylic Acid	$C_3H_4O_2$	163
		Methacrylic Acid	$C_4H_6O_2$	229
1-Octene	C_8H_{16}	Acetic Anhydride	$C_4H_6O_3$	333–335
		Acrylic Acid	$C_3H_4O_2$	162
N-Pentanoic Acid	$C_5H_{10}O_2$	Chloroacetic Acid	$C_2H_3ClO_2$	33–35
3-Pentenoic Acid (isomer not specified)	$C_5H_8O_2$	3-Pentenoic Acid Methyl Ester (isomer not specified)	$C_6H_{10}O_2$	260–262
3-Pentenoic Acid Methyl Ester (isomer not specified)	$C_6H_{10}O_2$	3-Pentenoic Acid (isomer not specified)	$C_5H_8O_2$	260–262
Pentyl Acetate	$C_7H_{14}O_2$	Acetic Acid	$C_2H_4O_2$	141–143
		Butyric Acid	$C_4H_8O_2$	245
Propionic Acid	$C_3H_6O_2$	Acetic Acid	$C_2H_4O_2$	58–64R
		Acetic Anhydride	$C_4H_6O_3$	180–183
		Acetonitrile	C_2H_3N	173–174

		Aniline	C_6H_7N	201–202
		Benzene	C_6H_6	199–200R
		Butyl Acetate	$C_6H_{12}O_2$	210
		Butyric Acid	$C_4H_8O_2$	184–186
		Cyclohexane	C_6H_{12}	205–208R
		Ethyl Acetate	$C_4H_8O_2$	187
		Ethyl Propionate	$C_5H_{10}O_2$	191–198R
		Formic Acid	CH_2O_2	14–16
		Heptane	C_7H_{16}	214–218R
		Hexane	C_6H_{14}	211
		1-Hexene	C_6H_{12}	209
		Isobutyric Acid	$C_4H_8O_2$	188
		Propionic Acid, Anhydride	$C_6H_{10}O_3$	203–204
		Propyl Bromide	C_3H_7Br	175–179
		Pyridine	C_5H_5N	189–190
		Tetrachloromethane	CCl_4	166–172
		Toluene	C_7H_8	212–213
Propionic Acid, Anhydride	$C_6H_{10}O_3$	Propionic Acid	$C_3H_6O_2$	203–204
Propyl Acetate	$C_5H_{10}O_2$	Acetic Acid	$C_2H_4O_2$	103
Propyl Bromide	C_3H_7Br	Acetic Acid	$C_2H_4O_2$	65–69R
		Propionic Acid	$C_3H_6O_2$	175–179
Propyl Butyrate	$C_7H_{14}O_2$	Butyric Acid	$C_4H_8O_2$	246
Pyridine	C_5H_5N	Acetic Acid	$C_2H_4O_2$	97–100
		Butyric Acid	$C_4H_8O_2$	239–240
		Formic Acid	CH_2O_2	18–19
		Propionic Acid	$C_3H_6O_2$	189–190

Sulfur Dioxide	O_2S	Acetic Acid	$C_2H_4O_2$	36
		Acetic Anhydride	$C_4H_6O_3$	312
Sulfuric Acid	H_2O_4S	Chloroacetic Acid	$C_2H_3ClO_2$	31
Tetrachloromethane	CCl_4	Acetic Acid	$C_2H_4O_2$	38–42R
		Acetic Anhydride	$C_4H_6O_3$	313–319R
		Propionic Acid	$C_3H_6O_2$	166–172
Tetradecane	$C_{14}H_{30}$	Hexanoic Acid	$C_6H_{12}O_2$	269
Toluene	C_7H_8	Acetic Acid	$C_2H_4O_2$	139
		Acetic Anhydride	$C_4H_6O_3$	329–330
		Benzoic Acid	$C_7H_6O_2$	273–278
		Butyric Acid	$C_4H_8O_2$	244
		Isobutyric Acid	$C_4H_8O_2$	256
		Propionic Acid	$C_3H_6O_2$	212–213
Trichloroacetic Acid	$C_2HCl_3O_2$	Chloroform	$CHCl_3$	25
		Nitric Acid	HNO_3	21–24
Tridecane	$C_{13}H_{28}$	Valeric Acid	$C_5H_{10}O_2$	266
Triethylamine	$C_6H_{15}N$	Acetic Acid	$C_2H_4O_2$	131–138
Trifluoroacetic Acid	$C_2HF_3O_2$	Acetic Acid	$C_2H_4O_2$	27
N-Undecane	$C_{11}H_{24}$	Butyric Acid	$C_4H_8O_2$	249
		Hexanoic Acid	$C_6H_{12}O_2$	267
		Methacrylic Acid	$C_4H_6O_2$	234
		Valeric Acid	$C_5H_{10}O_2$	264
Valeric Acid	$C_5H_{10}O_2$	Decane	$C_{10}H_{22}$	263
		Dodecane	$C_{12}H_{26}$	265
		Formic Acid	CH_2O_2	20
		Tridecane	$C_{13}H_{28}$	266
		N-Undecane	$C_{11}H_{24}$	264

Vinyl Acetate	$C_4H_6O_2$	Acetic Acid	$C_2H_4O_2$	75
Vinyl Butyrate	$C_6H_{10}O_2$	Acetic Acid	$C_2H_4O_2$	113–114
Vinyl Propionate	$C_5H_8O_2$	Acetic Acid	$C_2H_4O_2$	101–102
Xylene (isomer not specified)	C_8H_{10}	Maleic Anhydride	$C_4H_2O_3$	311
m-Xylene	C_8H_{10}	Methacrylic Acid	$C_4H_6O_2$	226
o-Xylene	C_8H_{10}	Acetic Anhydride	$C_4H_6O_3$	332
		Maleic Anhydride	$C_4H_2O_3$	310

Acetic Acid	$C_2H_4O_2$	Benzene	C_6H_6	Propionic Acid	$C_3H_6O_2$	297
				Tetrachloromethane	CCl_4	290–291
		Butyric Acid	$C_4H_8O_2$	Pentanoic Acid	$C_5H_{10}O_2$	300
		Ethyl Acetate	$C_4H_8O_2$	Hexane	C_6H_{14}	301
		Ethylbenzene	C_8H_{10}	Styrene	C_8H_8	302
		Heptane	C_7H_{16}	Acrylic Acid	$C_3H_4O_2$	292
		Methyl Acetate	$C_3H_6O_2$	Formic Acid	CH_2O_2	284
		Propionic Acid	$C_3H_6O_2$	Butyric Acid	$C_4H_8O_2$	295
				Cyclohexane	C_6H_{12}	298–299
				Ethyl Acetate	$C_4H_8O_2$	296
				Formic Acid	CH_2O_2	285–286
				Propyl Bromide	C_3H_7Br	293–294
				Tetrachloromethane	CCl_4	289
		Tetrachloromethane	CCl_4	Acrylic Acid	$C_3H_4O_2$	288
Acrylic Acid	$C_3H_4O_2$	Acetic Acid	$C_2H_4O_2$	Heptane	C_7H_{16}	292
				Tetrachloromethane	CCl_4	288
Benzene	C_6H_6	Propionic Acid	$C_3H_6O_2$	Acetic Acid	$C_2H_4O_2$	297
		Tetrachloromethane	CCl_4	Acetic Acid	$C_2H_4O_2$	290–291
Benzoic Acid	$C_7H_6O_2$	Biphenyl	$C_{12}H_{10}$	Toluene	C_7H_8	303–304
Biphenyl	$C_{12}H_{10}$	Toluene	C_7H_8	Benzoic Acid	$C_7H_6O_2$	303–304
Butyl Formate	$C_5H_{10}O_2$	Pyridine	C_5H_5N	Formic Acid	CH_2O_2	287
Butyric Acid	$C_4H_8O_2$	Acetic Acid	$C_2H_4O_2$	Propionic Acid	$C_3H_6O_2$	295
		Pentanoic Acid	$C_5H_{10}O_2$	Acetic Acid	$C_2H_4O_2$	300
Cyclohexane	C_6H_{12}	Acetic Acid	$C_2H_4O_2$	Propionic Acid	$C_3H_6O_2$	298–299
Ethyl Acetate	$C_4H_8O_2$	Acetic Acid	$C_2H_4O_2$	Propionic Acid	$C_3H_6O_2$	296
		Hexane	C_6H_{14}	Acetic Acid	$C_2H_4O_2$	301

Ethylbenzene	C_8H_{10}	Styrene	C_8H_8	Acetic Acid	$C_2H_4O_2$	302
Formic Acid	CH_2O_2	Acetic Acid	$C_2H_4O_2$	Methyl Acetate	$C_3H_6O_2$	284
				Propionic Acid	$C_3H_6O_2$	285–286
		Butyl Formate	$C_5H_{10}O_2$	Pyridine	C_5H_5N	287
Heptane	C_7H_{16}	Acrylic Acid	$C_3H_4O_2$	Acetic Acid	$C_2H_4O_2$	292
Hexane	C_6H_{14}	Acetic Acid	$C_2H_4O_2$	Ethyl Acetate	$C_4H_8O_2$	301
Methyl Acetate	$C_3H_6O_2$	Formic Acid	CH_2O_2	Acetic Acid	$C_2H_4O_2$	284
Pentanoic Acid	$C_5H_{10}O_2$	Acetic Acid	$C_2H_4O_2$	Butyric Acid	$C_4H_8O_2$	300
Propionic Acid	$C_3H_6O_2$	Acetic Acid	$C_2H_4O_2$	Benzene	C_6H_6	297
		Butyric Acid	$C_4H_8O_2$	Acetic Acid	$C_2H_4O_2$	295
		Cyclohexane	C_6H_{12}	Acetic Acid	$C_2H_4O_2$	298–299
		Ethyl Acetate	$C_4H_8O_2$	Acetic Acid	$C_2H_4O_2$	296
		Formic Acid	CH_2O_2	Acetic Acid	$C_2H_4O_2$	285–286
		Propyl Bromide	C_3H_7Br	Acetic Acid	$C_2H_4O_2$	293–294
		Tetrachloromethane	CCl_4	Acetic Acid	$C_2H_4O_2$	289
Propyl Bromide	C_3H_7Br	Acetic Acid	$C_2H_4O_2$	Propionic Acid	$C_3H_6O_2$	293–294
Pyridine	C_5H_5N	Formic Acid	CH_2O_2	Butyl Formate	$C_5H_{10}O_2$	287
Styrene	C_8H_8	Acetic Acid	$C_2H_4O_2$	Ethylbenzene	C_8H_{10}	302
Tetrachloromethane	CCl_4	Acetic Acid	$C_2H_4O_2$	Benzene	C_6H_6	290–291
				Propionic Acid	$C_3H_6O_2$	289
		Acrylic Acid	$C_3H_4O_2$	Acetic Acid	$C_2H_4O_2$	288
Toluene	C_7H_8	Benzoic Acid	$C_7H_6O_2$	Biphenyl	$C_{12}H_{10}$	303–304

Acetic Acid	$C_2H_4O_2$	Butyric Acid	$C_4H_8O_2$	N-Pentanoic Acid	$C_5H_{10}O_2$	Isocaproic Acid (4-Methylpentanoic Acid)	$C_6H_{12}O_2$	305
Butyric Acid	$C_4H_8O_2$	N-Pentanoic Acid	$C_5H_{10}O_2$	Isocaproic Acid (4-Methylpentanoic Acid)	$C_6H_{12}O_2$	Acetic Acid	$C_2H_4O_2$	305
Isocaproic Acid (4-Methylpentanoic Acid)	$C_6H_{12}O_2$	Acetic Acid	$C_2H_4O_2$	Butyric Acid	$C_4H_8O_2$	N-Pentanoic Acid	$C_5H_{10}O_2$	305
N-Pentanoic Acid	$C_5H_{10}O_2$	Isocaproic Acid (4-Methylpentanoic Acid)	$C_6H_{12}O_2$	Acetic Acid	$C_2H_4O_2$	Butyric Acid	$C_4H_8O_2$	305