Technical Information

Liquid Conductivity Table for Magnetic Flowmeters

TI 1E8A0-02E

CONTENTS

1. INTRODUCTION

When measuring liquids using a magnetic flowmeter, the measurable conductivity range of the liquid varies depending on the model of magmeter. This document is prepared as a reference for conductivity in liquid measurement. As it is created on the basis of chemical documents, not all the information comes directly from the field. Sometimes, a mixture of a process liquid may change the character of the main component, resulting in a change in the conductivity. Also, conductivity varies largely depending on temperature, impurity or concentration. Please use this document as a reference and consider the condition of process liquids before checking conductivity. When checking liquid conductivity using a sample liquid, it is recommended that you measure it right after it is dispensed into a cleaned vessel.

NOTE: Please use this document as a reference. YOKOGAWA does not garantee any data shown in this document.

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TI 1E8A0-02E

2nd Edition: Sep. 1999 (YK)

2. MEASURABLE CONDUCTIVITY RANGE

The minimum measurable conductivity ranges of the magnetic flowmeters from Yokogawa are as follows.

ADMAG, ADMAG AE Size: 2.5 to 10mm (0.1 to 0.4 in) ..... 20 µS/cm
ADMAG, ADMAG AE, ADMAG SE Size: 15mm (0.5 in) or Larger ..... 5 µS/cm
ADMAG CA Size: 15 to 100mm (0.5 to 4 in) ..... 0.01 µS/cm
Size: 150, 200mm (6, 8 in) ..... 1 µS/cm

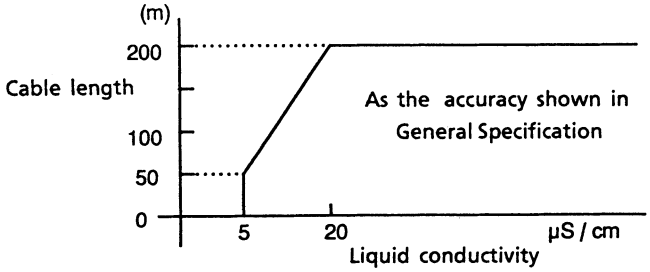
3. RELATION BETWEEN CONDUCTIVITY AND MEASUREMENT ACCURACY

The accuracy of a magnetic flowmeter may vary depending on conductivity. The relation between accuracy and conductivity is described below.

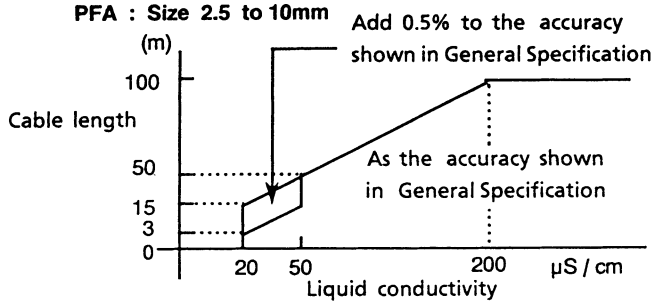
3.1 ADMAG

Accuracy varies depending on the length of the dedicated cables and conductivity.

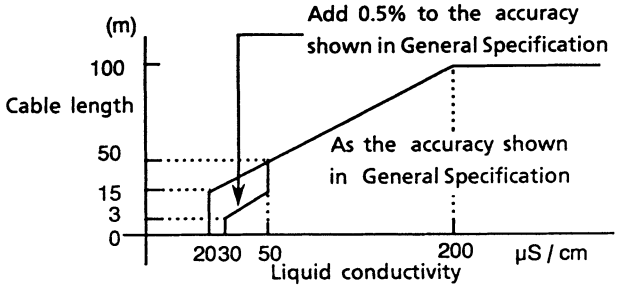
Size 15mm or more



PFA : Size 2.5 to 10mm

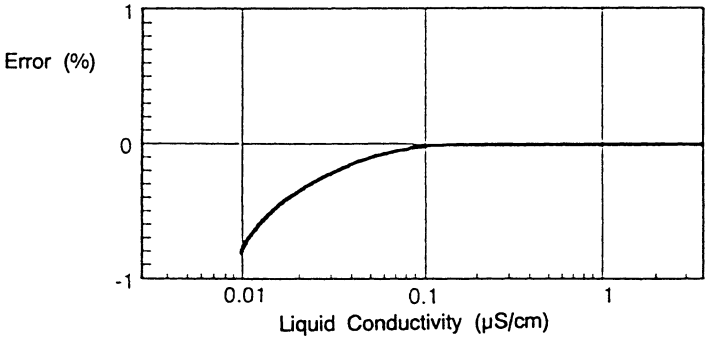


Ceramic : Size 2.5 to 10mm



3.2 ADMAG CA

For liquid conductivity of 0.1µS/cm or more, the accuracy is as shown in General Specification. For liquid conductivity from 0.01 to 0.1µS/cm , refer to the right figure .



4. LIQUID CONDUCTIVITY

The conductivity of typical chemicals is shown in the following table. For the items marked with reference numbers (for example, *1), the reference material is provided later in this document.

From Acetaldehyde to Asphalt emulsion

Liquid	Concentration(%)	Temp. (°C)	Conductivity (µs/cm)
Acetaldehyde CH_3CHO		15	1.7
Acetamide CH_3CONH_2		100	43.0 or less
Acetic acid *1 CH_3CO_2H	0.3	18	320
	1		580
	5		1230
	10		1530
	20		1610
	30		1400
	40		1080
	50		740
	60		460
	70		240
	99.7		0.04
		0	0.005
		25	0.001
Acetic anhydride *2 $(CH_3CO)_2O$		20	0.75
Acetone CH_3COCH_3		18	0.02
		25	0.06
Acetonitrile		20	0.02 or less
Acetophenone *3 $C_6H_5COCH_3$		25	0.006
Acetyl bromide		25	2.4
Acetyl chloride CH_3COCl		25	0.4
Adipic acid *4 $HOOC(CH_2)_4COOH$		25	0.7
		170	0.2
Alizarine *5		233	1.45
Allyl alcohol *6 CH_2-$CHCH_2OH$		25	7.0
Allyter-aldehyde		25	0.16
Alum *7		25	9000

Liquid	Concentration(%)	Temp. (°C)	Conductivity (µS/cm)
Alumina aqueous solution		25	350000
Aluminum chloride $AlCl_2$		25	250000
Ammonia		-79	0.13
NH_3	0.10	15	250
	0.40		490
	0.80		660
	1.60		870
	4.01		1100
	8.03	15	1040
	16.15		630
	30.5		190
Ammonium chloride NH_4Cl	5	18	9180
	10		178000
	15		259000
	20		337000
	25		403000
Ammonium iodide NH_4I *8	10	18	77200
	20		160000
	50		420000
Ammonium nitrate NH_4NO_3 *9	5	15	59000
	10		112000
	30		284000
	50		363000
Ammonium sulfate $(NH_4)_2SO_4$ *10	5	15	55200
	10		101000
	20		178000
	30		229000
	31		232000
Aniline *11		25	0.024
Anthracene *12		230	0.0003
Arsenic tribromide		35	1.5
Arsenic trichloride $AsCl_3$		25	1.2
Asphalt emulsion		30	9000

From Barium chloride to Cadmium sulfate

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Barium chloride $BaCl_2$	5	18	39000
	10		73000
	15		105000
	24		153000
Barium hydroxide $Ba(OH)_2$	1.25	18	25000
	2.5		48000
Barium nitrate $Ba(NO_3)_2$	4.2	18	21000
	8.4		35000
Benzaldehyde C_6H_5CHO		25	0.15
Benzene C_6H_6		20	3.8×10^{-8}
Benzoic acid		125	0.003
Benzoic benzyl		25	0.001 or less
Benzonitrile C_6H_5CN		25	0.02
Benzyl alcohol *13 $C_6H_5CH_2OH$		25	1.8
Benzylamine $C_6H_5CH_2NH_2$		25	0.0017 or less
Bromine Br *14		17.2	1.3×10^{-7}
Bromobenzene C_6H_5Br		25	1.2×10^{-5} or less
Bromoform $CHBr_3$		25	0.02 or less
Butyric acid *15 $C_4H_8O_2$	1.00	18	460
	5.02		860
	10.07		990
	15.03		960
	20.01		890
	50.04		300
	70.01		56
	100.00		0.06
1-butanol		25	0.009

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Cadmium bromide $CdBr_2$	0.03	18	230
	0.08		470
	0.15		840
	0.51		2130
	1		3570
	5		10900
	10		16400
	20		23600
	30		27300
	43		26100
Cadmium chloride $CdCl_2$	0.05	18	500
	0.20		1560
	0.6		3640
	1		5510
	5		16700
	10		24100
	15		28200
	20		29900
	30		28200
	40		22100
	50		13700
Cadmium iodide CdI_2	1	18	2120
	5		6090
	10		10400
	15		14600
	20		18600
	30		25400
	40		30300
	45		31400
Cadmium nitrate *16 $Cd(NO_3)_2$	1	18	6940
	5		28900
	10		51300
	20		82700
	30		95600
	40		90300
	48		75500
Cadmium sulfate $CdSO_4$	0.03	18	274
	0.1		692
	0.5		2390
	1		4160
	5		14600
	10		24700
	25		43000
	36		42100

From Calcium chloride to Ethyl benzoate

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Calcium chloride $CaCl_2$	5.0	18	64000
	10.0		114000
	20		173000
	25		178000
	30		166000
	35		137000
Calcium nitrate *17 $Ca(NO_3)_2$	6.25	18	49000
	12.5		80000
	25.0		105000
	37.5		88000
	50		47000
Carbamate acid		25	400
Chemonite		25	5000
Chlorinated ether		25	18
Chlorine Cl		-70	10^{-10} or less
Chloroacetic acid *18		60	1.4
Chlorobenzene C_6H_5Cl		20	1.9 to 2.4 $\times 10^{-6}$
Chloroform $CHCl_3$		25	0.0001 or less
Chlorohydrin *19		25	0.5
Copper Nitric *20 $Cu(NO_3)_2$	5	15	36500
	10		63500
	15		85800
	20		102000
	25		109000
	35		106000
Copper sulfate *21 $CuSO_4$	2.5	18	10900
	5		18900
	10		32000
	15		42100
	17.5		45800
Creosol		25	0.017 or less
Cupric chloride $CuCl_2$	1.35	18	18700
	9		71600
	18.2		92400
	28.75		89700
	35.2		69900
Cyanogen *22 CN_2		—	0.007 or less

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Cyclohexane C_6H_{12} *23		20	1.9×10^{-8}
Cyclohexanol $C_6H_{11}OH$		25	0.0008
Cyclohexanone $C_6H_{10}O$		25	0.05
Cymene $C_{10}H_{14}$		25	0.02 or less
Dichloroacetic acid $CHCl_2CO_2H$		25	0.07 or less
Dichlorohydrin		25	12.0
Diethyl carbonate		25	0.017
Diethyl ether		25	3.7×10^{-7} or less
Diethyl oxalate		25	0.76
Diethyl sulfate C2H5SO4		25	0.26
Diethylamine $(C_2H_5)_2NH$		-33.6	0.002
Dimethyl sulfate CH_3SO_4		0	0.16
Dimethylformamide		25	0.06 to 0.2
Dioxane		25	2 to 6×10^{-9}
Distilled water *24		—	0.04
Epichlorohydrin		25	0.034
Ethyl acetate *25 $CH_3CO_2C_2H_5$		25	0.001 or less
Ethyl acetoacetate		25	0.04
Ethyl alcohol (Ethanol) C_2H_5OH		25	0.0013
	95	25	0.26 to 0.27
Ethyl amine $C_2H_5NH_2$		0	0.001
Ethyl benzoate		25	0.001

From Ethyl bromide to Iodine

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Ethyl bromide C_2H_5Br		25	0.02
		0	0.001 or less
Ethyl chloride *26 C_2H_5Cl		0	0.003 or less
Ethyl ether *27 $(C_2H_5)_2O$		25	4×10^{-7}
Ethyl iodide *28 C_2H_5I		25	0.02 or less
Ethyl methyl ketone		25	0.1
Ethyl nitrate *29 $C_2H_5ONO_2$		25	0.53
Ethyl sulfate $C_2H_6SO_4$		25	0.53
Ethylene bromide BrH_2CCH_2Br		19	0.0002 or less
Ethylene chloride ClH_2CCH_2Cl		25	0.03
Ethylene diamine $H_2NCH_2CH_2NH_2$ *30		25	0.09 to 0.2
Ethylene glycol *31 $HOCH_2CH_2OH$		25	0.01 to 0.05
Eugenol *32		25	0.017 or less
2-ethoxyethanol		25	1.8
Formalin *33		25	4.0
Formamide $HCONH_2$		25	1.0 to 3.0
Formic acid HCO_2H	4.94	18	5500
	9.55		7560
	20.34		9840
	29.83		10400
	39.95		9840
	50.02		8640
	70.06		5230
	89.02		1870
	100		280
Gallium Ga		30	36.8×10^{9}
Glycerin *34		25	0.064
Glycerol-propyne		25	0.04
Guaiacol *35		25	0.28
Heptone		—	10^{-7} or less
Hexane C_6H_{14}		18	10^{-6} or less
Hydrochloric acid HCl	5	15	395000
	10		630000
	20		762000
	30		662000
	40		515000
Hydrogen bromide HBr		-80	0.008
	5	15	191000
	10		355000
	15		494000
Hydrogen chloride		-96	0.01
Hydrogen cyanide (prussic acid) HCN*36		0	3.3
Hydrogen disulfide		1	-4.2
Hydrogen fluoride HF	0.004	18	250
	0.007		380
	0.02		500
	0.03		800
	0.06		1230
	0.12		2100
	0.24		3630
	0.48		6730
	1.50		19800
	2.48		31500
	4.80		59300
	7.75		96300
	15.85		185000
	24.5		283000
	29.8		341000
Hydrogen iodide HI	5	15	133000
		BP	0.20
Hydrogen sulfide H_2S		BP	0.00001
Hydrogen tetrachloride		18	4×10^{-12}
Iodine *37		110	0.00013

From Isobutyl alcohol to Nonane

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Isobutyl alcohol *38 $(CH_3)_2CHCH_2OH$		25	0.02 or less
Kerosene		—	3×10^{-7}
Kerosine		25	0.017 or less
Latex (natural rubber)		25	5000
Lead nitrate $Pb(NO_3)_2$	5	15	19100
	10		32200
	15		42900
	20		52100
	25		60000
	30		66800
Lithium carbonate Li_2CO_3 *39	0.20	18	3430
	0.63		8850
Lithium chloride LiCl	2.5	18	41000
	5		73300
	10		122000
	20		168000
	30		140000
	40		844000
Lithium hydroxide LiOH	1.25	18	78100
	2.5		142000
	5.0		240000
	7.5		300000
Lithium iodide LiI	5	18	29600
	10		57300
	20		109000
	25		135000
Lithium sulfate Li_2SO_4	5	15	40000
	10		61000
Magnesium chloride $MgCl_2$	5	18	68300
	10		113000
	20		140000
	30		106000
	34		76800
Magnesium nitrate $Mg(NO_3)_2$	5	18	43800
	10		77000
	17		11000
Magnesium sulfate $MgSO_4$ *40	5	15	26300
	10		41400
	15		48000
	25		41500

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Manganese chloride $MnCl_2$	5	15	52600
	10		84400
	15		106000
	20		113000
	25		109000
	28		102000
Mercuric bromide $HgBr_2$	0.22	18	16
	0.42		26
Mercuric chloride $HgCl_2$	0.23	18	44
	1.01		114
	5.08		421
Mercury Hg *41		0	10.6×10^{9}
Methyl acetate $CH_3CO_2CH_3$		25	3.4
Methyl alcohol CH_3OH		25	0.002 to 0.007
Methyl ethyl ketone		25	0.1
Methyl iodide *42 CH_3I		25	0.02 or less
Methyl nitrate		25	4.5
Methyl thiocyanate $CH_3SC\text{-}N$		25	1.5
N-methyl acetamide		40	0.07
Naphthalene *43 $C_{10}H_8$		82	0.0004
Nitric acid *44 HNO_3	6.2	18	312000
	12.4		542000
	24.8		768000
	31.0		782000
	37.2		755000
	49.6		634000
	62.0		490000
Nitrobenzene $C_6H_5NO_2$		25	0.0002 to 0.0004
Nitromethane CH_3NO_2		25	0.22 to 0.66
Nitrotoluene $C_6H_4(CH_3)NO_2$		25	0.2 or less
Nonane		25	0.017 or less

From Oleic acid to Propionaldehyde

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Oleic acid		15	0.0002 or less
Oxalic acid $(CO_2H)_2$	3.5 7.0	18	51000 78000
Oxygen O_2		—	10^{-7} or less
Pentane C_5H_{12}		19.5	0.0002 or less
Phenetole $C_6H_5OC_2H_5$		25	0.017 or less
Phenol		25 50	0.017 or less
Phosgene $COCl_2$ *45		25	0.007
Phosphoric acid *46 H_3PO_4	10 20 30 35 50 70 80 85 87	15	56600 113000 165000 186000 207000 147000 97900 78000 70900
Phosphorus *47		25	0.4
Pinene $C_{10}H_{16}$		23	0.0002 or less
Potassium acetate KCH_3CO_2	4.67 9.33 28 46.67 65.33	15	34700 62500 126000 112000 47900
Potassium bromide KBr *48	5 10 20 30 36	15	47000 93000 191000 292000 351000
Potassium carbonate *49 K_2CO_3	5 10 20 30 40 50	15	56100 104000 181000 222000 217000 147000

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Potassium chloride KCl	5 10 15 20 21	18	69000 136000 202000 268000 281000
Potassium cyanide (potassiumprussiate) KCN *50	3.25 6.5	15	52700 103000
Potassium fluoride KF	5 10 20 30 40	18	65200 121000 208000 256000 252000
Potassium hydroxide KOH	4.2 8.4 16.8 25.2 33.6 42.0	15	146000 272000 456000 540000 522000 421000
Potassium iodide *51 KI	5 10 20 30 40 55	18	33800 68000 146000 230000 317000 423000
Potassium nitrate *52 KNO_3	5 10 15 20 22	18	45400 83900 119000 151000 163000
Potassium oxalate $K_2C_2O_4$	5 10	18	48800 91500
Potassium sulfate K_2SO_4 *53	5 10	18	45800 86000
Potassium sulfide K_2S	3.18 4.98 9.93 19.96 29.97 38.08 47.26	18	84500 128000 234000 402000 456000 411000 258000
Propenonitrile		25	0.1
Propionaldehyde		25	0.85

From 1-propanol to Strontium chloride

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
1-propanol		25	0.02
2-propanol		25	0.004
Propionic acid *54 $C_2H_5CO_2H$	1.00	18	480
	5.01		930
	10.08		1110
	20.02		1040
	30.03		820
	50.09		380
	69.99		85
	100.00		0.07
		25	0.001 or less
Propyl alcohol *55 C_3H_7OH		18	0.05
		25	0.02
Propyl bromide		25	0.02 or less
Pure water		—	0.04
Pyridine		25	0.0003
Quinoline *56		25	0.022
Salicylaldehyde *57		25	0.16
Silver nitrate *58 $AgNO_3$	5	18	26000
	10		48000
	20		87000
	40		157000
	60		210000
Sodium acetate $NaCH_3CO_2$	5	18	29500
	20		65000
	32		56900
Sodium carbonate Na_2CO_3 *59	5	18	45100
	10		70500
	15		83600
Sodium chloride NaCl	5	18	67200
	10		121000
	15		164000
	20		196000
	25		214000
	26		215000

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Sodium hydroxide NaOH	1	18	46500
	2		88700
	4		163000
	6		224000
	8		273000
	10		309000
	15		349000
	20		328000
	25		272000
	27.5		239000
	30		207000
	32.5		180000
	35		156000
	37.5		136000
	40		121000
	45		97700
	50		82000
Sodium iodide *60 NaI	5	18	29800
	10		58100
	20		114000
	40		211000
Sodium nitrate *61 $NaNO_3$	5	18	43600
	10		78200
	20		130000
	30		161000
Sodium silicate		25	26000
		25	24000
		25	14000
Sodium sulfate *62 Na_2SO_4	5	18	40900
	10		68700
	15		88600
Sodium sulfide Na_2S	2.02	18	61200
	5.03		132000
	9.64		202000
	14.02		240000
	16.12		224000
	18.05		218000
Sodium aluminate		25	7000
Stearic acid *63 $CH_3(CH_2)_{16}COOH$		80	4×10^{-7} or less
Strontium chloride $SrCl_2$	5	18	48300
	10		88600
	15		123000
	22		158000

From Strontium nitrate to Zinc sulfate

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Strontium nitrate $Sr(NO_3)_2$	5	15	30900
	10		52700
	15		69000
	20		80200
	25		86600
	35		86100
Sulfur S		115	10^{-6}
		130	0.00005 or less
		440	0.12
Sulfur dioxide *64 SO_2		35	0.015
Sulfuric acid *66 H_2SO_4	5	18	209000
	10		392000
	15		543000
	20		653000
	25		717000
	30		739000
	35		724000
	40		680000
	50		541000
	60		373000
	65		291000
	70		216000
	75		152000
	80		111000
	85		98500
	86		99200
	87		101000
	88		103000
	89		106000
	90		108000
	91		109000
	92		110000
	93		110000
	94		107000
	95		103000
	96		94400
	97		80000
	99.4		8500
Thioacetic acid		35	3.9
Titanium dioxide TiO_2		25	4000
Toluene *66 $C_6H_5CH_3$		—	10^{-8} or less

Liquid	Concentration(%)	Temp. (°C)	Conductivity (μS/cm)
Toluidine $C_6H_4(CH_3)NH_2$		25	2.0 or less
Trichloroacetic acid		25	0.003
Trichloroethylene $ClCH\text{-}CCl_2$ *67		25	Measurement disabled
Trifluoroacetic acid CF_3COOH		25	0.004 to 0.08
Trimethylamine $(CH_3)_3N$		-33.5	0.00022
Turpentine		—	2.0×10^{-7}
Uric acid		145	5000
		25	100
Valerianic acid *68 $C_5H_{10}O_2$		80	4×10^{-7} or less
Xylene *69 $C_6H_4(CH_3)_2$		—	10^{-9} or less
Zinc chloride $ZnCl_2$	2.5	15	27600
	5		48300
	10		72700
	20		91200
	30		92600
	40		84500
	60		36900
Zinc oxide ZnO *70		25	2000
Zinc sulfate *71 $ZnSO_4$	5	18	19100
	10		32100
	15		41500
	25		48000
	30		44400

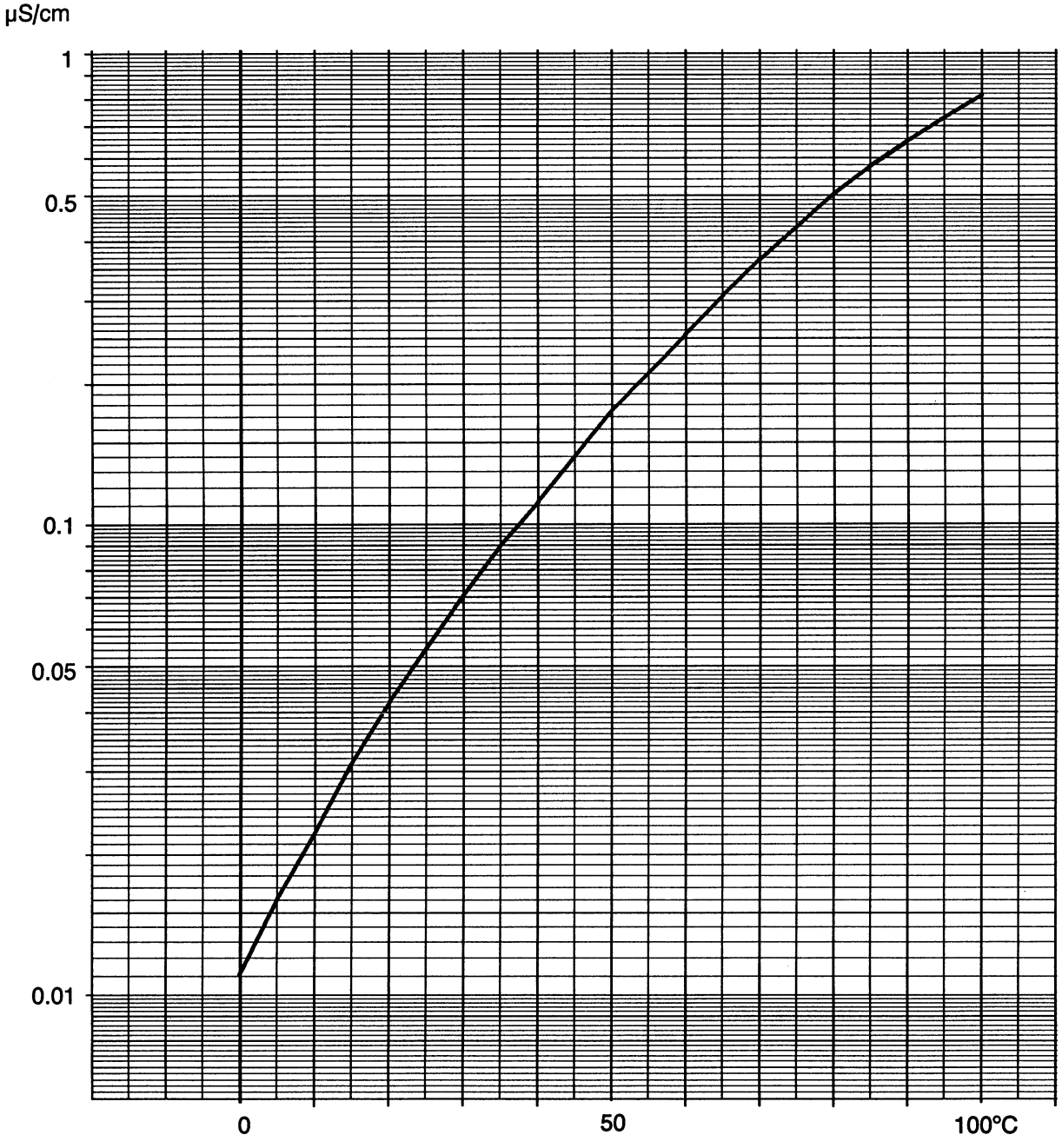
5. CONDUCTIVITY OF GENERAL NAME LIQUIDS

In this section, the conductivity of products to be measured in an actual application is described. The conductivity of the products listed in the table below varies largely depending on each application condition, factory situation and used materials. Therefore, we recommend that you refer to them as a standard and never fail to check them.

Liquid	Temp. (°C)	Conductivity (μS/cm)
Molasses	10 50	300 5000
Sugar liquid	25	1 to 3
Artificial sweetener	25	0.1 to 0.05
Pure sugar solution	10	3.0
Quasi-sugar solution	30	585
Low-class distilled spirits to which pure water is added	25	0.4
Gin (90proof)	25	10
Vodka (100proof)	25	4
Chocolate liqueur	-	10^{-7} or less
Soybean oil	25 104	0.04 or less 10^{-7} or less
Peanut butter (unsweetened)	30	10^{-7} or less
Peanut butter (sweetened)	28	1000
Animal fat	70	10^{-7} or less
Lard		10^{-7} or less
Water from New York City	25	72
Toothpaste	25	150
Paraffin wax	66	10^{-7} or less
Ink	60	2
Enamel	25	10^{-7}
Latex paint	25	700
Black liquor	93	5000

6. CHANGE IN CONDUCTIVITY OF PURE WATER DEPENDING ON TEMPERATURE

The conductivity of liquids varies depending on temperature and concentration. The graph below shows the change in conductivity of pure water.



7. REFERENCE MATERIAL

The following table shows the properties and applications of the representative chemicals described in Chapter 4. If chemicals have a byname, they are also included.

NO.	Name	Contents
1	**Acetic acid**	Used as a solvent, for dyeing, and for the production of synthetic vinegar.
2	**Acetic anhydride**	Acid anhydride of acetic acid
3	**Acetophenone**	Phenyl methyl ketone (byname)
4	**Adipic acid**	Readily soluble in alcohol and soluble in acetone. It can be recrystalized from water. Used as synthetic material in polyamide fibers, alkyd resins, polyester resins and plasticizers, etc.
5	**Alizarine**	It is almost insoluble in water, but soluble in alkalic liquids. A kind of mordant dye. Creates rugged alizarine lake insoluble in metallic oxides and water and used as pigment. The dye derived from alizarine is called alizarine dye.
6	**Allyl alcohol**	Mixes sufficiently with water. Used as an intermediate of manufacturing synthetic resins, spices and chemicals, etc.
7	**Alum**	Used in the same application with aluminum sulfate as mordants.
8	**Ammonium iodide**	Used as a material for the synthesis iodides or pharmaceuticals.
9	**Ammonium nitrate**	Raw material for fertilizers and explosive compounds.
10	**Ammonium sulfate**	Used for nitrogenous fertilizers and the salting of protein.
11	**Aniline**	Aminobenzene, phenylamine (byname) Poisonous liquid. It is slightly soluble in water and so the base is weak. Creates crystal hydrochlorate and sulfate. Used as dye material.
12	**Anthracene**	Creates anthracene oil and the material for dye production. As it is highly fluorescent, its crystal is used as a scintillator in a scintillation counter and regarded as an organic semiconductor.
13	**Benzyl alcohol**	Used in jasmine perfume and also as a mild local anesthetic.
14	**Bromine**	Used for the synthetic material of agricultural chemicals, fire retardants, medicines, dyes and artificial perfumes, etc.
15	**Butylic acid**	Classified into n-butylic acid and isobutylic acid.
16	**Cadmium nitrate**	Soluble in ethanol and ammonia water.
17	**Calcium nitrate**	Readily soluble in water and ethanol. It may be used as a fertilizer.

NO.	Name	Contents
18	**Chloroacetic acid**	The product when chlorine atoms of acetic acid are replaced. Classified into monochloroacetic acid (CH_2ClCO_2H), dichloroacetic acid ($CHCl_2CO_2H$), and trichloroacetic acid (CCl_3CO_2H) depending on the degree of replacement.
19	**Chlorohydrin**	Used as material in the organic synthetic industry and also for solvents.
20	**Copper nitrate**	Soluble in water and ethanol.
21	**Copper sulfate**	Used for pigments, bactericides and mordants.
22	**Cyanogen**	The byname is dicyan.
23	**Cyclohexane**	One of the cycloparaffins and called hexamethylene or hexahydrobenzene.
24	**Distilled water**	Water demineralized by distillation. The resistivity of the water obtained from ordinary distillation is $2 \times 10^5\Omega$cm or so. If distillation is repeated carefully in special equipment that prevents contact with carbon dioxide, the resistivity will become $10^6\Omega$cm or so. Conductance water is used for the precise measurement of electric conductivity of a water solution. Distilled water does not contain any organic matter or silicate gel unlike pure water (resistivity : $10^6\Omega$cm) purified by an ion-exchange resin. Therefore, it is used for the adjustment of injection liquids and pharmaceuticals.
25	**Ethyl acetate**	Used as the base for synthetic fruit perfumes.
26	**Ethyl chloride**	One of the alkyl halides
27	**Ethyl ether**	Typical ether. The byname is diethyl ether or ether.
28	**Ethyl iodide**	One of the alkyl halides
29	**Ethyl nitrate**	The byname is nitric ester. Aromatic, neutral and fluid liquid. It is almost insoluble in water but readily soluble in organic solvents. Volatile and explodes if heated.
30	**Ethylene diamine**	Used as raw material for ethylene-diaminete-traacetic acid (EDTA), a useful chelating agent. Catalyst or condensing agent in formaldehyde resin synthesis.
31	**Ethylene glycol**	Byname is glycol.
32	**Eugenol**	Used as raw material for vanillin production and as a preservative.
33	**Formalin**	Water solution containing 40% formaldehyde and used as a preservative and tissue fixative.
34	**Glycerin**	The byname for glycerol and typical tervalent alcohol. Used for nitroglycerin production and also for sweetening a gents, pharmaceuticals, and cosmetics.
35	**Guaiacol**	Used for vanillin production.

NO.	Name	Contents
36	**Hydrogen cyanide**	Material for acrylic and methacrylic resins.
37	**Iodine**	Used to produce pharmaceuticals, iodides, photosensitizers and pigments, etc.
38	**Isobutyl alcohol**	Butyl alcohol (byname) Used as material for spice production and solvents.
39	**Lithium carbonate**	Used for enamel glass and glaze.
40	**Magnesium sulfate**	Used for heat-resistant agents, mordants, flocculating agents, laxatives, and magnesia fertilizers.
41	**Mercury**	Soluble in nitric acid, concentrated sulfuric acid and aqua regina. Poisonous if absorbed through the skin or smoke containing mercury or mercury vapor is inhaled. Used as material for electrical machinery, apparatuses and instruments (ionization, fluorescent lamps and thermometers).
42	**Methyl iodide**	One of the alkyl halides
43	**Naphthalene**	Used to produce dyes, etc. and for insecticides.
44	**Nitric acid**	Used as the oxidizing agent to oxidize or nitrate organic substances. Used to produce explosive compounds.
45	**Phosgene**	Carbonyl chloride (Byname)
46	**Phosphoric acid**	Generic name of various oxoacids created by hydrolyzing P_4O_{10}. Orthophosphoric acid (byname) Mainly used for metal surface processing, food additive agents, dye processing and as a raw material for phosphates.
47	**Phosphorous**	High grade phosphorous is used as material for compound semiconductors and lower-grade phosphorous is used to produce matches, phosphides and agricultural chemicals. Can also be used as a deoxidizer and alloy additive agent.
48	**Potassium bromide**	Used as material for photographs, sedatives, and the powder for measuring the infrared absorption spectrum.
49	**Potassium carbonate**	Used for soap, glass, ceramics, flux, tanning of leather and as dehydrator.
50	**Potassium cyanide**	Used for metal plating, refining of metallic ore, photographs, and analyzing reagents.
51	**Potassium iodide**	Used in pharmaceuticals and chemicals for photographs.
52	**Potassium nitrate**	Element of gunpowder. Used as fusing agent, oxidizer, agent for preserving meat and pharmaceuticals.
53	**Potassium sulfate**	Used as a raw material for potash fertilizers, glass and alum.
54	**Propionic acid**	Pound in dairy products.
55	**Propyl alcohol**	Propanol

NO.	Name	Contents
56	**Quinoline**	Soluble in alcohol, ether, and benzene without inhibition but almost insoluble in water. The derivatives are used as a raw material for pharmaceuticals or used to quantify metal ions.
57	**Salicylaldehyde**	Used to produce coumarin and dye.
58	**Silver nitrate**	It helps in the cauterization of skin by protein solidification action. Poisonous and used in photosensitizers, production of various silvered mirrors, pharmaceuticals and contacts of electrical communication instruments.
59	**Sodium carbonate**	It is also called carbonic soda or soda. Very important compound in the chemical industry. Used as a raw material to produce soap, glass, caustic soda and for M pulp production and in the dye industry.
60	**Sodium iodide**	Used in pharmaceuticals (antiphlogistics)
61	**Sodium nitrate**	It is hygroscopic and readily soluble in water. Used as material for glasses, a combustion medium for tobacco, and for fertilizers.
62	**Sodium sulfate**	Anhydrates are used for drying agents, glass and dyes in pulp production. Decahydrate is used for diuretics.
63	**Stearic acid**	Used to produce candles.
64	**Sulfur dioxide**	Sulfur oxide and gas form sulfurous acid gas.
65	**Sulfuric acid**	Used in the chemical industry for fertilizers, textiles and pharmaceuticals, etc. and also in all the steel, metal and food industries, etc. It is used for the dehydration of hydrates and drying in desiccators.
66	**Toluene**	Called methylbenzene or toluol and used as a raw material for aromatic compounds
67	**Trichloroethylene**	Excellent solvent for rubber, oils and fats, resin and paint.
68	**Valerianic acid**	Pentanoic acid, found in the lipids of hair of sheep and dogs.
69	**Xylene**	Dimethylbenzene Used for solvents and synthetic material.
70	**Zinc oxide**	Used as agent for accelerating vulcanization, for coating-related agents, enameling, glazes, catalysts, and as raw material for ferrite and pharmaceuticals. By using the high electric resistance value of photo-electric conductivity, it is used as a photo-stabilizer for resins, photosensitizers, varistors and phosphors.
71	**Zinc sulfate**	Used for eye lotions, mordants and pigments.