

**Table 1 Binary Organic Azeotropes Useful for Solvent Cleaning**Sorted by Increasing Polarity – HSP<sub>Polar</sub> (values in Mpa<sup>1/2</sup>)

Azeotrope with Composition by Weight %	Boiling Point, °C	$\delta$ Dispersion	$\delta$ Polar	$\delta$ Hydrogen-Bonding
1 % Heptane & Benzene	80.0	18.4	0.0	2.0
3 % 1-Butanol & Hexane	67.0	14.9	0.1	0.4
2 % Acetic Acid & Cyclohexane	79.7	16.8	0.1	0.4
2 % Acetic Acid & Benzene	80.0	18.3	0.1	2.2
3 % Ethyl Acetate & Carbon Disulfide	46.1	20.3	0.2	0.8
96 % Hexane & 1-Propanol (nPA)	65.7	14.9	0.2	0.6
4 % Allyl Alcohol & Hexane	65.5	14.9	0.4	0.6
5 % 1,1-Dichloroethane & Carbon Disulfide	46.0	20.3	0.4	0.7
90 % Cyclohexane & 1-Butanol	79.8	16.7	0.6	1.7
10 % 1-Butanol & Cyclohexane	79.8	16.7	0.6	1.7
94 % Carbon Tetrachloride & Isobutyl Alcohol	75.8	17.5	0.6	2.2
7 % 2-Propanol (IPA) & Carbon Disulfide	44.6	20.0	0.7	2.3
86 % Cyclohexane & Isobutyl Alcohol	78.1	16.6	0.8	2.3
82 % Heptane & 1-Butanol	91.3	15.4	0.9	2.5
18 % 1-Butanol & Heptane	91.3	15.4	0.9	2.5
22 % t-Butyl Alcohol & Hexane	63.7	15.0	1.0	2.8
82 % Cyclohexane & 2-Butanol	76.0	16.6	1.0	2.7
18 % 2-Butanol & Cyclohexane	76.0	16.6	1.0	2.7
75 % Cyclohexane & Isopropyl Acetate	78.9	16.4	1.0	2.0
16 % 2-Butanol & Benzene	78.8	18.0	1.0	4.1
75 % Hexane & t-Butyl Alcohol	63.7	15.0	1.1	3.2
8 % Ethanol & Carbon Disulfide	42.4	19.9	1.1	2.9
17 % 1-Propanol (nPA) & Benzene	77.1	18.0	1.2	4.8
22 % 2-Propanol (IPA) & Hexane	61.0	15.1	1.2	3.1
80 % Cyclohexane & 1-Propanol (nPA)	74.2	16.6	1.3	3.6
88 % Carbon Tetrachloride & 1-Propanol (nPA)	72.8	17.4	1.4	4.0
82 % Carbon Tetrachloride & Ethyl Acetate	47.4	17.2	1.5	2.4
21 % Ethanol & Hexane	58.7	15.1	1.6	3.5
72 % Chloroform & Hexane	60.0	16.4	1.7	3.0
13 % Methyl Ethyl Ketone (MEK) & Carbon Disulfide	45.9	19.6	1.8	1.5
17 % Allyl Alcohol & Benzene	76.8	18.0	1.9	4.6
50 % n-Propyl Bromide & Hexane	67.2	15.3	1.9	1.4
94 % Toluene & Ethylene Glycol	110.2	17.9	1.9	2.0
63 % Cyclohexane & t-Butyl Alcohol	71.3	16.2	1.9	5.5
94 % Toluene & Ethylene Glycol	110.2	17.9	1.9	2.0
82 % Carbon Tetrachloride & 2-Propanol (IPA)	67.0	17.2	1.9	5.5
37 % t-Butyl Alcohol & Cyclohexane	71.3	16.2	1.9	5.5
78 % Carbon Tetrachloride & Ethylene Dichloride	75.3	18.1	2.0	1.5

**Table 1 Binary Organic Azeotropes Useful for Solvent Cleaning**Sorted by Increasing Polarity – HSP<sub>Polar</sub> (values in Mpa<sup>1/2</sup>)

Azeotrope with Composition by Weight %	Boiling Point, °C	$\delta$ Dispersion	$\delta$ Polar	$\delta$ Hydrogen-Bonding
67 % Cyclohexane & 2-Propanol (IPA)	68.6	16.5	2.0	5.5
37 % t-Butyl Alcohol & Benzene	74.0	17.1	2.0	7.0
47 % Hexane & Isopropyl Ether	67.5	14.3	2.0	1.2
96 % 1,1,2-Trichlorotrifluoroethane (CFC 113) & Ethanol	43.8	14.8	2.1	1.4
96 % 1,1,2-Trichlorotrifluoroethane (CFC 113) & Ethanol	43.8	14.8	2.1	1.4
11 % Allyl Alcohol & Carbon Tetrachloride	72.3	17.5	2.1	3.7
11 % Ethylene Glycol Monoethyl Ether (EE, Cellosolve) & Toluene	110.2	17.8	2.2	3.2
89 % Toluene & Ethylene Glycol Monoethyl Ether (EE, Cellosolve)	110.2	17.8	2.2	3.2
72 % Hexane & Methyl Ethyl Ketone (MEK)	64.3	15.2	2.2	1.2
33 % 2-Propanol (IPA) & Benzene	71.5	17.5	2.2	7.2
83 % Xylene & Ethylene Glycol	139.6	17.5	2.4	3.0
27 % Methyl Acetate & Carbon Disulfide	40.2	18.8	2.4	2.9
84 % Carbon Tetrachloride & Ethanol	65.0	17.3	2.4	5.8
54 % Tetrahydrofuran & Hexane	63.0	15.8	2.6	3.7
27 % 1-Butanol & Toluene	105.6	17.4	2.6	5.9
46 % Cyclohexane & Ethyl Acetate	72.8	16.3	2.7	3.7
69 % Cyclohexane & Ethanol	64.9	16.5	2.7	6.0
55 % Xylene & Propionic Acid	135.4	16.4	2.8	7.0
94 % 1,1,2-Trichlorotrifluoroethane (CFC 113) & Methanol	39.9	14.7	2.8	2.5
6 % Methanol & 1,1,2-Trichlorotrifluoroethane (CFC 113)	39.9	14.7	2.8	2.5
22 % Pyridine & Toluene	110.2	18.2	2.9	2.8
99 % Diethyl Ether & Carbon Disulfide	34.4	14.5	2.9	5.1
99 % Diethyl Ether & Water	34.2	14.5	3.0	5.1
28 % Acetic Acid & Toluene	105.4	17.1	3.0	4.8
32 % Ethanol & Benzene	67.8	17.5	3.1	8.0
25 % Ethylene Glycol Monomethyl Ether (EM, Methyl Cellosolve) & Toluene	105.9	17.6	3.2	5.3
4 % Acetic Acid & Trichloroethylene (TCE)	86.5	17.8	3.4	5.7
55 % Toluene & Isobutyl Alcohol	101.2	16.7	3.4	8.5
91 % Trichloroethylene (TCE) & Isobutyl Alcohol	85.4	17.6	3.5	6.9
37 % Methyl Ethyl Ketone (MEK) & Benzene	78.4	17.5	3.6	3.2
44 % Toluene & Isoamyl Alcohol (3-Methyl-1-Butanol)	100.5	16.7	3.6	8.5
64 % Cyclopentane & Acetone	41.0	16.1	3.6	3.6
44 % Toluene & Isoamyl Alcohol (3-Methyl-1-Butanol)	100.5	16.7	3.6	8.5
36 % Acetone & Cyclopentane	41.0	16.1	3.6	3.6
95 % n-Butyl Acetate & Dibutyl Ether	125.9	15.8	3.7	6.1
94 % Amyl Acetate & Ethylene Glycol	147.6	15.9	3.7	5.9
55 % 2-Butanol & Toluene	95.3	16.8	3.8	9.1
93 % Chloroform & Ethanol	59.4	17.6	3.8	7.4
48 % Ethanol & Heptane	72.0	15.5	3.9	8.6
71 % Carbon Tetrachloride & Methyl Ethyl Ketone (MEK)	73.8	17.0	4.0	2.6
82 % n-Butyl Acetate & Isoamyl Alcohol (3-Methyl-1-Butanol)	126.0	15.8	4.0	7.6
49 % 1-Propanol (nPA) & Toluene	92.6	17.0	4.1	9.8
45 % Propionic Acid & Dibutyl Ether	136.0	15.1	4.1	6.8
39 % Cyclohexane & Vinyl Acetate	67.4	16.3	4.1	3.4
17 % 1-Propanol (nPA) & Trichloroethylene (TCE)	81.8	17.5	4.1	8.6

**Table 1 Binary Organic Azeotropes Useful for Solvent Cleaning**Sorted by Increasing Polarity – HSP<sub>Polar</sub> (values in Mpa<sup>1/2</sup>)

Azeotrope with Composition by Weight %	Boiling Point, °C	$\delta$ Dispersion	$\delta$ Polar	$\delta$ Hydrogen-Bonding
30 % Acetone & Carbon Disulfide	39.3	18.5	4.2	3.2
79 % Carbon Tetrachloride & Methanol	55.7	16.9	4.2	8.0
58 % 2-Propanol (IPA) & Toluene	80.6	16.7	4.2	10.7
78 % Naphthalene & Diethylene Glycol	212.6	18.6	4.3	9.3
52 % n-Butyl Acetate & Propionic Acid	136.0	15.3	4.4	9.0
28 % 2-Propanol (IPA) & Trichloroethylene (TCE)	74.0	17.1	4.4	10.0
17 % Ethanol & Isopropyl Ether	64.0	14.0	4.7	5.0
77 % 1-Butanol & Xylene	116.8	16.4	4.7	13.0
45 % Isobutyl Acetate & Isobutyl Alcohol	107.4	15.1	4.8	11.8
16 % Allyl Alcohol & Trichloroethylene (TCE)	81.0	17.6	5.0	8.1
66 % Tetrahydrofuran & Chloroform	72.5	17.0	5.1	7.4
3 % Isoamyl Acetate & Isoamyl Alcohol (3-Methyl-1-Butanol)	129.1	15.8	5.1	13.1
87 % Chloroform & Methanol	53.5	17.2	5.1	9.3
67 % 1-Butanol & n-Butyl Acetate	117.6	15.9	5.1	12.9
71 % Acetic Acid & Triethylamine	163.0	15.7	5.2	8.9
20 % Ethanol & Methyl-t-butyl Ether	65.5	15.0	5.2	7.7
39 % Methanol & Benzene	58.3	17.0	5.2	10.5
83 % 1-Butanol & Dibutyl Ether	117.6	15.9	5.3	13.5
20 % Acetone & Chloroform	64.7	17.1	5.4	6.1
68 % Acetic Acid & Ethyl Benzene (Styrene)	114.7	15.7	5.4	9.2
27 % Ethanol & Trichloroethylene (TCE)	70.9	17.1	5.4	11.0
77 % Ethyl Acetate & 2-Propanol (IPA)	74.8	15.8	5.5	9.5
36 % Ethylene Glycol Monoethyl Ether (EE, Cellosolve) & n-Butyl Acetate	125.8	15.9	5.6	9.1
63 % 1-Octanol & Ethylene Glycol	184.4	12.8	5.6	9.1
59 % Acetone & Hexane	49.8	15.2	5.7	3.8
32 % 1-Butanol & Tetrachloroethylene (PERC)	110.0	17.2	5.7	7.7
16 % Heptane & Vinyl Acetate	72.0	15.9	5.7	4.6
14 % Water & n-Propyl Acetate	82.4	15.3	5.8	7.2
17 % 2-Propanol (IPA) & n-Propyl Bromide	66.6	15.9	5.9	7.3
63 % 1-Propanol (nPA) & n-Propyl Acetate	94.0	15.8	5.9	14.0
45 % 1,1,2,2-Tetrachloroethane & Cyclohexanone	159.0	18.1	5.9	5.2
48 % Heptane & Methanol	59.1	15.2	5.9	10.7
63 % 1-Propanol (nPA) & n-Propyl Acetate	94.0	15.8	5.9	14.0
50 % Ethylene Glycol Monoethyl Ether (EE, Cellosolve) & Dibutyl Ether	127.0	15.7	6.0	8.3
36 % Diethyl Ether & Methyl Formate	28.2	15.0	6.0	8.0
88 % t-Butyl Alcohol & Water	79.9	15.2	6.1	13.7
81 % 2-Propanol (IPA) & Tetrachloroethylene (PERC)	81.7	16.1	6.1	14.7
35 % 2-Propanol (IPA) & 2-Propanol (IPA)	80.1	15.8	6.1	16.4
50 % Allyl Alcohol & Toluene	91.5	17.1	6.1	9.4
75 % o-Dichlorobenzene & Phenol	171.1	18.9	6.2	6.7
23 % 2-Propanol (IPA) & Methyl Propionate	77.0	15.6	6.4	10.0
71 % 1-Butanol & Pyridine	118.7	16.8	6.5	13.3
95 % Methylene Chloride & Ethanol	39.9	18.0	6.5	7.2
31 % Ethanol & Ethyl Acetate	71.8	15.8	6.5	11.3
68 % Ethanol & Toluene	76.7	16.5	6.6	14.2
43 % Diethyl Ketone & 2-Propanol (IPA)	94.9	15.8	6.7	11.5

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Azeotrope with Composition by Weight %	Boiling Point, °C	$\delta$ Dispersion	$\delta$ Polar	$\delta$ Hydrogen-Bonding
45 % Tetrahydrofuran & 1,2-Dichloroethylene (CIS)	69.8	16.9	6.8	5.8
49 % Naphthalene & Ethylene Glycol	183.9	18.0	6.8	4.2
39 % Acetic Acid & Tetrachloroethylene (PERC)	107.4	16.4	6.8	6.6
67 % Acetone & Cyclohexane	53.0	15.9	6.9	4.7
16 % Acetic Acid & Dibromo Methane	94.8	16.8	6.9	9.0
81 % Acetic Acid & Dibutyl Ether	116.7	14.7	6.9	11.0
22 % 2-Propanol (IPA) & Vinyl Acetate	70.8	15.9	6.9	8.6
53 % Ethanol & Isopropyl Acetate	76.8	15.4	6.9	14.4
88 % 2-Propanol (IPA) & Water	80.4	15.8	7.1	15.2
86 % Methylene Chloride & Ethylene Glycol	168.7	18.0	7.1	5.6
93 % Ethylene Dichloride & Isobutyl Alcohol	83.5	18.6	7.2	5.2
57 % Acetone & Isopropyl Ether	53.3	14.7	7.4	4.9
10 % Water & Propylene Glycol Methyl Ether	79.9	15.4	7.4	14.3
52 % 2-Pentanol & Pyridine	117.4	17.1	7.4	10.1
95 % Methyl Acetate & Water	56.1	15.5	7.6	7.4
52 % Allyl Alcohol & n-Propyl Acetate	94.6	15.8	7.7	12.4
36 % Methanol & Trichloroethylene (TCE)	60.2	16.5	7.8	14.0
95 % Acetic Acid & Bromobenzene	118.3	14.7	7.9	13.2
22 % Methanol & n-Propyl Bromide	54.6	15.7	7.9	9.9
34 % Ethanol & Ethylene Dichloride	71.0	17.6	8.0	10.8
63 % Ethylene Dichloride & Ethanol	70.5	17.5	8.1	11.4
63 % Ethanol & Tetrachloroethylene (PERC)	76.8	16.4	8.1	15.1
30 % 2-Propanol (IPA) & Methyl Ethyl Ketone (MEK)	77.3	15.9	8.1	8.5
42 % Acetone & n-Propyl Bromide	54.1	15.7	8.3	5.7
19 % Methanol & Methyl Acetate	54.0	15.4	8.3	10.7
17 % Chloroform & Methyl Ethyl Ketone (MEK)	79.9	16.2	8.4	5.2
52 % Acetic Acid & Pyridine	139.7	16.7	8.4	9.7
68 % 2-Butanol & Water	99.9	15.7	8.5	11.7
89 % 1,1-Dichloroethane & Methanol	49.1	16.3	8.5	6.1
48 % Acetone & Methyl Acetate	55.6	15.5	8.9	7.3
34 % Ethanol & Methyl Ethyl Ketone (MEK)	74.8	15.9	8.9	10.0
51 % Ethyl Acetate & Methanol	62.1	15.4	8.9	15.0
72 % 1-Propanol (nPA) & Water	88.1	15.9	9.0	14.2
46 % Ethylene Glycol & Diethylene Glycol Ethyl Ether	192.0	16.5	9.1	8.4
96 % Ethanol & Water	78.2	15.8	9.1	18.9
37 % Methanol & Vinyl Acetate	58.5	15.6	9.3	12.5
80 % Ethylene Dichloride & Water	72.0	18.2	9.4	4.1
72 % Methanol & Toluene	63.7	15.8	9.5	17.1
35 % Methanol & Ethylene Dichloride	59.5	17.2	9.6	12.4
88 % Methyl Ethyl Ketone (MEK) & Water	73.4	16.0	9.7	5.0
88 % Acetone & Carbon Tetrachloride	56.1	15.6	9.8	6.6
50 % Water & Isoamyl Alcohol (3-Methyl-1-Butanol)	95.2	15.7	10.0	9.3
31 % Tetrahydrofuran & Methanol	60.7	15.6	10.4	18.2
88 % Acetone & Methanol	55.7	15.5	10.6	8.8
50 % Propylene Glycol Monoethyl Ether (PGEE, PE) & Water	97.3	15.6	11.0	7.5
51 % Propylene Glycol Methyl Ether & Water	97.5	15.4	11.0	10.1
20 % 2-Propanol (IPA) & Methanol	64.0	15.2	11.1	21.1
57 % Pyridine & Water	92.6	17.5	11.9	5.2

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Azeotrope with Composition by Weight %	Boiling Point, °C	$\delta$ Dispersion	$\delta$ Polar	$\delta$ Hydrogen-Bonding
73 % Allyl Alcohol & Water	88.2	16.0	12.1	13.7
26 % Acetic Acid & Dimethyl Formamide	159.0	16.7	12.3	11.8
20 % Cyclohexanol & Water	97.8	15.9	13.6	6.1
79 % Water & Ethylene Glycol Hexyl Ether	98.8	16.1	13.7	6.4
29 % Ethylene Glycol Monoethyl Ether (EE, Cellosolve) & Water	99.4	15.7	13.9	7.3
82 % Water & Propylene Glycol Mono-t-Butyl Ether (PGTBE, PTB)	55.0	15.5	14.0	5.6
18 % Propionic Acid & Water	99.9	15.4	14.1	5.7
15 % Ethylene Glycol Monomethyl Ether (EM, Methyl Cellosolve)) & Water	99.9	15.6	14.9	6.1
13 % Diacetone Alcohol & Water	99.6	15.5	14.9	5.1
9 % Benzyl Alcohol & Water	99.9	15.8	15.2	5.0
5 % Tetrahydrofuran & Water	64.0	15.6	15.4	4.4