

These two workbooks are provided by [www.hansen-solubility.com](http://www.hansen-solubility.com) as a convenient introduc

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tion to some of the basic HSP methods

### HSP Sphere

	dD	dP	dH	R	Good	11
	18.4	9.7	8.0	7.1	Bad	11
Test Value	16	7	8		Total	22
Delta	2.4	11.4	10.4			
	Distance	5.5	RED	0.77		

Solvents	dD	dP	dH	MVol	Score	Distance
Acetone	15.5	10.4	7	73.8	1	5.915773
Acetonitrile	15.3	18	6.1	52.9	0	10.52754
n-Amyl Acetate	15.8	3.3	6.1	148		0
n-Amyl Alcohol	15.9	5.9	13.9	108.6		0
Benzene	18.4	0	2	52.9	0	11.38507
Benzyl Alcohol	18.4	6.3	13.7	103.8		0
Benzyl Benzoate	20	5.1	5.2	190.3		0
1-Butanol	16	5.7	15.8	92		0
2-Butanol	15.8	5.7	14.5	92		0
n-Butyl Acetate	15.8	3.7	6.3	132.6		0
t-Butyl Acetate	15	3.7	6	134.8		0
t-Butyl Alcohol	15.2	5.1	14.7	96		0
Butyl Benzoate	18.3	5.6	5.5	178.1		0
Butyl Diglycol Acetate	16	4.1	8.2	208.2		0
Butyl Glycol Acetate	15.3	7.5	6.8	171.2		0
n-Butyl Propionate	15.7	5.5	5.9	149.3		0
Caprolactone (Epsilon)	19.7	15	7.4	110.8		0
Chloroform	17.8	3.1	5.7	80.5	1	7.075453
m-Cresol	18.5	6.5	13.7	105	1	6.563973
Cyclohexane	16.8	0	0.2	108.9	0	12.82752
Cyclohexanol	17.4	4.1	13.5	105.7		0
Cyclohexanone	17.8	8.4	5.1	104.2		0
Di-isoButyl Ketone	16	3.7	4.1	177.4		0
Diacetone Alcohol	15.8	8.2	10.8	124.3		0
Diethyl Ether	14.5	2.9	4.6	104.7	0	10.87429
Diethylene Glycol Monobu	16	7	10.6	170.4		0
Dimethyl Cyclohexane	16.1	0	1.1	140		0
Dimethyl Sulfoxide (DMSO)	18.4	16.4	10.2	71.3	1	7.066692
1,4-Dioxane	17.5	1.8	9	85.7	0	8.160898
1,3-Dioxolane	18.1	6.6	9.3	69.9	1	3.420207
Dipropylene Glycol	16.5	10.6	17.7	131.8		0
Dipropylene Glycol Methyl	15.5	5.7	11.2	156.1		0
Dipropylene Glycol Mono r	15.7	6.5	10	211.2		0
Ethanol	15.8	8.8	19.4	58.6	0	12.58658
Ethyl Acetate	15.8	5.3	7.2	98.6	1	6.846256
Ethyl Benzene	17.8	0.6	1.4	122.8		0
Ethyl Lactate	16	7.6	12.5	115		0
Ethylene Carbonate	18	21.7	5.1	66		0
Ethylene Glycol	17	11	26	55.9		0

Ethylene Glycol Monobutyl	16	5.1	12.3	132		0
Ethylene Glycol Monomet	16	8.2	15	79.3		0
gamma-Butyrolactone (GB	18	16.6	7.4	76.5		0
Glycerol Carbonate	17.9	25.5	17.4	83.2		0
Heptane	15.3	0	0	147		0
Hexane	14.9	0	0	131.4	0	14.36662
Iso-Butanol	15.1	5.7	15.9	92.9		0
Iso-Butyl Isobutyrate	15.1	2.8	5.8	169.8		0
Iso-Pentyl Acetate	15.3	3.1	7	150.2		0
iso-Pentyl Alcohol	15.8	5.2	13.3	109.3		0
Iso-Propyl Acetate	14.9	4.5	8.2	117.1		0
Iso-Propyl Ether	15.1	3.2	3.2	141.8	0	10.4113
Isophorone	17	8	5	150.3		0
d-Limonene	17.2	1.8	4.3	162.9		0
Methanol	14.7	12.3	22.3	40.6	0	16.33419
Methyl Acetate	15.5	7.2	7.6	79.8		0
Methyl Carbitol	16.2	7.8	12.6	118.2		0
Methyl Cellosolve	16	8.2	15	79.3		0
Methyl Cyclohexane	16	0	1	128.2		0
Methyl Ethyl Ketone (MEK)	16	9	5.1	90.2	1	5.629341
Methyl iso-Amyl Ketone	16	5.7	4.1	141.3		0
Methyl iso-Butyl Carbinol	15.4	3.3	12.3	127.2		0
Methyl Iso-Butyl Ketone (N	15.3	6.1	4.1	125.8		0
Methyl Oleate	16.2	3.8	4.5	340.7		0
Methyl Propyl Ketone	16	7.6	4.7	107.3		0
N-Methyl-2-Pyrrolidone (N	18	12.3	7.2	96.6	1	2.830107
Methylene Chloride	17	7.3	7.1	64.4	1	3.780303
N,N-Dimethyl Acetamide	16.8	11.5	10.2	93		0
N,N-Dimethyl Formamide (	17.4	13.7	11.3	77.4	1	5.577409
1-Nitropropane	16.6	12.3	5.5	89.5		0
2-Phenoxy Ethanol	17.8	5.7	14.3	124.7		0
2-Propanol	15.8	6.1	16.4	76.9		0
1-Propanol	16	6.8	17.4	75.1		0
n-Propyl Acetate	15.3	4.3	7.6	115.8		0
n-Propyl Propanoate	15.5	5.6	5.7	132.5		0
Propylene Carbonate	20	18	4.1	85.2		0
Propylene Glycol Monobut	15.3	4.5	9.2	132		0
Propylene Glycol Monoeth	15.6	6.3	7.7	155.1		0
Propylene Glycol Monome	15.6	6.3	11.6	98.2		0
Propylene Glycol Monome	15.6	5.6	9.8	137.1		0
Propylene Glycol Phenyl Et	17.4	5.3	11.5	143.2		0
sec-Butyl Acetate	15	3.7	7.6	134		0
Sulfolane (Tetramethylene	18	18	9.9	95.3		0
Tetrahydrofuran (THF)	16.8	5.7	8	81.9	1	5.113938
Tetrahydrofurfuryl Alcohol	17.8	8.2	12.9	97.4		0
Toluene	18	1.4	2	106.6	0	10.25007
Xylene	17.6	1	3.1	123.9	0	10.09184



Scaling	1000000 Wrong Out	0
Fit	1000000 Wrong In	0
Fit %	100%	

Use Excel Solver to Maximise J3  
 Start with a large R (say 10)  
 Then decrease R, re-fit till Fit% gets worse

Error	Total Error	RED
1	1	0.83
1	1	1.48
1	1	
1	1	
1	1	1.60
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	1.00
1	1	0.92
1	1	1.81
1	1	
1	1	
1	1	
1	1	
1	1	1.53
1	1	
1	1	
1	1	1.00
1	1	1.15
1	1	0.48
1	1	
1	1	
1	1	
1	1	1.77
1	1	0.96
1	1	
1	1	
1	1	
1	1	

1	1	
1	1	
1	1	
1	1	
1	1	
1	1	2.02
1	1	
1	1	
1	1	
1	1	
1	1	1.47
1	1	
1	1	2.30
1	1	
1	1	
1	1	
1	1	0.79
1	1	
1	1	
1	1	
1	1	0.40
1	1	0.53
1	1	
1	1	0.79
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	
1	1	0.72
1	1	
1	1	1.44
1	1	1.42





### HSP Solvent Blends

	dD	dP	dH	R				
Target	17.0	8.0	3.0	5.0				
Blend	17.9	6.5	12.3					
Delta	-0.9	1.6	-9.3					
	Distance	9.6 RED			1.91 Total	Total dD	Total dP	
					100	17.9	6.5	
Solvents	dD	dP	dH	MVol	%	Partial dD	Partial dP	
Acetone	15.5	10.4	7	73.8	10	1.6	1.0	
Acetonitrile	15.3	18	6.1	52.9				
n-Amyl Acetate	15.8	3.3	6.1	148				
n-Amyl Alcohol	15.9	5.9	13.9	108.6				
Benzene	18.4	0	2	52.9				
Benzyl Alcohol	18.4	6.3	13.7	103.8	80	14.7	5.0	
Benzyl Benzoate	20	5.1	5.2	190.3				
1-Butanol	16	5.7	15.8	92				
2-Butanol	15.8	5.7	14.5	92				
n-Butyl Acetate	15.8	3.7	6.3	132.6	10	1.6	0.4	
t-Butyl Acetate	15	3.7	6	134.8				
t-Butyl Alcohol	15.2	5.1	14.7	96				
Butyl Benzoate	18.3	5.6	5.5	178.1				
Butyl Diglycol Acetate	16	4.1	8.2	208.2				
Butyl Glycol Acetate	15.3	7.5	6.8	171.2				
n-Butyl Propionate	15.7	5.5	5.9	149.3				
Caprolactone (Epsilon)	19.7	15	7.4	110.8				
Chloroform	17.8	3.1	5.7	80.5				
m-Cresol	18.5	6.5	13.7	105				
Cyclohexane	16.8	0	0.2	108.9				
Cyclohexanol	17.4	4.1	13.5	105.7				
Cyclohexanone	17.8	8.4	5.1	104.2				
Di-isoButyl Ketone	16	3.7	4.1	177.4				
Diacetone Alcohol	15.8	8.2	10.8	124.3				
Diethyl Ether	14.5	2.9	4.6	104.7				
Diethylene Glycol Monobu	16	7	10.6	170.4				
Dimethyl Cyclohexane	16.1	0	1.1	140				
Dimethyl Sulfoxide (DMSO)	18.4	16.4	10.2	71.3				
1,4-Dioxane	17.5	1.8	9	85.7				
1,3-Dioxolane	18.1	6.6	9.3	69.9				
Dipropylene Glycol	16.5	10.6	17.7	131.8				
Dipropylene Glycol Methyl	15.5	5.7	11.2	156.1				
Dipropylene Glycol Mono r	15.7	6.5	10	211.2				
Ethanol	15.8	8.8	19.4	58.6				
Ethyl Acetate	15.8	5.3	7.2	98.6				
Ethyl Benzene	17.8	0.6	1.4	122.8				
Ethyl Lactate	16	7.6	12.5	115				
Ethylene Carbonate	18	21.7	5.1	66				
Ethylene Glycol	17	11	26	55.9				

Ethylene Glycol Monobutyl	16	5.1	12.3	132
Ethylene Glycol Monomet	16	8.2	15	79.3
gamma-Butyrolactone (GB	18	16.6	7.4	76.5
Glycerol Carbonate	17.9	25.5	17.4	83.2
Heptane	15.3	0	0	147
Hexane	14.9	0	0	131.4
Iso-Butanol	15.1	5.7	15.9	92.9
Iso-Butyl Isobutyrate	15.1	2.8	5.8	169.8
Iso-Pentyl Acetate	15.3	3.1	7	150.2
iso-Pentyl Alcohol	15.8	5.2	13.3	109.3
Iso-Propyl Acetate	14.9	4.5	8.2	117.1
Iso-Propyl Ether	15.1	3.2	3.2	141.8
Isophorone	17	8	5	150.3
d-Limonene	17.2	1.8	4.3	162.9
Methanol	14.7	12.3	22.3	40.6
Methyl Acetate	15.5	7.2	7.6	79.8
Methyl Carbitol	16.2	7.8	12.6	118.2
Methyl Cellosolve	16	8.2	15	79.3
Methyl Cyclohexane	16	0	1	128.2
Methyl Ethyl Ketone (MEK)	16	9	5.1	90.2
Methyl iso-Amyl Ketone	16	5.7	4.1	141.3
Methyl iso-Butyl Carbinol	15.4	3.3	12.3	127.2
Methyl Iso-Butyl Ketone (N	15.3	6.1	4.1	125.8
Methyl Oleate	16.2	3.8	4.5	340.7
Methyl Propyl Ketone	16	7.6	4.7	107.3
N-Methyl-2-Pyrrolidone (N	18	12.3	7.2	96.6
Methylene Chloride	17	7.3	7.1	64.4
N,N-Dimethyl Acetamide	16.8	11.5	10.2	93
N,N-Dimethyl Formamide (	17.4	13.7	11.3	77.4
1-Nitropropane	16.6	12.3	5.5	89.5
2-Phenoxy Ethanol	17.8	5.7	14.3	124.7
2-Propanol	15.8	6.1	16.4	76.9
1-Propanol	16	6.8	17.4	75.1
n-Propyl Acetate	15.3	4.3	7.6	115.8
n-Propyl Propanoate	15.5	5.6	5.7	132.5
Propylene Carbonate	20	18	4.1	85.2
Propylene Glycol Monobut	15.3	4.5	9.2	132
Propylene Glycol Monoeth	15.6	6.3	7.7	155.1
Propylene Glycol Monome	15.6	6.3	11.6	98.2
Propylene Glycol Monome	15.6	5.6	9.8	137.1
Propylene Glycol Phenyl Et	17.4	5.3	11.5	143.2
sec-Butyl Acetate	15	3.7	7.6	134
Sulfolane (Tetramethylene	18	18	9.9	95.3
Tetrahydrofuran (THF)	16.8	5.7	8	81.9
Tetrahydrofurfuryl Alcohol	17.8	8.2	12.9	97.4
Toluene	18	1.4	2	106.6
Xylene	17.6	1	3.1	123.9

### Blend Distance Calculator

Copy/Paste solvent pairs

	Solvent	dD	dP	dH	Distance	RED
Total dH	S1	Methyl Eth	16	9	5.1	3.07
12.3	S2	Toluene	18	1.4	2	6.97
Partial dH	% S1	% S2				
0.7	100	0	16	9	5.1	3.07
	90	10	16.2	8.24	4.79	2.41
	80	20	16.4	7.48	4.48	1.98
	70	30	16.6	6.72	4.17	1.91
	60	40	16.8	5.96	3.86	2.25
11.0	50	50	17	5.2	3.55	2.85
	40	60	17.2	4.44	3.24	3.59
	30	70	17.4	3.68	2.93	4.39
	20	80	17.6	2.92	2.62	5.23
0.6	10	90	17.8	2.16	2.31	6.09
	0	100	18	1.4	2	6.97

Distance	4
MVol	100
Temperature	25

RT 2475

Chi parameter 0.162

$$X = \frac{MVol \cdot Distance^2}{4RT}$$