Evaluation of ChemDisk™ Organic Vapor Samplers

Prepared by: C.R. Manning, PhD, CIH, FAHIA Revised: 6 Feb 2019

1. Background

Sampler Validation consists of lab tests designed to demonstrate that a Sampler functions as claimed. Since the scope of the claim includes a range of environmental conditions that may exist in the environments sampled, exposure conditions are varied so that each reader may consult the data herein to determine the suitability of a Sampler for a particular application. Protocols published by NIOSH(a), ANSI/ISEA(b), ASTM(c), CEN(d) have been consulted in selecting the tests performed in these studies.

2. Facilities, Equipment & Apparatus

Facilities at Assay Technology's chemical challenge lab were used including laboratory benches and sinks, fume hoods, exposure chambers, lab ware, pumps, chemical reagents, and safety devices. Extraction and analysis of test and reference samplers were conducted in Assay Technology's AIHA-accredited industrial hygiene test labs including benches, sinks, hoods, etc. as well as gas chromatographs. In some cases, test and reference samplers were presented with "natural" exposures in a field environment and analyzed by other accredited Labs.

3. Plan of Study

In the chemical challenge lab, dynamic (flowing and continuously renewed) test atmospheres were typically generated by controlled vaporization of liquid analytes metered into a flowing stream (with heating when required) from the Miller-Nelson HCS 401 or 501 Atmosphere Generator at a controlled flow rate, temperature, and relative humidity.

The atmosphere generated was conducted through inert tubing into an exposure chamber which featured an inert inner compartment in which generated vapors flow by each set of samplers at the same time (Fig 1). The desired linear flow velocity at the sampler's face was developed by a DC motor driven fan installed in the inner compartment and near to the samplers. Reference samplers were typically active samplers in which the front end penetrated the test chamber while the back end was connected to a critical orifice air sampler external to the exposure chamber.

After exposures, all samplers were capped and submitted to an accredited IH lab which extracted samplers and performed the analysis. Typically, results were analyzed by direct comparison of test samplers to reference samplers.

Dynamic atmospheres generated under variable environmental conditions were designed to challenge the samplers as suggested in the referenced test protocols to demonstrate sampler performance under the challenge conditions.

(a) Cassinelli, M.E., Hull, R.D, Crable, J.V., and Teass, A.W., "Protocol for the Evaluation of Passive Monitors," in Diffusive Sampling, Royal Society of Chemistry, London, England, 1987, pp. 190-202.
(b) ANSI/ISEA 104-1998 (R2015)
(c) ASTM D6246-98
(d) EN 838:1996

3.1 Nominal Uptake (Sampling) Rate Determination

Constant concentrations of several analytes were generated and presented to several test and reference samplers concomitantly during a fixed duration. This test was repeated for several groups each containing multiple analytes at different exposure concentrations and times deemed appropriate for the particular analyte. Replicate results for each analyte at multiple concentrations were assessed to determine average uptake (sampling) rate.

3.2 Air Velocity/Sampler Orientation

A constant concentration of analyte was generated and presented to several test and reference samplers as in Section 3.1. The tests were repeated at high and low values of air velocity and different orientations, after which the amounts recovered from test and reference samplers were compared to assess any differences due to air velocity or orientation.

3.3 Analyte Loss by Evaporation (Reverse Diffusion)

A constant concentration of selected volatile analytes was generated and presented to several test samplers as in Section 3.1. After a short exposure (1-2 hr), diffusive samplers were split into two groups. Group 1 was capped and stored for analysis, while Group 2 was returned to the chamber and subjected to a zero concentration exposure (pure air only) for another 4-6 hours (to later assess for analyte loss compared to the capped, stored controls. After exposure completion, samplers were capped and submitted for analysis. Analyte recovery for Group 2 was compared to recovery from Group 1 to determine the degree of analyte loss (due to reverse diffusion).

3.4 Effect on Uptake (Sampling) Rate of Temperature & Relative Humidity

A constant concentration of selected volatile analytes was generated and presented to several test and reference samplers as in Section 3.1 with temperature and humidity controlled at extreme values. The amount of analyte recovered from the sampler groups exposed at different extreme temperatures and humidities were compared with charcoal tubes subject to the same exposure to assess the effects of temperature and %RH on sampling rate.

3.5 Analyte Stability on Storage (after exposure)

A constant concentration of selected volatile analytes was generated and presented to test samplers as in Section 3.1. After a typical exposure (2-4 hr), diffusive samplers were split into several groups, and each groups was capped and stored for a specified storage conditions, e.g, Group 1 (freezer at -20oC), Group 2 (room temperature at 20-25oC), Group 3 (frig at 2-8oC). Freezer samples were analyzed as controls. Each separate storage group was submitted to an accredited IH Lab, then extracted and analyzed after specific storage times, e.g., 1 week, 2 weeks, etc. The amount of analyte recovered from the different sampler Groups at different storage times were compared to assess analyte stability on the sampler.

3.6 Background Blank

Several test samplers were extracted and analyzed by the lab in the same fashion as in Sections 3.1- 3.5. The amount of analytes (if any) found in micrograms were reported to confirm the validity of the claimed Reporting Limit for each analyte.

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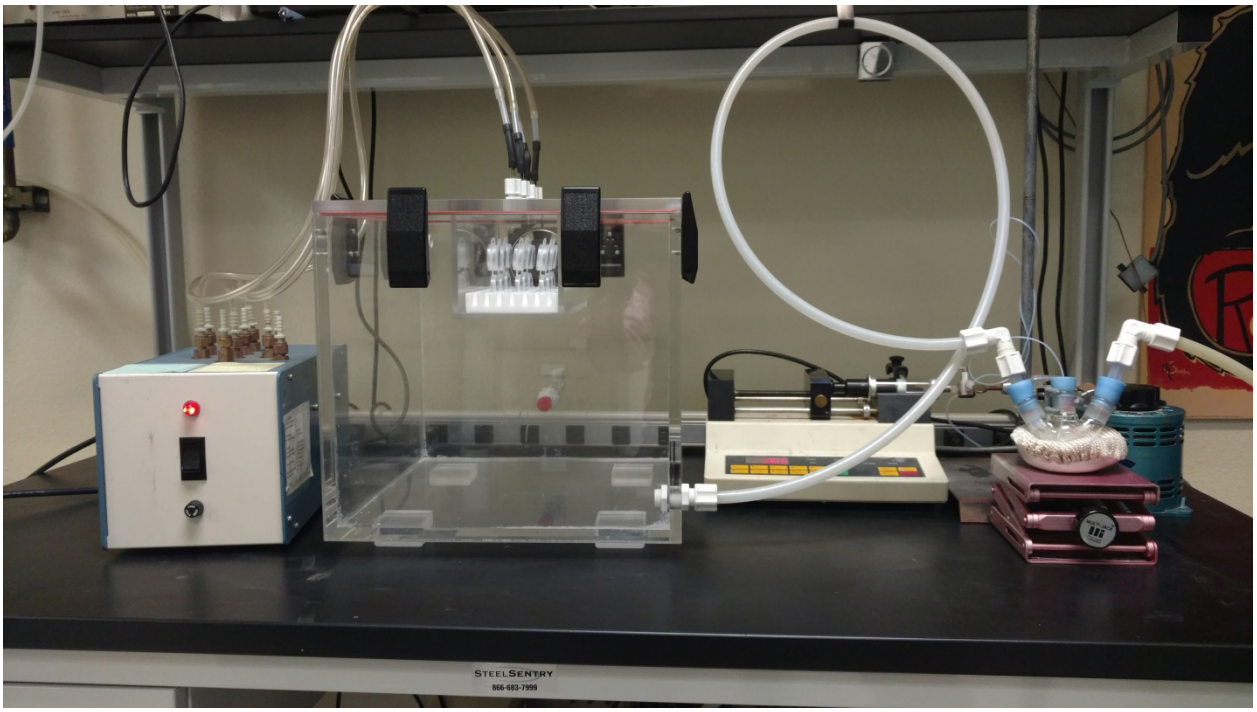
Fig 1
Test Chamber Used for laboratory Evaluation of Samplers



Results Summarized in Following Tables.

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Table 3.1.1
Typical Uptake (Sampling) Rate Determination

Analyte	Target Concn (µg/L)	Sampl'g Time (min)	Sampler Tested	Qty	Amount Found Tube (µg/L)	(±)	Badge (µg)	(±)	Sampling Rate (L/min)
Acetone	504	120	566	5	346	9%	576	3%	0.0139
	252	120	566	5	167	1%	292	2%	0.0145
							Average	=	**0.0142**
Acetone	504	120	546	5	346	9%	170	6%	0.00410
	252	120	546	5	167	1%	89.6	4%	0.00446
							Average	=	**0.00428**
Benzene	64	120	566	5	34	8%	43.6	2%	0.0108
	32	120	566	5	17	1%	22	0%	0.0110
							Average	=	**0.0109**
Benzene	64	120	546	5	34	8%	12.6	4%	0.00312
	32	120	546	5	17	1%	6.66	2%	0.00334
							Average	=	**0.00323**
Perchloroethylene	251	120	566	5	245	7%	238	2%	0.00811
	129	120	566	5	117	3%	120	0%	0.00852
							Average	=	**0.00831**
Perchloroethylene	251	120	546	5	245	7%	75.4	3%	0.00257
	129	120	546	5	117	3%	41.6	2%	0.00295
							Average	=	**0.00276**
Cyclohexane	503	120	566	5	477	9%	520	2%	0.00908
	251	120	566	5	232	2%	262	2%	0.00943
							Average	=	**0.00926**
Cyclohexane	503	120	546	5	477	9%	148	3%	0.00258
	251	120	546	5	232	2%	78.6	2%	0.00283
							Average	=	**0.00271**
1,2-Dichloroethane	126	120	566	5	116	8%	138	3%	0.00989
	65	120	566	5	57	5%	68.8	2%	0.01014
							Average	=	**0.01002**
1,2-Dichloroethane	126	120	546	5	116	8%	40.2	3%	0.00288
	65	120	546	5	57	5%	21	3%	0.00310
							Average	=	**0.0030**
Methylene Chloride	63	120	566	5	78	10%	99.6	1%	0.01061
	31	120	566	5	39	1%	52	2%	0.01114
							Average	=	**0.0109**
Methylene Chloride	63	120	546	5	78	10%	32	3%	0.00341
	31	120	546	5	39	1%	17	4%	0.00364
							Average	=	**0.0035**
Chloroform	127	120	566	5	105	9%	170	0%	0.01344
	63	120	566	5	51	1%	59.2	3%	0.00966
							Average	=	**0.0115**
Chloroform	127	120	546	5	105	9%	34.4	6%	0.00272
	63	120	546	5	51	1%	17.6	5%	0.00287
							Average	=	**0.0028**
Tetrahydrofuran	313	120	566	5	247	9%	292	4%	0.00986
	156	120	566	5	121	3%	142	3%	0.00981
							Average	=	**0.0098**
Tetrahydrofuran	313	120	546	5	247	9%	83.2	3%	0.00281
	156	120	546	5	121	3%	42.8	3%	0.00296
							Average	=	**0.0029**
Toluene	313	120	566	5	267	8%	180	1%	0.00561
	158	120	566	5	132	3%	150	0%	0.00950
							Average	=	**0.0076**
Toluene	313	120	546	5	267	8%	88.8	3%	0.00277
	158	120	546	5	132	3%	45.4	3%	0.00288
							Average	=	**0.0028**
Xylenes	252	120	566	5	213	9%	218	2%	0.00853
	126	120	566	5	103	3%	106	5%	0.00855
							Average	=	**0.0085**
Xylenes	252	120	546	5	213	9%	59.6	3%	0.00233
	126	120	546	5	103	3%	30.2	4%	0.00244
							Average	=	**0.0024**

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Table 3.1.2
Typical Uptake (Sampling) Rate Determination

Analyte	Target Concn (µg/L)	Sampl'g Time (min)	Sampler Tested	Qty	Amount Found Tube (µg/L)	(+)	Badge (µg)	(+)	Sampling Rate (L/min)
1,1,1-Trichloroethane	387	120	566	5	325	8%	322	3%	0.0083
	196	120	566	5	159	3%	156	4%	0.0082
							Average	**=**	**0.0082**
1,1,1-Trichloroethane	387	120	546	5	325	8%	96.6	4%	0.00248
	196	120	546	5	159	3%	47.8	4%	0.00251
							Average	**=**	**0.0025**
1- Butanol	264	120	566	5	164	8%	192	4%	0.0097
	133	120	566	5	60	24%	83.4	5%	0.0116
							Average	**=**	**0.0107**
1- Butanol	264	120	546	5	164	8%	47	5%	0.00239
	133	120	546	5	60	24%	19.8	13%	0.00275
							Average	**=**	**0.0026**
2- Butoxyethanol	68	120	566	5	27	3%	28.4	4%	0.0087
	34	120	566	5	12	23%	13.4	4%	0.0092
							Average	**=**	**0.0089**
2- Butoxyethanol	68	120	546	5	27	3%	7.88	9%	0.00242
	34	120	546	5	12	23%	1	224%	0.00068
							Average	**=**	**0.0016**
Acetonitrile	67	120	566	5	50	8%	85.6	4%	0.0143
	34	120	566	5	24	1%	43.4	4%	0.0149
							Average	**=**	**0.0146**
Acetonitrile	67	120	546	5	50	8%	25.6	3%	0.00427
	34	120	546	5	24	1%	13.4	11%	0.00459
							Average	**=**	**0.0044**
Heptane	332	120	566	5	287	7%	286	3%	0.0083
	164	120	566	5	137	13%	82.2	10%	0.0050
							Average	**=**	**0.0067**
Heptane	332	120	546	5	287	7%	71.4	11%	0.00207
	164	120	546	5	137	13%	26.4	34%	0.00161
							Average	**=**	**0.0018**
Isopropyl Alcohol	531	120	566	5	454	9%	648	4%	0.0119
	265	120	566	5	227	2%	320	3%	0.0117
							Average	**=**	**0.0118**
Isopropyl Alcohol	531	120	546	5	454	9%	190	4%	0.00348
	265	120	546	5	227	2%	95.6	4%	0.00351
							Average	**=**	**0.0035**
Methyl Ethyl Ketone	398	120	566	5	299	10%	384	3%	0.0107
	198	120	566	5	148	2%	186	3%	0.0105
							Average	**=**	**0.0106**
Methyl Ethyl Ketone	398	120	546	5	299	10%	108	4%	0.00463
	198	120	546	5	148	2%	53.8	4%	0.00536
							Average	**=**	**0.0050**
Methyl Methacrylate	135	120	566	5	70	7%	47.4	4%	0.0057
	66	120	566	5	25	10%	22.6	4%	0.0075
							Average	**=**	**0.0066**
Methyl Methacrylate	135	120	546	5	70	7%	15.2	3%	0.00182
	66	120	546	5	25	10%	7.32	12%	0.00244
							Average	**=**	**0.0021**
Naphthalene	68	120	566	5	41	3%	47	3%	0.0095
	31	120	566	5	23	16%	27.8	3%	0.0099
							Average	**=**	**0.0097**
Naphthalene	68	120	546	5	41	3%	29.8	65%	0.00601
	31	120	546	5	23	16%	10.14	33%	0.00360
							Average	**=**	**0.0048**

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Table 3.1.3
Typical Uptake (Sampling) Rate Determination

Analyte	Target Concn (µg/L)	Sampling Time (min)	Sampler Tested	Qty	Amount Found Tube (µg/L)	(+)	Badge (µg)	(+)	Sampling Rate (L/min)
Cyclohexanone	96	120	566	5	72	Nom	67.4	3%	0.00777
	48	120	566	5	36	Nom	34.2	1%	0.00789
							Average	=	**0.00783**
Cyclohexanone	96	120	546	5	72	Nom	21.6	3%	0.00249
	48	120	546	5	36	Nom	11.6	5%	0.00268
							Average	=	**0.00258**
Ethyl Acetate	490	120	566	5	522	5%	596	3%	0.0095
	245	120	566	5	261	2%	306	2%	0.0098
							Average	=	**0.0096**
Ethyl Acetate	490	120	546	5	522	5%	180	4%	0.00288
	245	120	546	5	261	2%	93.6	5%	0.00299
							Average	=	**0.0029**
Ethylbenzene	69	120	566	5	73	1%	70.2	6%	0.0080
	35	120	566	5	35	8%	37.4	1%	0.0088
							Average	=	**0.0084**
Ethylbenzene	69	120	546	5	73	1%	21.8	6%	0.00249
	35	120	546	5	35	8%	9.62	18%	0.00227
							Average	=	**0.0024**
Hexane	483	120	566	5	380	4%	390	2%	0.0085
	241	120	566	5	190	1%	210	0%	0.0092
							Average	=	**0.0089**
Hexane	483	120	546	5	380	4%	120	0%	0.00263
	241	120	546	5	190	1%	62.6	5%	0.00274
							Average	=	**0.0027**
Isobutyl Alcohol	103	120	566	5	87	4%	108	4%	0.0104
	52	120	566	5	43	1%	54.2	4%	0.0106
							Average	=	**0.0105**
Isobutyl Alcohol	103	120	546	5	87	4%	30	6%	0.00288
	52	120	546	5	43	1%	14.8	3%	0.00289
							Average	=	**0.0029**
Hexone (MIBK)	246	120	566	5	223	3%	240	4%	0.0090
	123	120	566	5	109	4%	120	0%	0.0092
							Average	=	**0.0091**
Hexone (MIBK)	246	120	546	5	223	3%	72	12%	0.00269
	123	120	546	5	109	4%	32.4	12%	0.00248
							Average	=	**0.0026**
N,N-Dimethyl Formamide	123	120	566	5	103	6%	170	3%	0.0137
	61	120	566	5	51	7%	73.8	4%	0.0120
							Average	=	**0.0129**
N,N-Dimethyl Formamide	123	120	546	5	103	6%	50.6	1%	0.00408
	61	120	546	5	51	7%	29.4	8%	0.00360
							Average	=	**0.0038**
Propylene Glycol Methyl Ether Acetate	297	120	566	5	221	4%	212	4%	0.0080
	149	120	566	5	107	8%	106	5%	0.0083
							Average	=	**0.0081**
Propylene Glycol Methyl Ether Acetate	297	120	546	5	221	4%	61.4	4%	0.00232
	149	120	546	5	107	8%	31	5%	0.00243
							Average	=	**0.0024**
t-Butyl Acetate	195	120	566	5	193	3%	180	3%	0.0078
	97	120	566	5	96	4%	96	1%	0.0084
							Average	=	**0.0081**
t-Butyl Acetate	195	120	546	5	193	3%	56.4	3%	0.00243
	97	120	546	5	96	4%	29.6	5%	0.00258
							Average	=	**0.0025**
Trichloroethylene	296	120	566	5	235	3%	252	3%	0.0089
	148	120	566	5	116	3%	130	0%	0.0093
							Average	=	**0.0091**
Trichloroethylene	296	120	546	5	235	3%	75.6	4%	0.00268
	148	120	546	5	116	3%	40	6%	0.00287
							Average	=	**0.0028**

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Table 3.2
Air Velocity/Sampler Orientation

Analyte(s) Tested	Target Concn	Air Velocity	Sampler Oriented	Sampler Tested	Qty	Amount Found Ave	Amount Found (±)	Comparison to Tube
	(ppm)	(cm/sec)				(ppm)	(%)	(%)
1,1-dichloro-2,2,2-trifluoroethane	8	153	perpendicular	C Tube	3	6.36	5%	100%
			perpendicular	AT541	6	6.28	10%	99%
			parallel	AT541	5	6.50	5%	102%
1,1-dichloro-2,2,2-trifluoroethane	60	19	perpendicular	C Tube	5	53.6	9%	100%
			perpendicular	AT541	6	58.1	4%	109%
			parallel	AT541	5	54.1	5%	101%

Table 3.4
Effect on Uptake (Sampling) Rate of Temperature & Relative Humidity

Analyte(s) Tested	Target Concn	Test Temp	Test Humidity	Sampler Tested	Qty	Amount Found Ave	Amount Found (±)	Comparison to Tube
	(ppm)	(°C)	(%RH)			(ppm)	(%)	(%)
1,1-dichloro-2,2,2-trifluoroethane	100	10	14	C Tube	4	101	3%	100%
				AT541	6	113	6%	112%
1,1-dichloro-2,2,2-trifluoroethane	100	40	15	C Tube	4	106.0	5%	100%
				AT541	6	111.5	3%	105%
1,1-dichloro-2,2,2-trifluoroethane	100	10	74	C Tube	4	98.1	3%	100%
				AT541	6	105.1	3%	107%
1,1-dichloro-2,2,2-trifluoroethane	100	40	72	C Tube	3	96.6	3%	100%
				AT541	6	97.7	4%	101%

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Table 3.3.1
Analyte Loss by Evaporation
(Reverse Diffusion or Back Diffusion)

	All Data			*Outliers Removed*		
	% Initial Recovery found after			% Initial Recovery found after		
Analyte	**2 hr**	**4 hr**	**8 hr**	**2 hr**	**4 hr**	**8 hr**
Acetone	97	96	**92**	96	94	**93**
Acetone	101	97	**95**		N/C	
Acetonitrile	89	84	**76**	89	84	**76**
Acetonitrile	91	86	**84**		N/C	
Acetonitrile (0.5 PEL, solo)	93	88	**79**	93	86	**79**
Acetonitrile (2.0 PEL, solo)	92	88	**77**		N/C	
Acrylonitrile	95	94	**89**		N/C	
Benzene	98	95	**96**		N/C	
Butanol	102	101	**99**		N/C	
2-Butoxyethanol (solo)	108	104	**107**	104	104	**107**
2-Butoxyethanol	109	102	**93**		N/C	
Butyl (n) Acetate	100	102	**104**		N/C	
Carbon Tetrachloride	102	98	**91**		N/C	
Chloroform	102	100	**93**		N/C	
Cyclohexane	101	98	**89**	101	89	**89**
Cyclohexane	111	103	**92**		N/C	
Cyclohexanone	99	99	**96**		N/C	
Diacetone Alcohol	94	93	**88**		N/C	
Dimethylformamide	96	95	**80**		N/C	
Dimethylformamide	102	99	**86**		N/C	
Ethanol	90	87	**81**	95	92	**86**
Ethanol (541, solo)	95	89	**80**	98	89	**80**
Ethanol (546, solo)	94	89	**82**		N/C	
Ethanol	96	94	**86**		N/C	
2-Ethoxylethanol	100	98	**102**		N/C	
Ethyl Acetate	103	100	**100**		N/C	
Ethyl Benzene	105	101	**101**		N/C	
Ethyl Ether	94	99	**99**		N/C	
Ethylene Dichloride	95	99	**95**		N/C	
Heptane	97	103	**94**	95	105	**90**
Hexane	95	101	**90**	91	105	**82**
Isobutanol	101	99	**95**		N/C	
Isobutyl Acetate	100	102	**102**		N/C	

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Table 3.3.2
Analyte Loss by Evaporation
(Reverse Diffusion or Back Diffusion)

	All Data			*Outliers Removed*		
	% Initial Recovery found after			% Initial Recovery found after		
Analyte	**2 hr**	**4 hr**	**8 hr**	**2 hr**	**4 hr**	**8 hr**
Isopropanol	97	96	**91**	97	98	**93**
Isopropanol	94	95	**93**		N/C	
Isopropyl Acetate	97	100	**100**		N/C	
Mesitylene	99	100	**98**		N/C	
Methylene Chloride	93	91	**88**	95	93	**90**
Methylene Chloride	96	93	**90**		N/C	
Methylene Chloride, 546	95	93	**90**		N/C	
Methyl Ethyl Ketone	98	98	**96**	100	101	**99**
Methyl Ethyl Ketone	98	95	**102**		N/C	
Methyl Isobutyl Ketone	97	94	**95**		N/C	
Methyl Methacrylate	103	100	**98**		N/C	
Nonane	99	101	**96**		N/C	
Octane	99	102	**96**		N/C	
Pentane	91	97	**84**	85	98	**73**
Perchloroethylene	94	95	**93**		N/C	
Propanol (n)	93	93	**90**	100	101	**97**
Propanol (n)	103	101	**99**		N/C	
Propyl Acetate	103	99	**100**		N/C	
Propyleneglycolmethylether	103	99	**94**		N/C	
Styrene	94	96	**95**		N/C	
1122-Tetrachloroethane	101	104	**94**		N/C	
Tetrahydrofuran	98	96	**91**	98	98	**94**
Tetrahydrofuran	97	94	**92**		N/C	
Tetrahydrofuran, 546	96	96	**95**		N/C	
Toluene	97	96	**97**		N/C	
111-Trichloroethane	89	81	**81**		N/C	
Trichloroethylene	97	95	**94**		N/C	
Trichloroethylene, 546	97	99	**98**		N/C	
112-Trichlorotrifluoroethane	89	81	**80**		N/C	
Vinyl Chloride	93	87	**80**		N/C	
m-Xylene	98	96	**99**		N/C	

assay technology

Evaluation of ChemDisk™ Organic Vapor Samplers

Prepared by: C.R. Manning, PhD, CIH, FAHIA Revised: 6 Feb 2019

Table 3.5
Analyte Stability on Storage
(after exposure)

			% of Initial Recovery found after					
Analyte	**0 days** (µg)	RSD(±)	**4 days** (%)	RSD(±)	**7 days** (%)	RSD(±)	**14 days** (%)	RSD(±)
Acetone	**719**	1.1%	**103**	2.2%	**106**	1.3%	**104**	1.6%
Acetonitrile	**26**	2.9%	**97**	3.9%	**100**	2.3%	**101**	0.9%
Benzene	**27**	5.5%	**99**	0.5%	**99**	2.6%	**96**	2.5%
Butanol (n)	**56**	0.7%	**99**	0.9%	**96**	2.2%	**97**	1.6%
2-Butoxyethanol	**16**	5.6%	**95**	2.3%	**81**	2.8%	**105**	4.6%
Butyl (n) Acetate	**296**	1.3%	**100**	3.0%	**99**	1.9%	**103**	8.1%
Carbon Tetrachloride	**36**	5.4%	**82**	4.1%	**84**	4.6%	**88**	4.3%
Chloroform	**26**	4.7%	**95**	0.9%	**98**	4.3%	**94**	3.0%
Cyclohexane	**385**	1.8%	**96**	7.1%	**92**	3.3%	**84**	0.9%
Cyclohexanone	**32**	0.9%	**102**	6.2%	**107**	1.7%	**87**	2.1%
Diacetone Alcohol	**45**	9.3%	**93**	4.8%	**113**	1.8%	**102**	6.5%
Dimethylformamide	**25**	1.3%	**94**	2.1%	**97**	4.1%	**90**	4.0%
2-Ethoxylethanol	**222**	4.2%	**95**	2.1%	**95**	2.0%	**95**	4.0%
Ethyl Acetate	**696**	2.7%	**101**	1.7%	**104**	2.8%	**97**	0.7%
Ethyl Benzene	**197**	3.4%	**108**	2.2%	**103**	1.4%	**105**	2.3%
Ethyl Ether	**478**	1.8%	**102**	3.2%	**105**	0.7%	**102**	2.9%
Ethylene Dichloride	**28**	1.3%	**101**	3.0%	**105**	6.4%	**106**	3.1%
Heptane	**681**	10.9%	**94**	1.5%	**97**	2.3%	**92**	5.1%
Hexane	**78**	15.9%	**93**	5.6%	**104**	2.8%	**96**	11.0%
Isobutanol	**72**	2.6%	**97**	1.4%	**98**	2.3%	**97**	3.7%
Isobutyl Actetate	**320**	1.5%	**92**	3.0%	**99**	2.1%	**102**	8.4%
Isopropanol	**330**	1.8%	**105**	1.5%	**108**	2.4%	**105**	1.8%
Isopropyl Acetate	**463**	2.2%	**104**	3.0%	**100**	1.7%	**99**	7.3%
Mesitylene	**42**	2.8%	**109**	6.7%	**101**	2.4%	**102**	2.2%
Methylene Chloride	**655**	4.5%	**96**	2.5%	**99**	1.7%	**99**	1.2%
Methyl Ethyl Ketone	**212**	7.1%	**97**	4.7%	**100**	0.9%	**101**	2.2%
Methyl Isobutyl Ketone	**78**	1.3%	**104**	3.3%	**95**	1.4%	**98**	4.0%
Methyl Methacrylate	**171**	4.5%	**106**	1.9%	**108**	3.9%	**101**	3.7%
Nonane	**606**	8.5%	**97**	0.7%	**99**	2.2%	**97**	2.9%
Octane	**635**	10.0%	**96**	0.5%	**100**	1.4%	**96**	3.8%
Pentane	**546**	17.7%	**90**	10.3%	**99**	4.6%	**89**	13.6%
Perchloroethylene	**70**	2.2%	**108**	3.7%	**107**	8.2%	**105**	4.4%
Propanol (n)	**411**	1.2%	**99**	0.4%	**102**	2.8%	**97**	5.9%
Propyl Acetate	**390**	1.4%	**98**	1.4%	**100**	2.6%	**102**	1.0%
Propylenegylcolmethylether	**135**	3.0%	**103**	4.4%	**104**	1.3%	**110**	3.8%
Styrene	**95**	1.2%	**106**	3.6%	**107**	8.0%	**103**	3.4%
1122-Tetrachloroethane	**20**	1.5%	**96**	1.6%	**98**	3.0%	**92**	2.3%
Tetrahydrofuran	**189**	9.7%	**101**	3.4%	**103**	1.0%	**102**	3.3%
Toluene	**147**	5.9%	**109**	1.0%	**107**	2.2%	**107**	2.3%
111-Trichloroethane	**694**	6.6%	**107**	1.9%	**114**	3.2%	**116**	0.6%
112-Trichlorotrifluoroethane	**2201**	8.1%	**101**	4.9%	**98**	3.1%	**111**	8.0%
Vinyl Chloride	**11**	4.0%	**114**	3.5%	**119**	0.2%	**111**	2.9%
m-Xylene	**126**	6.1%	**113**	1.4%	**115**	2.0%	**110**	3.0%

assay technology

Evaluation of ChemDisk™ Organic Vapor Samplers

Prepared by: C.R. Manning, PhD, CIH, FAHIA Revised: 6 Feb 2019

Table 3.6.1
Background Blank

Analyte	Sampler	Spike Amt, (µg/mL)	Reporting Limit (µg)	Reporting Limit (µg/mL)	Blank Value (µg/mL)	Recovery (µg/mL)
1,1,1 Trichloroethane	566	1.48	3.0	1.5	<0.2	1.281
1,2 DCB	566	0.24	0.5	0.3	0.2	0.354
1,2 Dichloroethane	566	0.98	2.0	1.0	<0.2	0.956
1,2 Dichloroethylene trans	566	1.00	2.0	1.0	<0.2	0.000
1,2-Dibromoethane	566	0.96	2.3	1.2	<0.2	0.000
1,3-Butadiene	566	0.30	0.6	0.3	<0.2	0.213
1,3-Dioxolane	566	0.99	2.0	1.0	<0.2	0.936
1,4 DCB	566	0.45	1.0	0.5	<0.2	0.510
1-4 Dioxane	566	0.93	2.0	1.0	<0.2	0.912
1-Butanol	566	0.50	1.0	0.5	<0.2	0.439
1-Methyl-2-Pyrrolidinone	566	5.47	11.0	5.5	<0.2	0.000
2-Ethoxyethanol	566	0.49	2.0	1.0	<0.2	0.604
2-Ethyl-1-hexanol	566	2.50	2.5	5.0	0.2	0.000
2-Hexanone	566	0.24	0.5	0.3	<0.2	0.185
2-Methoxyethyl Acetate	566	2.48	5.0	2.5	<0.2	5.168
2-Methoxyethanol	566	0.92	2.2	1.1	<0.2	0.000
3-Pentanone(DIEK)	566	0.68	3.0	1.5	<0.2	0.000
4-Vinylcyclohexene	566	0.15	0.3	0.2	<0.2	0.000
Acetonitrile	566	0.59	1.4	0.7	0.4	0.561
Acetophenone	566	2.48	5.0	2.5	<0.2	0.000
AK-225	566	1.02	2.0	2.0	<0.2	0.000
Amyl acetate	566	0.38	0.9	0.5	<0.2	0.423
Aniline	566	0.29	0.6	0.3	<0.2	0.290
Benzene	566	0.20	0.4	0.2	<0.2	0.248
Benzene-D6	566	0.19	0.4	0.2	<0.2	0.000
Benzyl Chloride	566	0.17	0.5	0.3	<0.2	0.240
beta-Pinene	566	0.20	0.4	0.2	<0.2	0.000
Butyl Carbitol	566	4.99	10.0	5.0	<0.2	0.000
Camphor	566	0.30	0.6	0.3	<0.2	0.000
Cumene	566	0.25	0.5	0.3	<0.2	0.255
Cyclohexane	566	0.28	0.6	0.3	<0.2	0.301
Cyclohexanone	566	0.26	0.6	0.3	<0.2	0.379
Cyclohexanol	566	0.28	0.7	0.4	<0.2	0.272
D P Glycol Methyl Ether	566	7.16	17.0	8.5	<0.2	0.000
Diacetone	566	0.47	1.0	0.5	<0.2	0.526
Dicyclopentadiene	566	0.84	2.0	1.0	<0.2	0.990
Dibromoethane	566	1.49	3.0	1.5	<0.2	1.379
Dodecane	566	2.48	5.0	2.5	<0.2	2.192
Epichlorohydrin	566	0.57	1.2	0.6	<0.2	0.497
Ethanol	566	5.00	10.0	5.0	<0.2	3.838
Ethy Methacrylate	566	0.50	1.0	0.5	<0.2	0.448
Ethyl Acetate	566	1.00	2.0	1.0	<0.2	0.794
Ethyl Benzene	566	0.25	0.5	0.3	<0.2	0.231

Evaluation of ChemDisk™ Organic Vapor Samplers

Prepared by: C.R. Manning, PhD, CIH, FAHIA Revised: 6 Feb 2019

Table 3.6.2
Background Blank

Analyte	Sampler	Spike Amt, (µg/mL)	Reporting Limit (µg)	Reporting Limit (µg/mL)	Blank Value (µg/mL)	Recovery (µg/mL)
Ethylene Chlorohydrin	566	0.65	1.4	0.7	<0.2	0.830
Ethyl Ether	566	1.50	3.0	1.5	<0.2	1.277
Ethyl Lactate	566	0.42	1.0	0.5	<0.2	0.400
Heptane	566	0.25	0.5	0.3	<0.2	0.294
Hexane	566	0.25	0.6	0.3	<0.2	0.269
Isobutyl Acetate	566	0.44	1.0	0.5	<0.2	0.440
Isobutyl alcohol	566	0.34	0.7	0.4	<0.2	0.280
Isooctane	566	0.48	1.5	0.8	<0.2	0.525
Isophorone	566	0.28	0.6	0.3	<0.2	0.302
Isopropyl Acetate	566	0.44	1.0	0.5	<0.2	0.405
Isopropyl Alcohol	566	0.50	1.0	0.5	<0.2	0.520
Limonene	566	0.84	2.0	1.0	<0.2	0.638
m,p-Xylene	566	0.50	1.0	0.5	<0.2	0.527
Methanol	566	1.50	3.0	1.5	<0.2	1.111
Methyl Acetate	566	0.34	1.0	0.5	<0.2	0.366
Methyl Ethly Ketone	566	0.40	0.8	0.4	<0.2	0.408
Methyl Ethyl Ketoxamine	566	0.72	1.4	0.7	<0.2	1.020
Methyl Isoamyl Ketone	566	0.24	0.5	0.3	<0.2	0.213
Methyl Isobutyl Ketone	566	0.34	0.7	0.4	<0.2	0.292
Methyl Methacrylate	566	0.42	1.0	0.5	<0.2	0.423
Methylcyclohexene	566	0.23	0.5	0.3	<0.2	0.230
Methylene Chloride	566	1.49	3.0	1.5	<0.2	1.245
MTBE	566	0.44	0.9	0.5	<0.2	0.652
N,N-Dimethylformamide	566	0.57	1.3	0.7	<0.2	0.463
Naphthalene	566	3.21	6.5	3.3	<0.2	3.980
n-Butyl Acetate	566	0.44	0.9	0.5	<0.2	0.431
N-Nonane	566	0.12	0.5	0.3	<0.2	0.577
n-Propyl Bromide	566	0.81	2.0	1.0	<0.2	1.102
Octane	566	0.84	2.0	1.0	<0.2	0.819
o-Xylene	566	0.50	1.0	0.5	<0.2	0.517
Pentane	566	0.25	0.6	0.3	<0.2	0.264
Perchloroethylene	566	0.81	2.0	1.0	<0.2	0.998
PGMEA	566	0.42	1.0	0.5	<0.2	0.437
PGMME	566	0.99	2.0	1.0	<0.2	1.441
Propyl Acetate	566	0.49	1.0	0.5	<0.2	0.436
Propylene Oxide	566	0.50	1.0	0.5	<0.2	0.264
Pyridine	566	0.39	0.9	0.5	0.7	0.450
Styrene	566	0.22	0.5	0.3	<0.2	0.110
Tert Butyl Acetate	566	0.86	2.0	1.0	<0.2	0.791
Tetrahydrofuran	566	0.39	0.8	0.4	<0.2	0.519
Toluene	566	1.00	2.0	1.0	<0.2	0.786
Trichloroethylene	566	0.83	2.0	1.0	<0.2	0.978
Vinyl Acetate	566	0.42	1.0	0.5	<0.2	0.359
Vinyl Chloride	566	0.24	0.5	0.3	<0.2	0.239