METHOD 4020

SCREENING FOR POLYCHLORINATED BIPHENYLS BY IMMUNOASSAY

1.0 SCOPE AND APPLICATION

1.1 Method 4020 is a procedure for screening soils and non-aqueous waste liquids to determine when total polychlorinated biphenyls (PCBs) are present at concentrations above 5, 10 or 50 mg/kg. Method 4020 provides an estimate for the concentration of PCBs by comparison with a standard.

1.2 Using the test kit from which this method was developed, 95% of soil samples containing 0.625 ppm or less of PCBs will produce a negative result in the 5 ppm test configuration. Using another commercially available test kit, 97% of soil samples containing 0.25 ppm or less of PCBs will produce a negative result in the assay and greater than 99% of the samples containing 1.0 ppm or more will produce a positive result. Tables 2-5, 7, 10, and 11 present false positive and false negative data generated from commercially available test kits. Using a test kit commercially available for screening non-aqueous waste liquids, >95% of samples containing 0.2-0.5 ppm or less of PCB will produce a negative result.

1.3 In cases where the exact concentrations of PCBs are required, quantitative techniques (i.e., Method 8082) should be used.

1.4 This method is restricted to use by or under the supervision of trained analysts. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 Test kits are commercially available for this method. The manufacturer's directions should be followed.

2.2 In general, the method is performed using a sample extract. Sample and an enzyme conjugate reagent are added to immobilized antibody. The enzyme conjugate "competes" with PCB present in the sample for binding to immobilized anti-PCB antibody.

2.3 The test is interpreted by comparing the response produced by testing a sample to the response produced by testing standard(s) simultaneously.

3.0 INTERFERENCES

Chemically similar compounds and compounds which might be expected to be found in conjunction with PCB contamination were tested to determine the concentration required to produce a positive test result. These data are shown in Tables 1A, 1B, 1C, and 1D.

4.0 APPARATUS AND MATERIALS

4.1 Immunoassay test kit: PCB RISc™ (EnSys, Inc.), EnviroGard™ PCB in Soil (Millipore, Inc.), D TECH ™ PCB test (Strategic Diagnostics Inc.), PCB RISc™ Liquid Waste Test System (EnSys, Inc.), or equivalent.

4.2 Each commercially available test kit will supply or specify the apparatus and materials necessary for successful completion of the test.

5.0 REAGENTS

Each commercially available test kit will supply or specify the reagents necessary for successful completion of the test.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 See the introductory material to this chapter, Organic Analytes, Section 4.1. Also refer to Reference 9 for the collection and handling of non-aqueous waste liquids.

6.2 Samples may be contaminated, and should therefore be considered hazardous and handled accordingly.

7.0 PROCEDURE

7.1 Follow the manufacturer's instructions for the test kit being used.

7.2 Those test kits used must meet or exceed the performance specifications indicated in Tables 2-11.

8.0 QUALITY CONTROL

8.1 Follow the manufacturer's instructions for the test kit being used for quality control procedures specific to the test kit used. Additionally, guidance provided in Method 4000 and Chapter One should be followed.

8.2 Use of replicate analyses, particularly when results indicate concentrations near the action level, is recommended to refine information gathered with the kit.

8.3 Do not use test kits past their expiration date.

8.4 Do not use tubes or reagents designated for use with other test kits.

8.5 Use the test kits within their specified storage temperature and operating temperature limits.

8.6 Method 4020 is intended for field or laboratory use. The appropriate level of quality assurance should accompany the application of this method to document data quality.

9.0 METHOD PERFORMANCE

9.1 A study was conducted with the PCB RISc™ test kit using fourteen standard soils and three soil samples whose PCB concentration had been established by Method 8082. Replicates were performed on seven of the standard soils and on one of the soil samples for a total of 25 separate analyses. Each of two different analysts ran the 25 analyses. Results indicated that "<" assignments are accurate with almost 99% certainty at the 50 ppm level while ">" assignments can be up to about 96% inaccurate as the sample concentration approaches that of the testing level. Corresponding certainties at the 5 ppm level are 92% and 82% respectively. Tables 2 and 3 summarize these results.

9.2 Table 4 presents method precision data generated using the PCB RISc™ test kit, comparing immunoassay test results with results obtained using Method 8082.

9.3 Method precision was determined with the EnviroGard PCB in Soil test kit by assaying 4 different soils (previously determined to contain 5.04, 9.78, 11.8, and 25.1 mg/kg by Method 8082), at three different sites, using three different lots of assay kits, three times a day for 9 days. A total of 81 analyses were performed for each soil. Error attributable to site, lot, date, and operator were determined. Separately, the relative reactivity of Aroclors 1242, 1248, 1254, and 1260 were determined. Based on Aroclor heterogeneity, and method imprecision, concentrations of Aroclor 1248 were selected that would result in greater than 99% confidence for negative interpretation. A study was conducted (Superfund SITE demonstration) on 114 field samples whose PCB concentration were also determined by Method 8082. 32 of the field samples were collected in duplicate (as coded field duplicates) and assayed by standard and immunoassay methods. The results for all 146 samples are summarized in Tables 5 and 6.

9.4 Grab samples were obtained from sites in Pennsylvania, Iowa and Illinois using a stainless steel trowel. Each sample was homogenized by placing approximately six cubic inches in a stainless steel bucket and mixing with the trowel for approximately two minutes. The soils was aliquotted into 2 six ounce glass bottles. The samples were tested on site using the D TECH PCB test kit, and sent to an analytical laboratory for analysis by Method 8082. These data are compared in Table 7.

9.5 Tables 8 and 9 present data on the inter- and intra-assay precision of the PCB RISc™ Liquid Waste Test System. The data were generated using 11 samples, each spiked at 0, 0.2 and 5 ppm, and assayed 4 times.

9.6 Tables 10 and 11 provide data from application of the PCB RISc™ Liquid Waste Test System to a series of liquid waste samples whose PCB concentration had been established by Method 8082.

10.0 REFERENCES

1. J.P. Mapes, T.N. Stewart, K.D. McKenzie, L.R. McClelland, R.L. Mudd, W.B. Manning, W.B. Studabaker, and S.B. Friedman, "PCB-RISc™ - An On-Site Immunoassay for Detecting PCB in Soil", Bull. Environ. Contam. Toxicol. (1993) 50:219-225.

2. PCB RISc™ Users Guide, Ensys Inc.

3. R.W. Counts, R.R. Smith, J.H. Stewart, and R.A. Jenkins, "Evaluation of PCB Rapid Immunoassay Screen Test System", Oak Ridge National Laboratory, Oak Ridge, TN 37831, April 1992, unpublished

4. EnviroGard PCB in Soil Package Insert, Millipore Corp. 2/93.

5. Technical Evaluation Report on the Demonstration of PCB Field Screening Technologies, SITE Program. EPA Contract Number 68-CO-0047. 2/93.

6. D TECH™ PCB Users Guide , SDI/Em Sciences

7. Melby, J.M., B.S. Finlin, A.B. McQuillin, H.G. Rovira, J.W. Stave, "PCB Analysis by Enzyme Immunoassay", Strategic Diagnostics Incorporated, Newark, Delaware, 1993

8. Melby, J.M., B.S. Finlin, A.B. McQuillin, H.G. Rovira, "Competitive Enzyme Immunoassay (EIA) Field Screening System for the Detection of PCB", 1993 PCB Seminar, EPRI, September 1993

9. T.A. Bellar and J.J Lichtenberg. The Analysis of Polychloringated Biphenyls in Transformer Fluid and Waste Oils. U.S. EPA Research and Development, EPA/EMSL-ORD, Cincinnati, Ohio (June 24, 1980). Revised June 1981, EPA 600/4-81-045.

10. PCB RISc™ Liquid Waste Test System, User's Guide, EnSys Environmental Products, Inc.

TABLE 1A

CROSS REACTIVITY OF DIFFERENT COMPOUNDS[a]

Compound	Soil Equivalent Concentration (ppm) Required to Yield a Positive Result
1-Chloronaphthalene	10,000
1,2,4-Trichlorobenzene	10,000
2,4-Dichlorophenyl-benzenesulfonate	1,000
2,4-Dichloro-1-naphthol	>10,000
Bifenox	500
Diesel fuel	>10,000
Pentachlorobenzene	>10,000
2,5-Dichloroaniline	>10,000
Hexachlorobenzene	>10,000
Gasoline	>10,000
Dichlorofenthion	10,000
Tetradifon	125

(a) PCB RISc™ test kit, Ensys, Inc. publication

TABLE 1B

CROSS REACTIVITY OF DIFFERENT COMPOUNDS[a]

Compound	% Cross Reactivity
Aroclor 1248	100
Aroclor 1242	50
Aroclor 1254	90
Aroclor 1260	50
1,2-, 1,3-, & 1,4-Dichlorobenzene	<0.5
1,2,4-Trichlorobenzene	<0.5
biphenyl	<0.5
2,4-dichlorophenol	<0.5
2,5-dichlorophenol	<0.5
2,4,5-trichlorophenol	<0.5
2,4,6-trichlorophenol	<0.5
Pentachlorophenol	<0.5

[a] EnviroGard PCB Test Kits (Millipore Corporation)

TABLE 1C

CROSS REACTIVITY OF DIFFERENT COMPOUNDS[a]

Compound	MDL[b] (ppm)	IC 50[c] (ppm)	% Cross Reactivity[d]
Aroclor 1016	5.7	83	12
Aroclor 1221	25.5	300	3
Aroclor 1232	9.0	105	10
Aroclor 1242	1.5	31	32
Aroclor 1248	0.8	24	42
Aroclor 1254	0.5	10	100
Aroclor 1260	0.75	10	100
Aroclor 1262	0.5	10	100
Aroclor 1268	3.8	40	25

METHOD: The compounds listed were assayed at various concentrations and compared against an inhibition curve generated using Aroclor 1254. The concentration of the compound required to elicit a positive response at the MDL as well as the concentration required to yield 50% inhibition compared to the standard curve were determined.

[a] D TECH™ PCB test kit

[b] The Minimum Detection Limit (MDL) is defined as the lowest concentration of compound that yields a positive test result.

[C] The IC_{50} is defined as the concentration of compound required to produce a test response equivalent to 50% of the maximum response.

[d] % Cross reactivity is determined by dividing the equivalent Aroclor 1254 concentration by the actual compound concentration at IC_{50}

TABLE 1D

CROSS REACTIVITY OF DIFFERENT COMPOUNDS[a]

Compound	% Cross-Reactivity	Soil Equivalent Concentration (ppm) Required to Yield a Positive Result
1-Chloronaphthalene	0.05%	10,000
1,2,4-Trichlorobenzene	0.05%	10,000
2,4-Dichloro-1-naphthol	<0.20%	>10,000
Bifenox	<0.10%	500
Pentachlorobenzene	<0.05%	>10,000
2,5-Dichloroaniline	<0.05%	>10,000
Hexachlorobenzene	<0.05%	>10,000
Dichlorofenthion	0.05%	10,000
Tetradifon	<0.10%	125

(a) PCB RISc™ Liquid Waste Test System, Ensys, Inc.

TABLE 2

ESTIMATED ERROR RATES FOR 5 PPM DILUTION[a]

True Value (ppm)	0	1	2	3	4	5	6	7	8	9	10	20
Estimated Rate of False Positives (%)	1.3	13.2	39.2	65.2	82.3	.	.	.	.	.	.	.
Estimated Rate of False Negatives (%)	.	.	.	.	.	8.5	4.1	2.0	1.0	0.5	0.3	<0.1

TABLE 3

ESTIMATED ERROR RATES FOR 50 PPM DILUTION[a]

True Value (ppm)	0	5	10	15	20	30	40	50	60	70	80	100
Estimated Rate of False Positives (%)	1.0	7.9	24.5	46.0	65.0	87.3	95.6	.	.	.	.	.
Estimated Rate of False Negatives (%)	.	.	.	.	.	.	.	1.7	0.7	0.3	0.2	<0.1

(a) PCB RISc™ test kit

TABLE 4

Comparison of PCB RISc™ Test Kit with GC

Sample ID	Screening Test Results	GC Results (Method 8082)	Agreement[a] Y, FP, FN
101	<5 ppm	<0.5 ppm	Y
284	<5 ppm	<0.5 ppm	Y
292	<5 ppm	<0.5 ppm	Y
199	<5 ppm	0.5 ppm	Y
264	<5 ppm	1 ppm	Y
257	<5 ppm	1.8 ppm	Y
259	<5 ppm	4 ppm	Y
265	<5 ppm	4.5 ppm	Y
200	<5 ppm	5 ppm	Y
170	5-50	5.8 ppm	Y
198	<5 ppm	2.2-5.8 ppm	Y
172	5-50	6.2 ppm	Y
169	5-50	7.2 ppm	Y
171	5-50	7.2 ppm	Y
202	<5 ppm, 5-50	1.3-7.2 ppm	Y
163	5-50	8.7 ppm	Y
165	5-50	9 ppm	Y
168	5-50	9 ppm	Y
166	5-50	9.3 ppm	Y
164	5-50	11.9 ppm	Y
204	5-50	12.8 ppm	Y
253	5-50	13 ppm	Y
203	5-50	13.5 ppm	Y
258	5-50	15 ppm	Y
106	5-50	15-19 ppm	Y
161	5-50	15.3 ppm	Y
167	5-50	16.2 ppm	Y

TABLE 4 (cont.)

Sample ID	Screening Test Results	GC Results (Method 8082)	Agreement[a] Y, FP, FN
247	5-50	18 ppm	Y
148	>50	18-34 ppm	FP
205	5-50	20 ppm	Y
162	5-50	20.4 ppm	Y
175	5-50	21.2 ppm	Y
176	5-50	21.6 ppm	Y
197	5-50	32 ppm	Y
243	5-50	32 ppm	Y
252	5-50	32 ppm	Y
178	5-50	43.7 ppm	Y
201	5-50	43 ppm	Y
254	5-50, >50	56 ppm	Y
238	>50	46-60 ppm	Y
248	5-50	44-60 ppm	Y
250	>50	68 ppm	Y
242	5-50	30-69 ppm	Y
256	>50	73 ppm	Y
249	>50	96 ppm	Y
245	>50	102 ppm	Y
241	5-50	154 ppm	FN
246	>50	154 ppm	Y
261	>50	204 ppm	Y
240	>50	251 ppm	Y
267	>50	339 ppm	Y
239	>50	460 ppm	Y
104	>50	200-3772 ppm	Y
108	>50	531-1450 ppm	Y

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 5

Comparison of EnviroGard™ PCB Kit with GC

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
001	>10	5.98	FP[g]
002	>10	1.27	FP
003	<10	0.11	Y
004	>10	6.71	FP[g]
005	>10	1.37	FP
006	>10	0.68	FP
007	>10	0.55	FP
008	>10	2.00	FP
009	>10	1.30	FP
010	>10	0.17	FP
011	>10	1.15	FP
012	<10	ND[f]	Y
013	<10	1.13	Y
014	<10	0.18	Y
015	>10	9.13	FP[g]
015	>10	9.84	FP[g]
016	>10	2110	Y
017	>10	2.55	FP
018	>10	45.4	Y
019	>10	6.70	FP[g]
020	<10	0.07	Y
021	<10	0.06	Y
022	<10	0.54	Y
022	<10	0.72	Y
023	>10	20.8	Y
024	<10	0.06	Y

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
024D	<10	0.05	Y
025	>10	11.7	Y
026	<10	1.96	Y
027	<10	0.06	Y
028	<10	0.22	Y
028D	<10	0.22	Y
029	<10	0.23	Y
030	<10	1.15	Y
031	<10	0.26	Y
032	>10	47.6	Y
033	>10	6.00	FP[g]
034	>10	34.0	Y
035	<10	ND[f]	Y
035D	<10	ND[f]	Y
036	>10	816	Y
037	<10	0.06	Y
037D	<10	0.04	Y
038	>10	1030	Y
039	<10	0.68	Y
040	>10	4.25	FP
041	<10	ND[f]	Y
042	>10	0.52	FP
042D	>10	0.47	FP
043	>10	1.69	FP
043D	>10	1.74	FP

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
044	<10	0.59	Y
045	<10	ND[f]	Y
046	<10	ND[f]	Y
046D	<10	ND[f]	Y
047	<10	0.09	Y
047D	<10	0.10	Y
048	<10	ND[d]	Y
049	<10	ND[d]	Y
050	>10	3.60	FP
050D	>10	4.41	FP
051	<10	ND[f]	Y
052	>10	4.21	FP
053	<10	0.96	Y
054	<10	0.52	Y
055	<10	2.40	Y
056	<10	0.51	Y
057	<10	ND[f]	Y
058	<10	0.69	Y
059	>10	7.86	FP[g]
060	>10	0.62	FP
060D	<10	0.58	Y
061	>10	580	Y
062	>10	2.35	FP
063	<10	0.09	Y
063D	<10	0.15	Y

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
064	>10	19.0	Y
065	>10	3.08	FP
066	<10	1.98	Y
067	<10	0.08	Y
068	<10	0.50	Y
069	<10	ND[f]	Y
069D	<10	ND[f]	Y
070	<10	ND[f]	Y
071	<10	0.05	Y
071D	<10	ND[f]	Y
072	<10	0.04	Y
073	>10	15.8	Y
074	>10	13.3	Y
075	>10	23.0	Y
076	>10	46.7	Y
077	<10	ND[f]	Y
078	>10	2.27	FP
079	>10	42.8	Y
080	<10	3.77	Y
081	<10	0.69	Y
081D	<10	0.45	Y
082	<10	ND[f]	Y
082D	<10	0.24	Y
083	<10	0.48	Y
083D	<10	0.41	Y
084	>10	1.16	FP

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
084D	>10	1.08	FP
085	>10	428	Y
085D	>10	465	Y
086	<10	1.42	Y
086D	<10	1.25	Y
087	<10	0.08	Y
087D	<10	ND[f]	Y
088	>10	2.70	FP
088D	>10	1.77	FP
089	>10	45.0	Y
090	<10	1.01	Y
090D	<10	1.40	Y
091	>10	1630	Y
091D	>10	1704	Y
092	<10	1.21	Y
092D	<10	ND[f]	Y
093	<10	0.30	Y
094	<10	0.36	Y
095	>10	17.5	Y
095D	>10	31.2	Y
096	<10	0.06	Y
097	<10	1.23	Y
097D	<10	0.29	Y
098	>10	1.17	FP
098D	>10	0.83	FP
099	<10	ND[f]	Y

TABLE 5 (cont.)

Sample Number	Screening Result[c,d]	GC Result[c] [8082]	Agreement[e] Y, FN, FP
100	>10	177	Y
100D	>10	167	Y
101	>10	1.21	FP
102	>10	293	Y
102D	>10	177	Y
103	>10	40.3	Y
104	>10	7.66	FP[g]
105	<10	0.21	Y
106	<10	2.50	Y
107	>10	14.1	Y
108	>10	3.84	FP
109	<10	ND[f]	Y
109D	<10	ND[f]	Y
110	<10	ND[f]	Y
111	<10	ND[f]	Y
112	>10	315	Y
113	>10	14.9	Y
114	>10	66.3	Y

[c] mg/kg (ppm)

[d] Screening Calibrator is 5 mg/kg Aroclor 1248

[e] Y=Yes, FN=False Negative, FP=False Positive

[f] ND = Not Detectable

[g] Expected Result Based on Calibrator Concentration

TABLE 6

EnviroGard™ PCB Kit Field Performance Summary

Specificity:	[1-(Reported Positives/True Negatives)] = [1-(37/109)] = 66%
Note 1:	8 of the 37 reported positive samples had PCB contamination levels between 5 and 10 mg/kg. Soils in this range should test "positive" because the assay calibrator is 5 mg/kg Aroclor 1248. A positive assay bias is necessary to prevent false negative results. Eliminating these samples from the calculations produces a Specificity of: [1-(Reported Positives/True Negatives)] = [1-(29/101)] = 71%
Note 2:	The distribution of false positives is not random ($p < 0.05$), with a clustering at the beginning of the sample set. This observation was included in *Developers Comments* which were added to the final draft of the Technical Evaluation Report. One explanation for the higher frequency of false positive results at the beginning is inexperience of the operator with the method. If the first 20 samples are eliminated from the Specificity analysis, the following result is obtained: [1-(Reported Positives/True Negatives)] = [1-(20/86)] = 77% In the SITE demonstration, the PCB Immunoassay had a 77% positive predictive value.
Sensitivity:	[1-(Reported Negatives/True Positives)] = [1-(0/31)] = 100% In the SITE demonstration, the PCB Immunoassay had a 100% negative predictive value.

TABLE 7

Comparison of D TECH™ PCB Test Kit with GC

Sample	D TECH™ (ppm)	GC (8082) (ppm)	Agreement[a] Y, FN, FP
J1	4.0-15	5.0	Y
J2	>50	147	Y
J3	15-50	54	Y
J5	15-50	160	FN
J6	>50	1200	Y
J7	4.0-15	12	Y
J8	4.0-15	28	FN
J9	>50	463	Y
J10	>50	1760	Y
J11	>50	28	FP
J12	15-50	17	Y
J13	>50	1300	Y
J14	>50	186	Y
J15	15-50	31	Y
J16	15-50	36	Y
J17	>50	31	FP
J18	>50	130	Y
J19	>50	1310	Y
J20	>50	2620	Y
J21	>50	111000	Y
J22	1.0-4.0	0.01	FP
J23	1.0-4.0	0.60	Y
J24	<0.5	0.10	Y

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 7 (cont.)

Sample	D TECH™ (ppm)	GC (8082) (ppm)	Agreement[a] Y, FN, FP
J25	0.5-1.0	0.12	FP
J26	<0.5	0.01	Y
J27	1.0-4.0	1.8	Y
J28	<0.5	0.18	Y
J29	0.5-1.0	0.54	Y
J30	>50	21	FP
J31	4.0-15	13	Y
J32	0.5-1.0	0.72	Y
J33	0.5-1.0	0.32	Y
J34	1.0-4.0	0.36	FP
J35	1.0-4.0	0.26	FP
J36	>50	70	Y
J37	<0.5	0.12	Y
J38	0.5-1.0	0.81	Y
J39	0.5-1.0	0.33	Y
J40	<0.5	0.19	Y
J41	<0.5	0.01	Y
J42	1.0-4.0	0.43	FP
J43	1.0-4.0	0.31	FP
J44	15-50	503.4	FN
J45	15-50	5.6	FP
J46	<0.5	0.02	Y
J47	<0.5	0.22	Y

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 7(cont.)

Sample	D TECH™ (ppm)	GC (8082) (ppm)	Agreement[a] Y, FN, FP
G1	15-50	18	Y
G2	4.0-15	11	Y
G3	1.0-4.0	3.4	Y
G4	15-50	6.5	FP
G5	<0.5	0.01	Y
G6	1.0-4.0	1.4	Y
G7	1.0-4.0	0.30	FP
G8	15-50	7.5	FP
G9	4.0-15	33	FN
G10	15-50	8	FP
G11	4.0-15	11	Y
G12	4.0-15	24	FN
G13	4.0-15	4.3	Y
G14	0.5-1.0	1.3	Y
G15	<0.5	0.01	Y
G16	1.0-4.0	3.2	Y
G17	4.0-15	18	Y
G18	4.0-15	4.6	Y
G19	1.0-4.0	2.3	Y
G20	>50	37	FP

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 7(cont.)

Sample	D TECH™ (ppm)	GC (8082) (ppm)	Agreement[a] Y, FN, FP
W1A	4.0-15	9.1	Y
W2A	4.0-15	11	Y
W3A	1.0-4.0	2.8	Y
W4A	4.0-15	13	Y
W5A	>50	29	FP
W6A	>50	1200	Y
W7A	>50	57	Y
W8A	4.0-15	18	Y
W9A	1.0-4.0	1.3	Y
W10A	0.5-1.0	0.44	Y
W11A	15-50	120	FN
W12A	15-50	48	Y
W13A	15-50	19	Y
W14A	4.0-15	2.7	Y
W15A	1.0-4.0	1.3	Y
W16A	1.0-4.0	0.3	FP
W17A	4.0-15	1.4	FP
W18A	1.0-4.0	2.2	Y
W19A	4.0-15	8.2	Y
W20A	>50	9.3	FP
W21A	>50	110	Y
W22A	1.0-4.0	0.6	Y
W23A	>50	46	Y

[a] Y=Yes, FN=False Negative, FP=False Positive

TABLE 8

Intraassay Precision of the PCB RISc™ Liquid Waste Test System

PCB 1248 Spike Concentration (ppm)	Signal %RSD (OD_{450nm}) N=44 (11 data sets)	Statistical Percentage of False Results Compared to Standards
0	6.4%	<0.02%
0.2	5.9%	4.1%
5	7.9%	1.4%

TABLE 9

Interassay Precision of the PCB RISc™ Liquid Waste Test System

PCB 1248 Spike Concentration (ppm)	Signal %RSD (OD_{450nm}) N=44 (11 data sets)
0	6.4%
0.2	8.3%
5	8.5%

TABLE 10

Comparison of PCB RISc™ Liquid Waste Test with Method 8082

Sample ID	Sample Matrix	GC Results		IA Results	
		Aroclor	Conc. ppm	Test Results	Corr. with GC Results
302	Condensate	ND[b]	ND	<5	yes
303	Condensate	ND	ND	<5	yes
304	Condensate	1242	25	≥5	yes
306	Condensate	1242	5	≥5	yes
307	Condensate	1242	<10	<5	yes
308	Condensate	1242	58	≥5	yes
310	Condensate	1254	25	≥5	yes
311	Condensate	1242	200	≥5	yes
331	Transformer Oil	1260	183	≥5	yes
380	Transformer Oil	PCB[c]	20	≥5	yes
381	Transformer Oil	PCB	38	≥5	yes
382	Transformer Oil	PCB	163	≥5	yes
383	Transformer Oil	PCB	176	≥5	yes
384	Transformer Oil	PCB	336	≥5	yes
385	Transformer Oil	PCB	6400	≥5	yes
387	Coolant	PCB	10	≥5	yes
388	2,4-D Rinse Water	1254	<10	<5	yes
389	Waste Solvent	1242	29	≥5	yes
390	Herbicide	ND	<2	<5	yes
391	Paint/Solvent	1254	9	≥5	yes
394	Waste Solvent	1242/1260	11/17	≥5	yes
395	Waste Solvent	1242/1260	2/2	<5	yes
396	Waste Oil	1260	323	≥5	yes
398	Chlor. Solvent	ND	<5	<5	yes
399	Paint	ND	<50	<5	yes
400	Pump Oil	ND	<50	<5	yes
401	Waste Solvent	ND	<35	<5	yes
402	Herbicide	ND	<50	<5	yes
403	Paint/Solvent	ND	<5	<5	yes
404	Printing Solvent	ND	<5	<5	yes
405	Waste Solvent	ND	<50	<5	yes

TABLE 10 (cont.)

Sample ID	Sample Matrix	GC Results		IA Results	
		Aroclor	Conc. ppm	Test Results	Corr. with GC Results
407	Waste Oil	ND	ND	≥5	FP[d]
408	Waste Oil	ND	ND	<5	yes
409	Waste Oil	ND	ND	<5	yes
410	Waste Oil	ND	ND	<5	yes
411	Waste Oil	ND	ND	<5	yes
412	Waste Oil	ND	ND	<5	yes
413	Waste Oil	ND	ND	<5	yes
414	Waste Oil	ND	ND	<5	yes
415	Waste Oil	ND	ND	<5	yes
416	Waste Oil	PCB	50	>5	yes
417	Waste Oil	ND	ND	<5	yes
418	Waste Oil	ND	ND	<5	yes
419	Waste Oil	ND	ND	<5	yes
420	Waste Oil	ND	ND	<5	yes
421	Waste Oil	ND	ND	<5	yes
422	Waste Oil	ND	ND	<5	yes
423	Waste Oil	ND	ND	<5	yes
424	Waste Oil	ND	ND	<5	yes
425	Waste Oil	ND	ND	<5	yes
Number of False Positive Results				1/32	
Rate				3.1%	
Number of False Negative Results				0/18	
Rate				0.0%	

[a] Trial 1 data

[b] ND = Not Detectable

[c] PCB = Aroclor was not determined

[d] FP = False positive

TABLE 11

Correlation of PCB RISc™ Liquid Waste Test and Method 8082 Results
Using Spiked and Unspiked Liquid Waste Field Samples

ID	Matrix	GC Results Unspiked ppm	Immunoassay Result		Interp.
			Unspiked ppm	Spiked (5 ppm 1248)	
001	Aromatic solvent	<5	<5	≥5	
002	Aviation gas	<5	<5	≥5	
003	Chiller oil	<5	<5	≥5	
004	Compressor oil	<5	<5	≥5	
005	Coolant + water	<5	<5	≥5	
006	Coolant oil	NR[b]	NR	≥5	
007	Coolant oil	NR	<5	≥5	
008	Cutting oil	<5	<5	≥5	
009	Cutting oil	<5	<5	≥5	
010	Degreaser still bottom	<5	<5	≥5	
011	Dope oil	<5	<5	≥5	
012	Draw Lube oil	<5	<5	≥5	
013	Fleet crankcase oil	<5	<5	≥5	
014	Floor sealer	<5	<5	≥5	
015	Fuel oil	<5	<5	≥5	
016	Hi-BTU oil	<5	<5	≥5	
017	Honing oil	<5	<5	≥5	
018	Hydraulic oil	<5	<5	≥5	
019	Hydraulic oil	<5	<5	≥5	
020	Hydraulic oil	<5	<5	≥5	
021	Machine oil	NR	<5	NR	
022	Mineral oil	<5	<5	≥5	
023	Mineral spirits	<5	<5	≥5	
024	Mineral spirits + ink	<5	≥5	≥5	FP
025	Mixed flammables	<5	<5	≥5	
026	Mixed solvents	<5	<5	≥5	
027	Naphtha	<5	<5	≥5	
028	Oil	<5	<5	≥5	
029	Oil	<5	<5	≥5	
030	Oil	<5	<5	≥5	
031	Oil	<5	<5	≥5	

TABLE 11 (cont.)

ID	Matrix	GC Results Unspiked ppm	Immunoassay Result		Interp.
			Unspiked ppm	Spiked (5 ppm 1248)	
032	Oil	<5	<5	≥5	
033	Oil	<5	<5	≥5	
034	Oil + 1,1,1-trichloroethane	<5	<5	≥5	
035	Oil sludge	<5	≥5	≥5	FP
036	Oil + freon	<5	<5	≥5	
037	Oil + mineral spirits	<5	<5	≥5	
038	Oil + scum solution	<5	<5	≥5	
039	Oily water	<5	<5	≥5	
040	Paint thinner	<5	<5	≥5	
041	Paint thinner	<5	<5	≥5	
042	Paint thinner	<5	<5	≥5	
043	Paint waste	<5	<5	≥5	
044	Paint waste + thinner	<5	<5	≥5	
045	Perce + oil	<5	<5	≥5	
046	Petroleum distillates	<5	≥5	≥5	FP
047	Petroleum naphtha	<5	<5	≥5	
048	Pumping oil	<5	<5	≥5	
049	RAC-1 SKOS	<5	<5	≥5	
050	Sk oil	NR	<5	≥5	
051	Sk oil	<5	<5	≥5	
052	Smog Hog	<5	<5	≥5	
053	Toluene + hexane	<5	<5	≥5	
054	Toluene + stain	<5	<5	≥5	
055	1,1,1-Trichloroethane	<5	≥5	≥5	FP
056	1,1,1-Trichloroethane	<5	<5	≥5	
057	1,1,1-Trichloroethane	<5	<5	≥5	
058	1,1,1-Trichloroethane	<5	<5	≥5	
059	1,1,1-TCE + methanol	<5	<5	≥5	
060	Trichloroethylene	<5	<5	≥5	
061	Trichloroethylene	<5	<5	≥5	
062	Trichloroethylene	<5	<5	≥5	
063	Turpentine	<5	<5	≥5	

TABLE 11 (cont.)

ID	Matrix	GC Results Unspiked ppm	Immunoassay Result		Interp.
			Unspiked ppm	Spiked (5 ppm 1248)	
064	Used n-butylacetate	<5	<5	≥5	
065	Used oil + freon	<5	<5	≥5	
066	Used oil + freon	<5	<5	≥5	
067	Used oils	<5	<5	≥5	
068	Used petroleum	<5	<5	≥5	
069	Used petroleum	<5	<5	≥5	
070	Used synthetic oil	<5	<5	≥5	
071	Varnish + stain	<5	<5	≥5	
072	Varsol	<5	<5	≥5	
073	Waste coolant + oil	<5	<5	≥5	
074	Waste ink + solvent	<5	<5	≥5	
075	Waste naphtha	<5	<5	≥5	
076	Waste oil	<5	<5	≥5	
077	Waste oil	<5	<5	≥5	
078	Waste oil	<5	<5	≥5	
079	Waste oil	<5	<5	≥5	
080	Waste oil	<5	<5	≥5	
081	Waste oil	<5	<5	≥5	
082	Waste oil	<5	<5	≥5	
083	Waste oil	<5	<5	≥5	
084	Waste oil	<5	<5	≥5	
085	Waste oil + kerosene	<5	<5	≥5	
086	Waste oil + gas	<5	<5	≥5	
087	Waste paint	<5	<5	≥5	
088	Waste paint	<5	<5	≥5	
089	Waste paint	<5	<5	≥5	
090	Waste paint	<5	<5	≥5	
091	Waste paint	<5	<5	≥5	
092	Waste paint	<5	<5	≥5	FP
093	Waste SC-49 solvent	<5	<5	≥5	
094	Waste solvent	<5	<5	≥5	
095	Waste stoddard	<5	<5	≥5	
096	Waste toner	<5	<5	≥5	

TABLE 11 (cont.)

ID	Matrix	GC Results Unspiked ppm	Immunoassay Result		Interp.
			Unspiked ppm	Spiked (5 ppm 1248)	
097	Waste tramp oil	<5	<5	≥5	
098	Waste transmission fluid	<5	<5	≥5	
099	Xylene	<5	≥5	≥5	FP
100	Not Recorded	<5	<5	NR	
No. of False Positive Results		6/99			
Rate		6.1%			
No. of False Negative Results				0/98	
Rate				0.0%	

[a] Trial 2 data

[b] NR = not run