



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

# Field Test Experiments and Validation of CEN/TS 1948-4 Dioxin-like PCBs from stationary sources

– CEN/TC 264/WG 1 “Dioxins and PCBs (Emission)” –

## Annex 1

### Interlaboratory comparison study



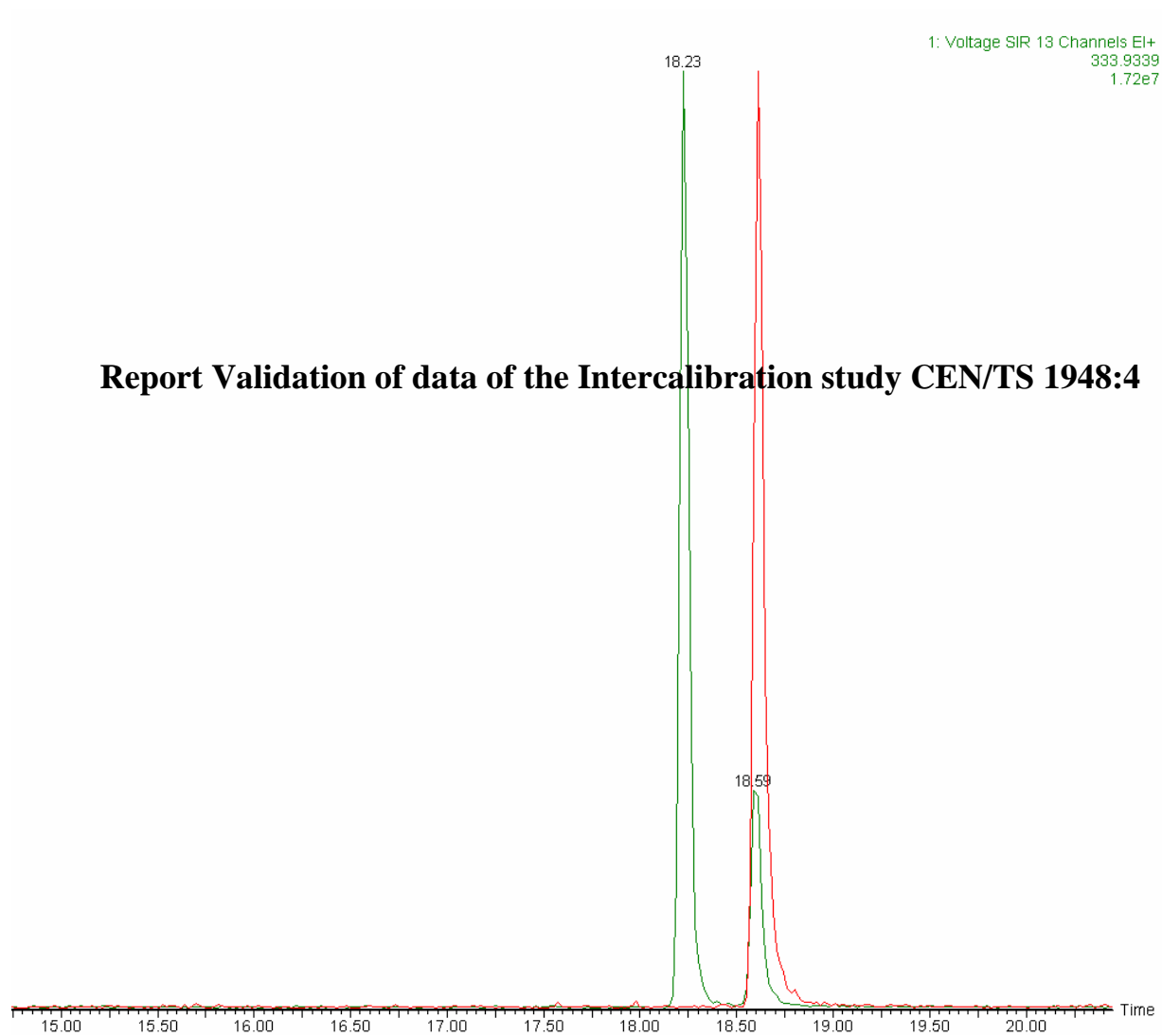
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## **1 Validation of data of the Intercalibration study CEN/TS 1948:4**

### **1.1 Samples**

At two time intervals (November and January) two sets of samples were sent to 9 laboratories registered for the validation study. The first set of samples consisted of a low level fly ash sample, a high level fly ash sample, a medium level extract and a mixed low/medium level standard. In addition a complete set of  $^{13}\text{C}$  labeled standards and calibration curves according to CEN/TC 264/WG 1 revised Table D1 and D2 was sent to all participating laboratories. This shipment was sent by an international courier the 15<sup>th</sup> of November. All samples arrived in good condition in the 9 laboratories at the 17<sup>th</sup> of November. The second set of samples consisted of a medium/high level standard solution and again a set of all  $^{13}\text{C}$  labeled standards and calibration solutions of a different supplier. These samples were sent the 16<sup>th</sup> of January and arrived between the 18<sup>th</sup> and 19<sup>th</sup> of January. This was somewhat later than anticipated because of late delivery from the US and additional delays at customs at Arlanda Airport in Sweden.

The deadline for the first set of samples was set for the 15<sup>th</sup> of February. In total 8 laboratories were able to send the 'Resform WP1 CEN TC264 2006 (1).xls' before the set deadline. The second deadline was set for the 31<sup>st</sup> of January and all 8 laboratories were able to submit the results on the 30<sup>th</sup> or 31<sup>st</sup> of January in 'Resform WP1 CEN TC264 2006 (2).xls'.

Additional information needed for the validation of the method as described in CEN/TS 1948:4 was received during the month of February (Resform WP1 CEN TC264 2006 (3).xls'. This data was not used for the validation of analytical quality of the laboratories in the Intercalibration study, but will be used for the total validation of the method. All recoveries were acceptable and > 50% with the exception of two entries for PCB #180, and one entry for PCB #28 and two of the triplicate analysis of Ash A.

### **1.2 Results**

The results are given in detail in the appendix. In summary both Ash 1 and Ash 2 were analyzed in triplicate by five laboratories and as a single sample by another three laboratories. The extract (Extract 1) was analyzed in triplicate by two laboratories and as a single sample by six laboratories. The standard solutions were analyzed as a single sample by three of the laboratories, in duplicate by one laboratory and in triplicate by four laboratories. From the data the average, median, maximum, minimum, standard deviation and the % RSD were calculated for all PCB congeners. Obvious outliers were removed using the modified 'graphical consistency technique' as described in ISO 5725-2:1994 (E). An indicator of 2.00 was used corresponding to a Mandel's h value of 2.06 for the number of laboratories reporting data (8). This resulted in the removal of 6 outliers from the data of Ash 1, 5 outliers from the data of Ash 2, two data points from the data of Extract 1, two data points from the data of Standard 1. No outliers were detected in the results for Standard 2.

After removal the outliers a new average, median, minimum, maximum and standard deviation were calculated. A summary of the results after omitting obvious outliers is given in Table 1.1. to Table 1.5

*Table 1.1 Results low level Ash 1 after omitting obvious outliers.*

Ash 1 (ng/g)		n	Average	Median	Min	Max	SD	%RSD
<b>Non-Ortho PCBs</b>	<b>PCB #77</b>	7	0.064	0.066	0.046	0.080	0.0104	16%
	<b>PCB #81</b>	8	0.035	0.036	0.031	0.038	0.0029	8%
	<b>PCB #126</b>	8	0.071	0.073	0.058	0.085	0.0079	11%
	<b>PCB #169</b>	8	0.031	0.035	0.011	0.040	0.0102	33%
<b>Mono-Ortho PCBs</b>	<b>PCB #105</b>	8	0.078	0.071	0.039	0.133	0.0334	43%
	<b>PCB #114</b>	7	0.016	0.016	0.012	0.018	0.0023	15%
	<b>PCB #118</b>	8	0.162	0.148	0.059	0.290	0.0882	55%
	<b>PCB #123</b>	7	0.021	0.019	0.007	0.040	0.0117	55%
	<b>PCB #156</b>	7	0.042	0.041	0.035	0.052	0.0059	14%
	<b>PCB #157</b>	8	0.026	0.026	0.020	0.030	0.0035	13%
	<b>PCB #167</b>	7	0.026	0.025	0.018	0.037	0.0069	26%
	<b>PCB #189</b>	8	0.037	0.036	0.034	0.041	0.0027	8%
<b>Marker PCBs</b>	<b>PCB #28</b>	6	0.227	0.214	0.110	0.414	0.1068	47%
	<b>PCB #52</b>	6	0.207	0.171	0.060	0.442	0.1511	73%
	<b>PCB #101</b>	6	0.313	0.321	0.120	0.495	0.1392	44%
	<b>PCB #153</b>	7	0.358	0.291	0.174	0.580	0.1503	42%
	<b>PCB #138</b>	7	0.284	0.268	0.121	0.440	0.1482	52%
	<b>PCB #180</b>	7	0.166	0.155	0.060	0.300	0.0973	59%

*Table 1.2 Results high level Ash 2 after omitting obvious outliers.*

Ash 2 (ng/g)		n	Average	Median	Min	Max	SD	%RSD
<b>Non-Ortho PCBs</b>	<b>PCB #77</b>	8	4.63	4.73	3.68	5.05	0.448	10%
	<b>PCB #81</b>	8	0.81	0.84	0.58	0.94	0.117	14%
	<b>PCB #126</b>	8	5.10	5.02	4.10	6.80	0.848	17%
	<b>PCB #169</b>	8	2.10	2.11	1.63	2.53	0.315	15%
<b>Mono-Ortho PCBs</b>	<b>PCB #105</b>	8	1.90	1.93	1.20	2.61	0.405	21%
	<b>PCB #114</b>	8	0.47	0.47	0.38	0.58	0.061	13%
	<b>PCB #118</b>	8	1.91	1.95	1.42	2.38	0.311	16%
	<b>PCB #123</b>	8	0.65	0.31	0.28	1.39	0.500	77%
	<b>PCB #156</b>	8	2.48	2.45	2.04	2.92	0.334	13%
	<b>PCB #157</b>	8	1.24	1.30	0.92	1.43	0.187	15%
	<b>PCB #167</b>	8	1.02	1.01	0.83	1.31	0.159	16%
	<b>PCB #189</b>	8	2.07	2.08	1.40	2.55	0.377	18%
<b>Marker PCBs</b>	<b>PCB #28</b>	6	0.36	0.36	0.19	0.55	0.151	42%
	<b>PCB #52</b>	6	0.32	0.29	0.14	0.58	0.174	54%
	<b>PCB #101</b>	7	0.63	0.67	0.27	1.21	0.346	55%
	<b>PCB #153</b>	8	0.82	0.80	0.31	1.21	0.315	38%
	<b>PCB #138</b>	8	1.43	1.30	0.75	2.14	0.482	34%
	<b>PCB #180</b>	8	1.29	1.34	0.78	1.96	0.427	33%

Table 1.3 Results medium level Extract 1 after omitting obvious outliers.

Extract 1 (ng/ul)		n	Average	Median	Min	Max	SD	%RSD
Non-Ortho PCBs	PCB #77	8	1.42	1.37	1.20	1.75	0.178	12%
	PCB #81	8	0.58	0.59	0.49	0.62	0.042	7%
	PCB #126	8	1.67	1.68	1.34	1.89	0.171	10%
	PCB #169	8	0.92	0.90	0.77	1.12	0.100	11%
Mono-Ortho PCBs	PCB #105	8	1.52	1.46	1.24	1.85	0.220	14%
	PCB #114	8	0.45	0.43	0.34	0.58	0.081	18%
	PCB #118	8	2.15	2.27	1.72	2.37	0.273	13%
	PCB #123	8	0.36	0.26	0.17	0.68	0.207	57%
	PCB #156	8	1.33	1.34	1.13	1.53	0.117	9%
	PCB #157	8	0.73	0.73	0.63	0.82	0.062	9%
	PCB #167	8	0.47	0.47	0.38	0.58	0.055	12%
	PCB #189	8	1.18	1.20	0.95	1.36	0.143	12%
Marker PCBs	PCB #28	6	1.47	1.48	1.16	1.80	0.277	19%
	PCB #52	7	1.12	1.07	0.89	1.57	0.227	20%
	PCB #101	6	1.25	1.21	1.17	1.39	0.097	8%
	PCB #153	7	1.45	1.35	1.11	2.06	0.315	22%
	PCB #138	7	2.10	2.13	1.70	2.61	0.292	14%
	PCB #180	7	1.17	1.20	0.83	1.69	0.278	24%

Table 1.4 Results mixed level Standard 1 after omitting obvious outliers.

Standard 1 (pg/ul)		n	Average	Median	Min	Max	SD	%RSD
Non-Ortho PCBs	PCB #77	8	19.63	19.39	17.66	22.71	1.735	9%
	PCB #81	8	3.98	3.88	3.50	4.70	0.436	11%
	PCB #126	8	3.95	3.85	3.27	4.80	0.522	13%
	PCB #169	8	4.33	4.22	3.74	5.60	0.641	15%
Mono-Ortho PCBs	PCB #105	8	39.25	39.67	33.70	48.90	4.754	12%
	PCB #114	8	4.17	4.27	3.59	4.70	0.375	9%
	PCB #118	8	39.22	39.55	31.74	46.70	4.264	11%
	PCB #123	8	4.04	4.17	3.48	4.60	0.451	11%
	PCB #156	8	19.41	19.14	16.52	24.50	2.664	14%
	PCB #157	8	4.16	4.10	3.33	5.30	0.593	14%
	PCB #167	7	3.90	4.12	3.49	4.14	0.298	8%
	PCB #189	7	3.94	3.85	3.55	4.31	0.328	8%

Table 1.5 Results high level Standard 2 no outliers detected.

Standard 2 (pg/ul)		n	Average	Median	Min	Max	SD	%RSD
Non-Ortho PCBs	PCB #77	8	20.03	20.09	18.86	20.73	0.542	3%
	PCB #81	8	20.26	20.21	19.71	21.01	0.457	2%
	PCB #126	8	20.13	19.98	19.00	21.67	0.884	4%
	PCB #169	8	19.92	19.77	18.00	21.61	1.310	7%
Mono-Ortho PCBs	PCB #105	8	19.91	20.00	19.20	20.74	0.577	3%
	PCB #114	8	20.78	20.85	18.90	22.36	1.085	5%
	PCB #118	8	20.02	20.03	19.05	21.00	0.772	4%
	PCB #123	8	20.05	19.97	19.30	21.16	0.591	3%
	PCB #156	8	20.23	20.05	19.30	22.00	0.804	4%
	PCB #157	8	20.28	20.57	18.00	21.46	1.227	6%
	PCB #167	8	19.77	19.81	18.48	21.18	0.924	5%
	PCB #189	8	20.15	20.17	19.00	21.79	0.900	4%

In summary the data is very good for both the planar and mono ortho PCBs, with the exception of PCB#123. The results for the 'marker PCBs show larger variation especially for both Ash samples showing RSDs between 33-73%. The corresponding results for the WHO PCBs are 8-45% for the low level sample and 13-21% for the high level sample. The results for Extract 1 for the marker PCBs are somewhat better with RSDs varying from 8-25%. The results for both standard solutions are very good with RSDs between 8-15% for the low/medium level standard and RSDs between 2 and 7% for high level Standard 2.

### 1.3 z-Scores

For each laboratory and PCB congener z-scores were calculated using the average and the standard deviation from the corrected data after removing obvious outliers from Tables 1.1 to 1.5. The z-scores were calculated as  $z = (x - X) / SD$  where  $x$  = average of individual PCB of the laboratory,  $X$  = consensus value or grand mean and  $SD$  = standard deviation between the reported results for each PCB congener. The z-scores are given in Tables 1.6 to 1.10.



Table 1.6. Laboratory code and z-score for low level Ash 1

	1	2	3	4	5	6	7	8	9
<b>PCB #77</b>	0.27	-0.40	-0.33	0.16	1.51	-1.75	6.33	0.54	NA
<b>PCB #81</b>	0.34	0.72	-1.48	-0.97	1.02	-0.97	0.28	1.07	NA
<b>PCB #126</b>	0.17	0.34	0.15	-0.69	0.52	-1.71	-0.49	1.72	NA
<b>PCB #169</b>	0.48	0.92	-0.08	-1.05	0.46	-1.92	0.29	0.91	NA
<b>PCB #105</b>	-0.98	-1.16	-0.62	0.09	1.00	0.57	1.64	-0.54	NA
<b>PCB #114</b>	-1.50	-0.62	3.77	0.19	1.22	-0.67	1.18	0.19	NA
<b>PCB #118</b>	-0.90	-1.16	-0.70	0.21	1.41	0.10	1.46	-0.41	NA
<b>PCB #123</b>	0.65	-1.21	0.06	-0.20	1.63	-0.88	-0.57	0.57	NA
<b>PCB #156</b>	-0.37	0.31	-0.09	1.76	7.42	-1.14	-1.03	0.57	NA
<b>PCB #157</b>	-0.92	-0.55	0.51	0.39	1.35	-1.63	-0.13	0.97	NA
<b>PCB #167</b>	-0.68	-1.19	-1.22	0.53	1.56	0.82	-0.84	-0.20	NA
<b>PCB #189</b>	-0.77	1.36	-0.35	-0.93	1.63	0.16	-0.15	-0.93	NA
<b>PCB #28</b>	0.08	0.96	-0.32	-0.72	1.75	-1.10	127.68	0.31	NA
<b>PCB #52</b>	0.26	0.81	-0.73	-0.77	1.56	-0.97	44.09	0.66	NA
<b>PCB #101</b>	0.47	0.12	-1.39	0.70	1.31	-0.74	5.41	-0.34	NA
<b>PCB #153</b>	-0.44	-0.19	-1.22	1.48	0.86	0.68	-0.73	-0.63	NA
<b>PCB #138</b>	-1.09	0.31	-0.96	0.99	1.00	1.06	-0.88	-0.10	NA
<b>PCB #180</b>	-1.06	1.69	-0.71	1.38	0.83	0.76	-1.09	-0.11	NA

Table 1.7. Laboratory codes and z-score for high level Ash 2

	1	2	3	4	5	6	7	8	9
<b>PCB #77</b>	0.37	0.95	-0.04	-0.65	0.92	-2.11	0.09	0.48	NA
<b>PCB #81</b>	0.27	0.73	0.22	-0.29	0.75	-2.00	-0.74	1.07	NA
<b>PCB #126</b>	-0.50	0.40	0.33	-0.69	0.33	-1.18	-0.70	2.01	NA
<b>PCB #169</b>	-0.25	0.44	-0.30	-1.49	0.29	-1.15	1.09	1.36	NA
<b>PCB #105</b>	0.06	0.06	-0.14	-0.75	0.54	-1.73	0.20	1.75	NA
<b>PCB #114</b>	-0.46	-0.18	-0.74	-1.56	-0.01	1.73	0.48	0.74	NA
<b>PCB #118</b>	-1.58	0.24	0.57	-0.92	0.01	-0.61	1.52	0.77	NA
<b>PCB #123</b>	1.20	-0.66	-0.75	-0.74	1.48	-0.70	-0.72	0.90	NA
<b>PCB #156</b>	-0.26	0.95	0.08	-0.96	0.98	-1.31	-0.81	1.33	NA
<b>PCB #157</b>	0.06	0.85	0.64	-1.03	0.72	-1.71	-0.56	1.02	NA
<b>PCB #167</b>	0.17	0.59	-0.19	-1.01	0.49	-1.17	-0.72	1.85	NA
<b>PCB #189</b>	-0.18	0.94	0.25	-0.69	0.70	-1.78	-0.52	1.27	NA
<b>PCB #28</b>	0.78	0.47	-0.43	-1.10	1.31	-1.03	208.55	6.92	NA
<b>PCB #52</b>	0.72	0.26	-1.02	-0.59	1.50	-0.88	84.43	7.52	NA
<b>PCB #101</b>	0.12	-0.80	-0.97	0.49	0.52	-1.05	6.07	1.67	NA
<b>PCB #153</b>	-1.61	-0.31	-0.91	1.23	0.20	-0.45	0.96	0.89	NA
<b>PCB #138</b>	-1.42	-0.33	-0.93	0.57	-0.33	1.17	-0.22	1.48	NA
<b>PCB #180</b>	-1.20	1.57	0.45	-0.92	0.09	-1.06	0.13	0.95	NA

Table 1.8. Laboratory codes and  $z$ -score for medium level Extract 1.

	1	2	3	4	5	6	7	8	9
<b>PCB #77</b>	-0.18	0.31	-0.40	0.90	-1.23	-0.86	1.87	-0.41	NA
<b>PCB #81</b>	0.11	0.20	-0.98	0.97	-1.99	0.57	0.32	0.80	NA
<b>PCB #126</b>	-0.35	-0.07	-0.57	0.62	-1.94	0.91	1.25	0.15	NA
<b>PCB #169</b>	-0.12	-0.16	-0.39	-0.38	-1.42	0.54	2.08	-0.15	NA
<b>PCB #105</b>	-0.72	-0.20	-0.70	-0.32	-1.29	1.49	1.34	0.40	NA
<b>PCB #114</b>	-0.22	-0.24	-0.01	-0.35	-1.38	1.62	1.31	-0.72	NA
<b>PCB #118</b>	-1.60	0.48	0.61	0.76	-1.56	0.39	0.81	0.10	NA
<b>PCB #123</b>	1.03	-0.86	-0.95	-0.68	1.53	-0.31	-0.71	0.95	NA
<b>PCB #156</b>	-0.66	0.18	-0.41	0.08	-1.72	1.73	0.17	0.62	NA
<b>PCB #157</b>	-0.40	0.47	0.25	0.89	-1.68	-0.83	1.49	-0.18	NA
<b>PCB #167</b>	-0.46	0.34	-0.13	-0.18	-1.63	0.00	0.08	1.99	NA
<b>PCB #189</b>	0.04	0.26	-0.33	0.25	-1.09	-1.59	1.18	1.28	NA

Table 1.9. Laboratory codes and  $z$ -score for mixed level Standard 1.

	1	2	3	4	5	6	7	8	9
<b>PCB #77</b>	-1.14	0.97	-0.51	1.77	-1.09	0.02	0.29	-0.31	NA
<b>PCB #81</b>	-1.11	0.59	-0.91	1.00	-0.75	-0.55	0.08	1.65	NA
<b>PCB #126</b>	-1.30	0.70	-0.45	0.86	-1.01	-0.47	0.05	1.62	NA
<b>PCB #169</b>	-0.79	0.79	-0.48	0.12	-0.85	-0.92	0.15	1.98	NA
<b>PCB #105</b>	-1.17	0.25	-0.03	0.28	-1.02	-0.54	0.21	2.03	NA
<b>PCB #114</b>	-0.04	0.51	-1.54	0.35	-1.40	0.51	0.20	1.41	NA
<b>PCB #118</b>	-1.75	0.38	-0.27	0.41	-0.67	0.02	0.14	1.75	NA
<b>PCB #123</b>	-1.11	0.76	-1.04	0.48	-1.26	0.88	0.06	1.23	NA
<b>PCB #156</b>	-1.08	0.46	-0.46	0.54	-0.65	-0.98	0.26	1.91	NA
<b>PCB #157</b>	-1.41	0.69	-0.41	-0.03	-0.79	-0.18	0.21	1.91	NA
<b>PCB #167</b>	-1.06	0.75	-0.69	0.80	-1.39	0.80	0.79	5.70	NA
<b>PCB #189</b>	-1.19	1.11	-0.35	0.89	-1.18	-0.28	0.99	4.14	NA

Table 1.10. Laboratory codes and z-score for mixed level Standard 2.

	1	2	3	4	5	6	7	8	9
<b>PCB #77</b>	0.67	-0.17	-0.05	1.29	-0.19	0.28	-2.15	0.32	NA
<b>PCB #81</b>	0.25	1.65	-0.57	1.05	-0.46	0.30	-1.21	-1.01	NA
<b>PCB #126</b>	-0.50	1.74	-1.27	0.13	-0.92	0.97	-0.45	0.31	NA
<b>PCB #169</b>	0.95	-0.99	-1.46	-0.53	0.01	0.97	1.30	-0.24	NA
<b>PCB #105</b>	1.43	0.15	0.16	-0.86	-1.14	1.09	0.39	-1.23	NA
<b>PCB #114</b>	0.80	0.61	0.20	-0.67	-0.59	1.46	-0.08	-1.73	NA
<b>PCB #118</b>	-0.15	-0.90	1.27	-1.25	0.19	1.04	0.85	-1.06	NA
<b>PCB #123</b>	1.88	-0.31	-0.08	-0.18	-1.05	0.32	0.70	-1.27	NA
<b>PCB #156</b>	2.20	0.19	-0.29	-0.52	-0.57	-0.16	0.31	-1.16	NA
<b>PCB #157</b>	0.95	0.96	-1.86	-0.33	0.70	0.59	-0.12	-0.88	NA
<b>PCB #167</b>	1.00	1.52	0.24	-0.72	-1.40	-0.18	0.49	-0.95	NA
<b>PCB #189</b>	0.20	1.83	-0.17	-0.81	0.27	-0.81	0.76	-1.28	NA

From Tables 1.6 to 1.10 absolute z-score were calculated and the sum of absolute z-scores was calculated for both the WHO PCBs and the 'marker' PCBs. The average z-score per group were calculated and the sums of all groups except for the marker PCBs in Extract 1 were calculated in Table 1.11. The data of the marker PCBs of Extract 1 were not further validated due to the limited number of triplicate analysis or data submitted by the laboratories.

## 2.4 Conclusion

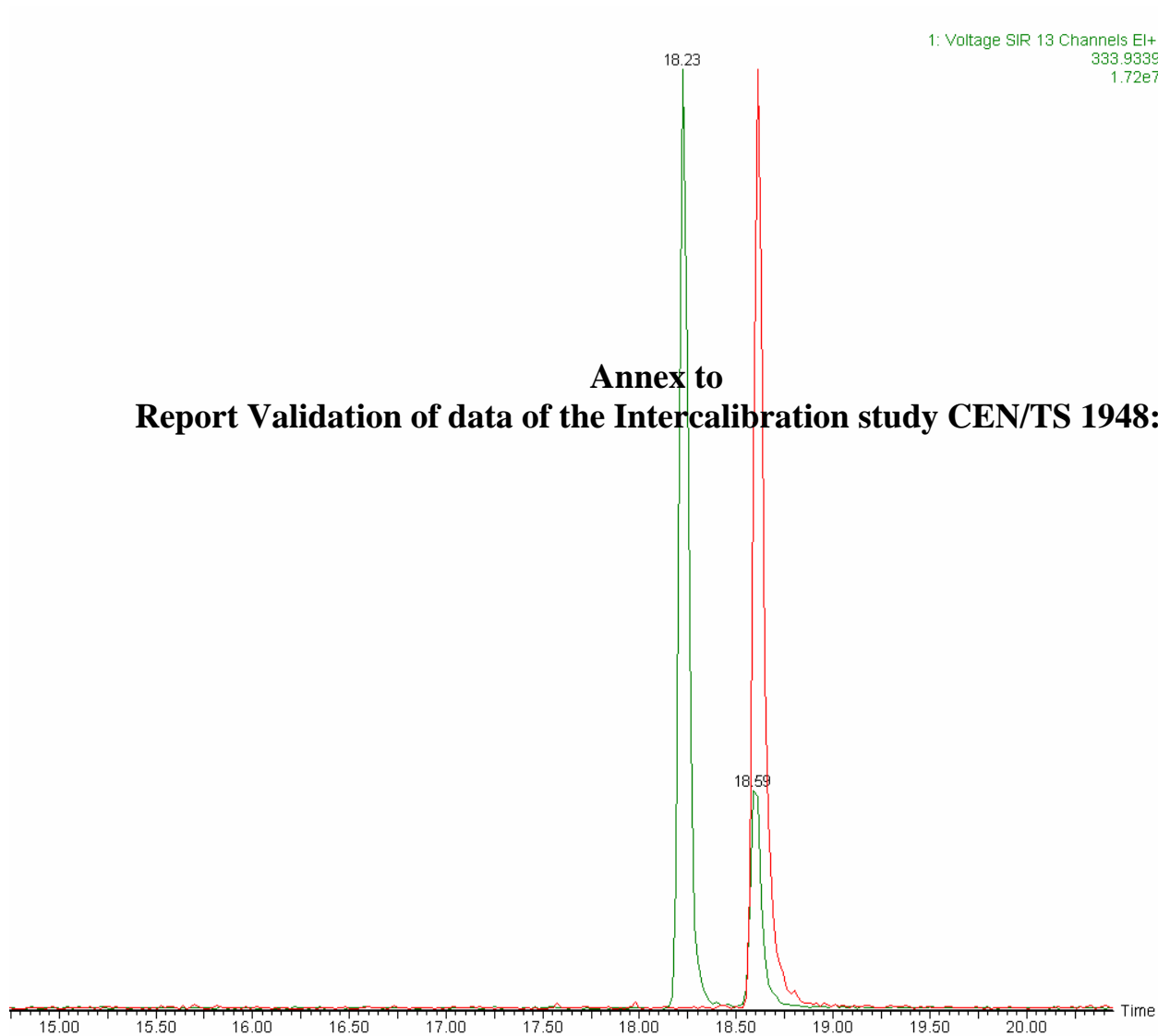
The scores of all laboratories are given in Table 1.12. The majority of the laboratories performed very well showing very good z-scores and would qualify in normal QA/QC studies. The results from the first 4 laboratories are considered to be excellent with average z-score below 1.

Table 1.11. Scores calculated from the absolute z-scores for each sample

	Laboratory Code								
<b>Ash 1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
<b>WHO PCB</b>									
Total Score	8.00	9.93	9.37	7.17	20.73	12.32	14.38	8.62	NA
Absolute z-score	0.67	0.83	0.78	0.60	1.73	1.03	1.20	0.72	NA
<b>Marker PCB</b>									
Total Score	3.41	4.09	5.34	6.04	7.30	5.31	179.88	2.15	NA
Absolute z-score	0.57	0.68	0.89	1.01	1.22	0.88	29.98	0.36	NA
<b>Ash 2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
<b>WHO PCB</b>									
Total Score	5.36	7.00	4.24	10.78	7.23	17.18	8.15	14.56	NA
Absolute z-score	0.45	0.58	0.35	0.90	0.60	1.43	0.68	1.21	NA
<b>Marker PCB</b>									
Total Score	5.86	3.74	4.70	4.91	3.95	5.63	300.37	19.43	NA
Absolute z-score	0.98	0.62	0.78	0.82	0.66	0.94	50.06	3.24	NA
<b>Extract 1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
<b>WHO PCB</b>									
Total Score	5.89	3.78	5.72	6.39	18.48	10.84	12.59	7.76	NA
Absolute z-score	0.49	0.31	0.48	0.53	1.54	0.90	1.05	0.65	NA
<b>Standard 1</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
<b>WHO PCB</b>									
Total Score	13.16	7.96	7.13	7.53	12.05	6.15	3.42	25.65	NA
Absolute z-score	1.10	0.66	0.59	0.63	1.00	0.51	0.28	2.14	NA
<b>Standard 2</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>
Total Score	10.99	11.03	7.63	8.36	7.51	8.17	8.80	11.42	NA
Absolute z-score	0.92	0.92	0.64	0.70	0.63	0.68	0.73	0.95	NA
<b>Sum Total Score</b>	<b>52.66</b>	<b>47.52</b>	<b>44.14</b>	<b>51.18</b>	<b>77.24</b>	<b>65.60</b>	<b>527.60</b>	<b>89.60</b>	<b>NA</b>
<b>Sum Absolute z-scores</b>	<b>5.16</b>	<b>4.61</b>	<b>4.52</b>	<b>5.18</b>	<b>7.37</b>	<b>6.38</b>	<b>83.99</b>	<b>9.26</b>	<b>NA</b>

Table 1.12. Laboratory score intercalibration CEN /TC 264/WG

Lab code	Score	Lab code	Score
<b>1</b>	<b>5.16</b>	<b>3</b>	<b>4.52</b>
<b>2</b>	<b>4.61</b>	<b>2</b>	<b>4.61</b>
<b>3</b>	<b>4.52</b>	<b>1</b>	<b>5.16</b>
<b>4</b>	<b>5.18</b>	<b>4</b>	<b>5.18</b>
<b>5</b>	<b>7.37</b>	<b>6</b>	<b>6.38</b>
<b>6</b>	<b>6.38</b>	<b>5</b>	<b>7.37</b>
<b>7</b>	<b>83.99</b>	<b>8</b>	<b>9.26</b>
<b>8</b>	<b>9.26</b>	<b>7</b>	<b>83.99</b>
<b>9</b>	<b>NA</b>	<b>9</b>	<b>NA</b>



**Annex to  
Report Validation of data of the Intercalibration study CEN/TS 1948:4**

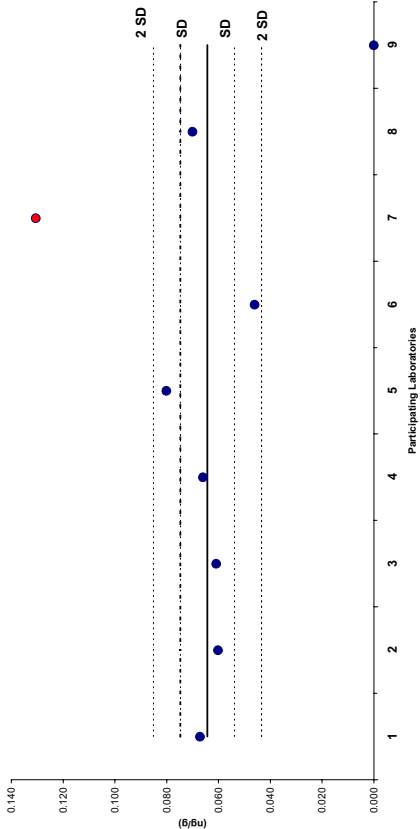
Bert van Bavel  
March 2007

Laboratory	Non-Ortho PCBs (ng/g)									
	PCB #77	n	PCB #81	n	PCB #126	n	PCB #169	n		
1	0.067	2	0.036	2	0.073	2	0.036	2		
2	0.060	3	0.037	3	0.074	3	0.040	3		
3	0.061	3	0.031	3	0.073	3	0.030	3		
4	0.066	3	0.032	3	0.066	3	0.020	3		
5	0.080	2	0.038	2	0.076	2	0.035	2		
6	0.046	1	0.032	1	0.058	1	0.011	1		
7	0.130	1	0.036	1	0.068	1	0.034	1		
8	0.070	1	0.038	1	0.085	1	0.040	1		
9	NR		NR		NR		NR			
Average	0.073	8	0.035	8	0.071	8	0.031	8		
Median	0.067	8	0.036	8	0.073	8	0.035	8		
Min	0.046	8	0.031	8	0.058	8	0.011	8		
Max	0.13	8	0.04	8	0.09	8	0.04	8		
SD	0.025	8	0.003	8	0.008	8	0.010	8		
%RSD	35%	8	8%	8	11%	8	33%	8		

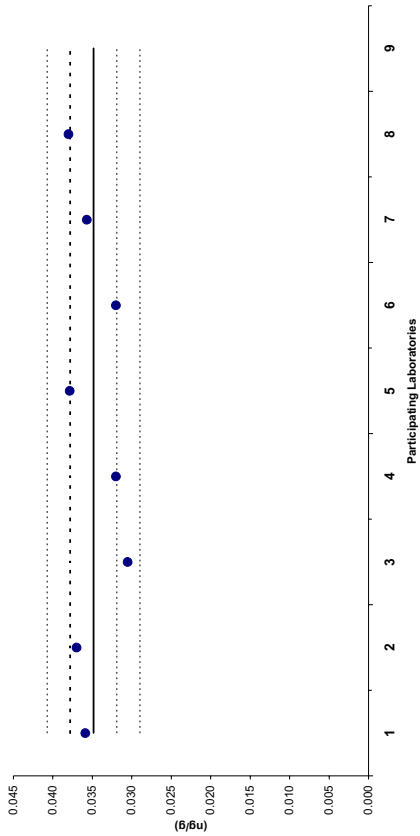
Laboratory	Mono-Ortho PCBs (ng/g)									
	PCB #105	n	PCB #114	n	PCB #118	n	PCB #123	n	PCB #156	n
1	0.045	2	0.012	2	0.083	2	0.029	2	0.022	2
2	0.039	3	0.014	3	0.059	3	0.007	3	0.024	3
3	0.057	3	0.024	3	0.099	3	<0.022	3	0.027	3
4	0.081	3	0.016	3	0.180	3	0.019	3	0.027	3
5	0.111	2	0.018	2	0.286	2	0.040	2	0.030	2
6	0.097	1	0.014	1	0.170	1	0.011	1	0.032	1
7	0.133	1	0.018	1	0.290	1	0.015	1	0.021	1
8	0.060	1	0.016	1	0.125	1	0.028	1	0.025	1
9	NR		NR		NR		NR		NR	
Average	0.078	8	0.017	8	0.162	8	0.021	8	0.026	8
Median	0.071	8	0.016	8	0.148	8	0.019	8	0.026	8
Min	0.039	8	0.012	8	0.059	8	0.007	8	0.020	8
Max	0.13	8	0.02	8	0.29	8	0.04	8	0.03	8
SD	0.033	8	0.004	8	0.088	8	0.012	8	0.003	8
%RSD	43%	8	23%	8	55%	8	55%	8	13%	8
									26%	8
									8%	8

Laboratory	Marker PCBs (ng/g)											
	PCB #28	n	PCB #52	n	PCB #101	n	PCB #153	n	PCB #138	n	PCB #180	n
1	0.235	2	0.246	2	0.378	2	0.291	2	0.121	2	0.062	2
2	< 0.33	3	< 0.33	3	< 0.33	3	< 0.33	3	< 0.33	3	< 0.33	3
3	0.193	3	0.096	3	0.120	3	0.174	3	0.141	3	0.097	3
4	0.150	3	0.090	3	0.410	3	0.580	3	0.430	3	0.300	3
5	0.414	2	0.442	2	0.495	2	0.487	2	0.432	2	0.246	2
6	0.110	1	0.060	1	0.210	1	0.460	1	0.440	1	0.240	1
7	13.865	1	6.871	1	1.065	1	0.249	1	0.153	1	0.060	1
8	0.260	1	0.306	1	0.265	1	0.264	1	0.268	1	0.155	1
9	NR		NR		NR		NR		NR		NR	
Average	2.175	8	1.159	8	0.420	8	0.358	8	0.284	8	0.166	8
Median	0.235	8	0.246	8	0.378	8	0.291	8	0.268	8	0.155	8
Min	0.110	8	0.060	8	0.120	8	0.174	8	0.121	8	0.060	8
Max	13.87	8	6.87	8	1.07	8	0.58	8	0.44	8	0.30	8
SD	5.156	8	2.523	8	0.312	8	0.150	8	0.148	8	0.097	8
%RSD	237%	8	218%	8	74%	8	42%	8	52%	8	59%	8

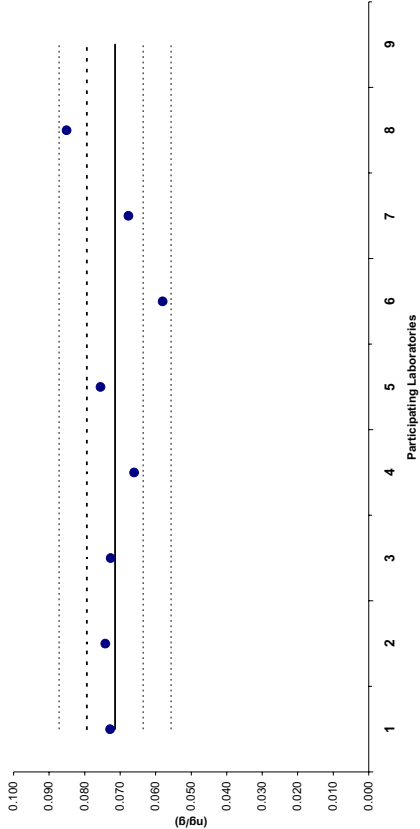
PCB #77 Ash 1 (RSD 16 %, n = 7)



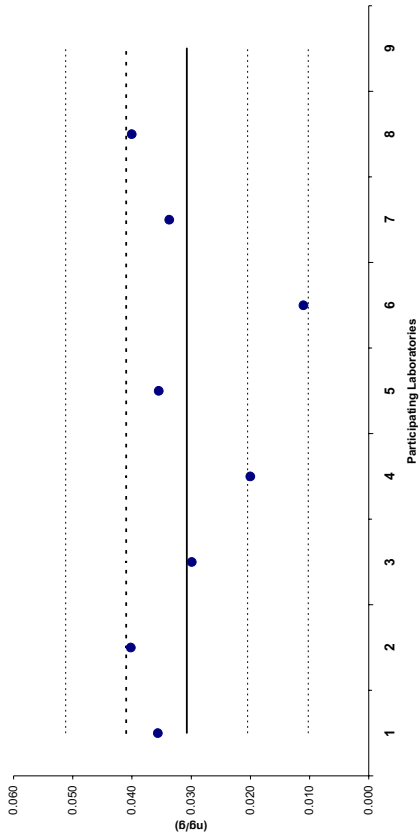
PCB #81 Ash 1 (RSD 8 %, n = 8)



PCB #126 Ash 1 (RSD 11 %, n = 8)

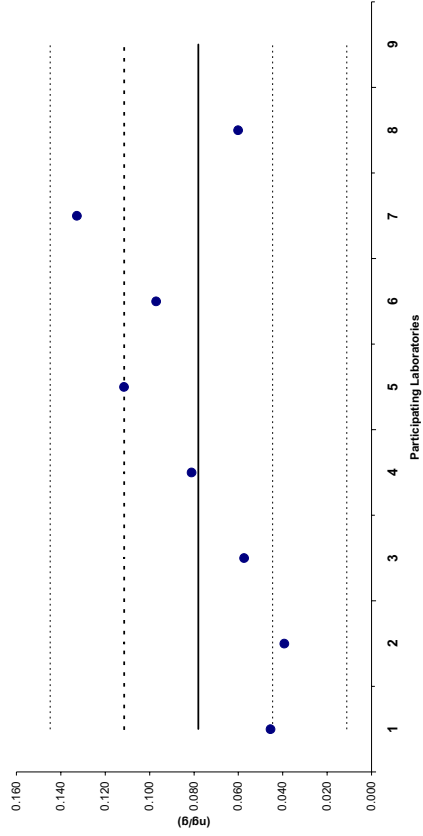


PCB #169 Ash 1 (RSD 33 %, n = 8)

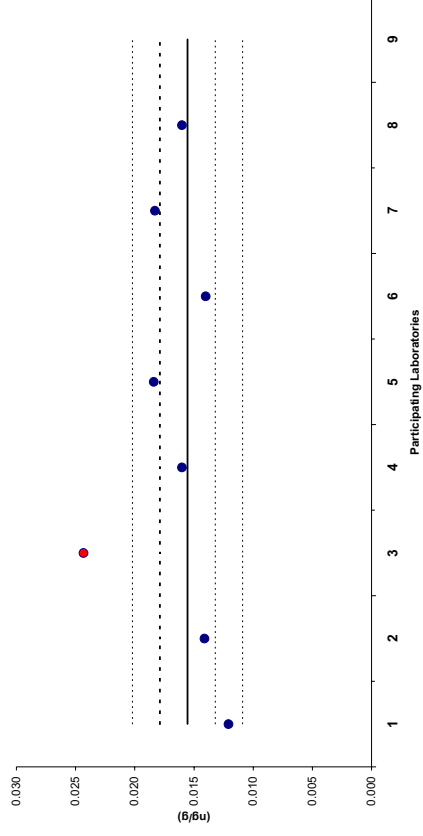




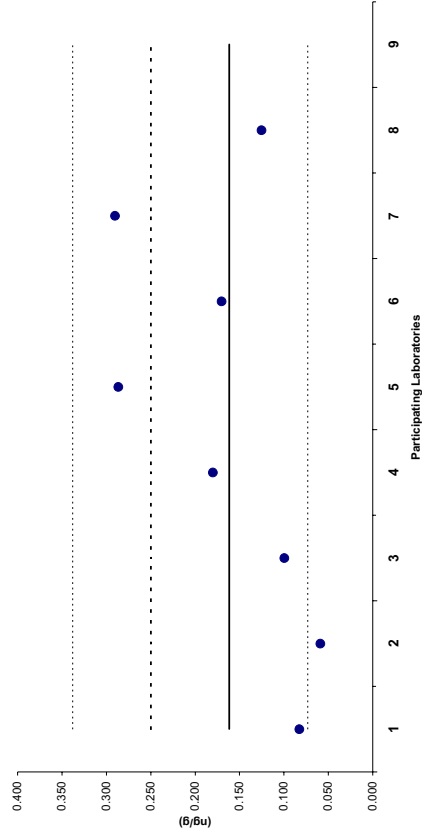
PCB #105 Ash 1 (RSD 43 %, n = 8)



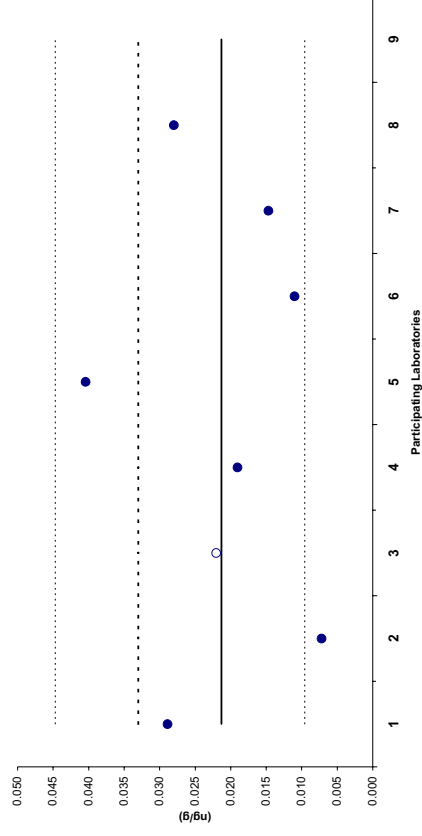
PCB #114 Ash 1 (RSD 15 %, n = 7)



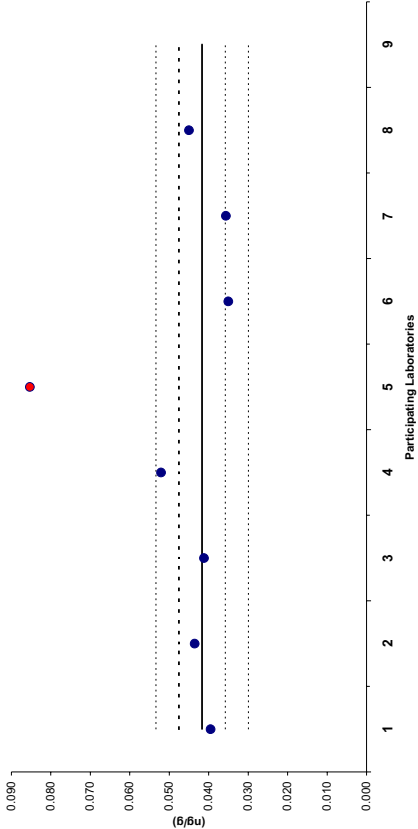
PCB #118 Ash 1 (RSD 55 %, n = 8)



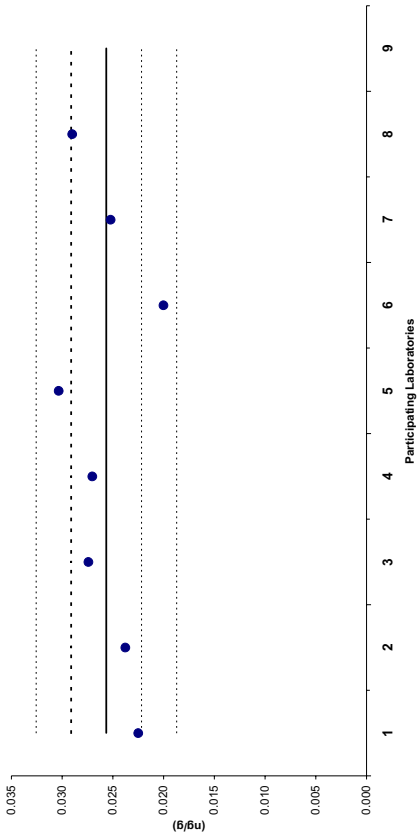
PCB #123 Ash 1 (RSD 55 %, n = 8)



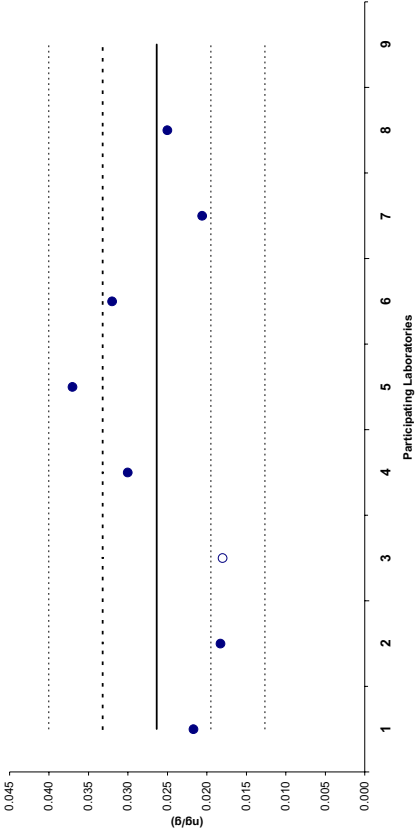
PCB #156 Ash 1 (RSD 14 %, n = 7)



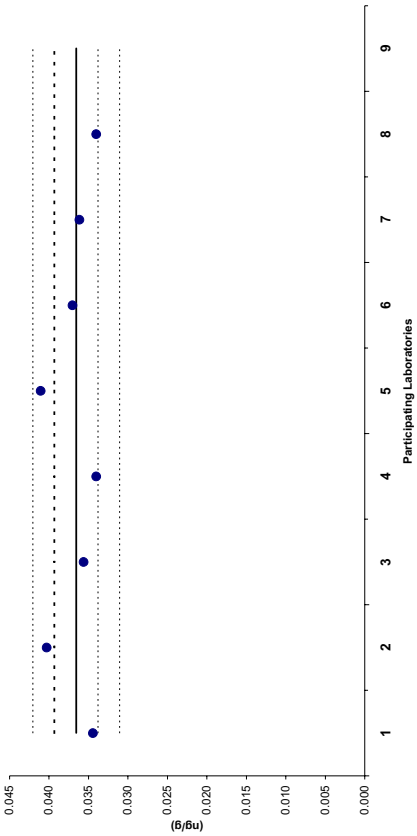
PCB #157 Ash 1 (RSD 13 %, n = 8)



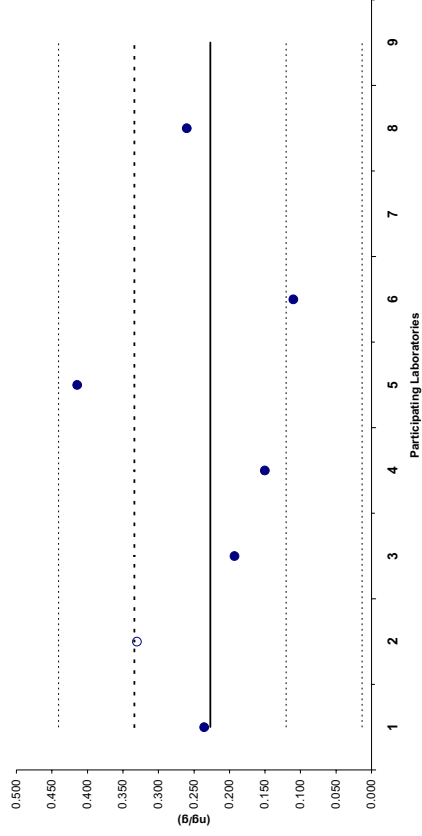
PCB #167 Ash 1 (RSD 26 %, n = 8)



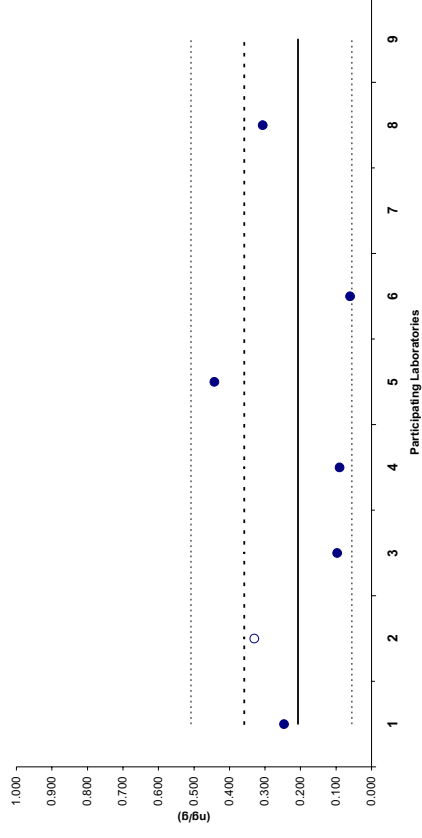
PCB #189 Ash 1 (RSD 8 %, n = 8)



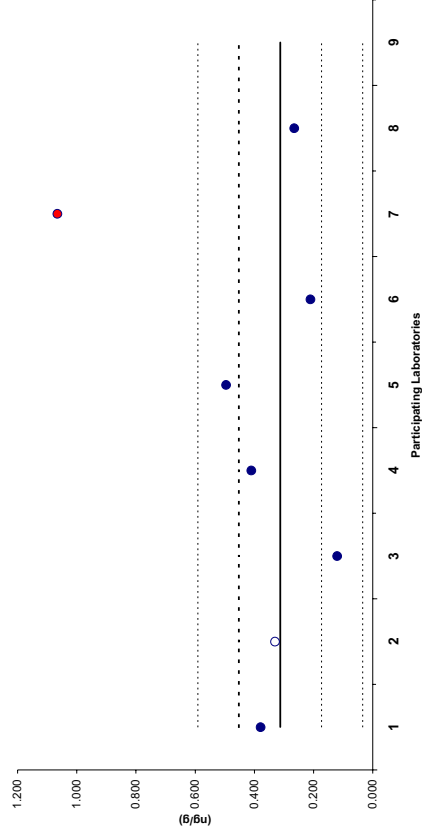
PCB #28 Ash 1 (RSD 47 %, n = 7)



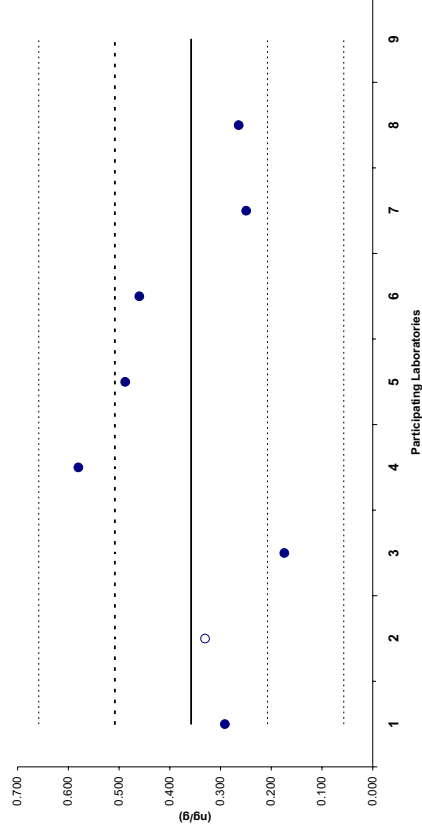
PCB #52 Ash 1 (RSD 73 %, n = 7)



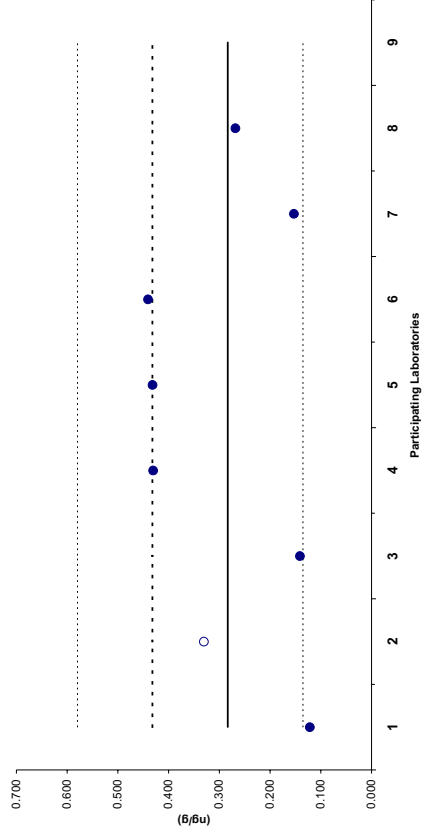
PCB #101 Ash 1 (RSD 44 %, n = 7)



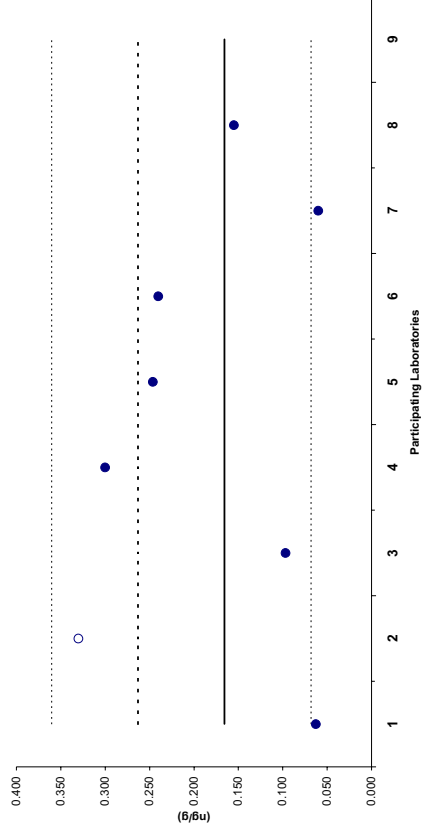
PCB #153 Ash 1 (RSD 42 %, n = 8)



PCB #138 Ash 1 (RSD 52 %, n = 8)



PCB #180 Ash 1 (RSD 59 %, n = 8)

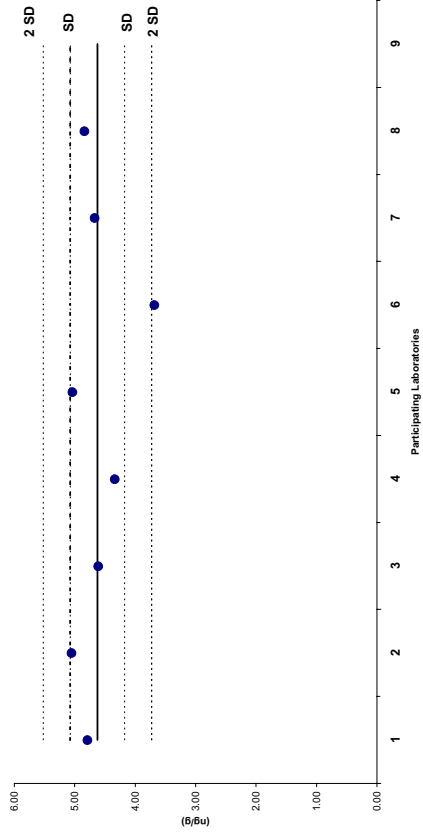


Laboratory	Non-Ortho PCBs (ng/g)									
	PCB #77	n	PCB #81	n	PCB #126	n	PCB #169	n		
1	4.790	3	0.846	3	4.673	3	2.023	3		
2	5.051	3	0.900	3	5.434	3	2.238	3		
3	4.608	3	0.840	3	5.376	3	2.005	3		
4	4.336	3	0.780	3	4.516	3	1.633	3		
5	5.038	2	0.902	2	5.377	2	2.192	2		
6	3.680	1	0.580	1	4.100	1	1.740	1		
7	4.667	1	0.728	1	4.507	1	2.445	1		
8	4.840	1	0.940	1	6.800	1	2.530	1		
9	NR		NR		NR		NR			
Average	4.63	8	0.81	8	5.10	8	2.10	8		
Median	4.73	8	0.84	8	5.02	8	2.11	8		
Min	3.68	8	0.58	8	4.10	8	1.63	8		
Max	5.05	8	0.94	8	6.80	8	2.53	8		
SD	0.45	8	0.12	8	0.85	8	0.31	8		
%RSD	10%	8	14%	8	17%	8	15%	8		

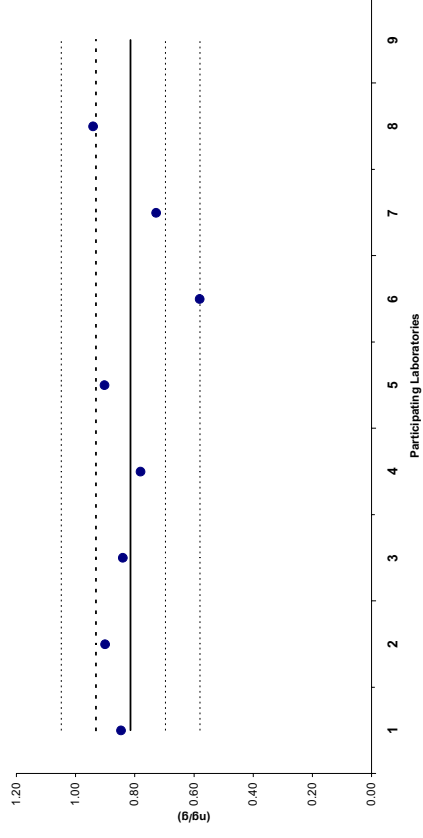
Laboratory	Mono-Ortho PCBs (ng/g)																	
	PCB #105	n	PCB #114	n	PCB #118	n	PCB #123	n	PCB #156	n	PCB #157	n	PCB #167	n	PCB #189	n		
1	1.927	3	0.446	3	1.417	3	1.253	3	2.389	3	1.251	3	1.042	3	2.004	3		
2	1.927	3	0.464	3	1.986	3	0.319	3	2.791	3	1.398	3	1.110	3	2.427	3		
3	1.847	3	0.430	3	2.088	3	0.278	3	2.502	3	1.359	3	0.986	3	2.164	3		
4	1.596	3	0.380	3	1.625	3	0.281	3	2.154	3	1.047	3	0.856	3	1.809	3		
5	2.122	2	0.474	2	1.912	2	1.392	2	2.803	2	1.374	2	1.094	2	2.335	2		
6	1.200	1	0.580	1	1.720	1	0.300	1	2.040	1	0.920	1	0.830	1	1.400	1		
7	1.984	1	0.504	1	2.381	1	0.291	1	2.205	1	1.134	1	0.902	1	1.876	1		
8	2.610	1	0.520	1	2.150	1	1.100	1	2.920	1	1.430	1	1.310	1	2.550	1		
9	NR		NR		NR		NR		NR		NR		NR		NR			
Average	1.90	8	0.47	8	1.91	8	0.65	8	2.48	8	1.24	8	1.02	8	2.07	8		
Median	1.93	8	0.47	8	1.95	8	0.31	8	2.45	8	1.30	8	1.01	8	2.08	8		
Min	1.20	8	0.38	8	1.42	8	0.28	8	2.04	8	0.92	8	0.83	8	1.40	8		
Max	2.61	8	0.58	8	2.38	8	1.39	8	2.92	8	1.43	8	1.31	8	2.55	8		
SD	0.40	8	0.06	8	0.31	8	0.50	8	0.33	8	0.19	8	0.16	8	0.38	8		
%RSD	21%	8	13%	8	16%	8	77%	8	13%	8	15%	8	16%	8	18%	8		

Laboratory	Marker PCBs (ng/g)											
	PCB #28	n	PCB #52	n	PCB #101	n	PCB #153	n	PCB #138	n	PCB #180	n
1	0.474	3	0.448	3	0.674	3	0.315	3	0.746	3	0.782	3
2	0.427	3	0.367	3	0.355	3	0.723	3	1.270	3	1.962	3
3	0.290	3	0.145	3	0.297	3	0.536	3	0.982	3	1.485	3
4	0.190	3	0.220	3	0.800	3	1.210	3	1.705	3	0.900	3
5	0.553	2	0.583	2	0.812	2	0.884	2	1.272	2	1.332	2
6	0.200	1	0.170	1	0.270	1	0.680	1	1.990	1	0.840	1
7	31.824	1	14.997	1	2.730	1	1.125	1	1.321	1	1.350	1
8	1.400	1	1.630	1	1.210	1	1.100	1	2.140	1	1.700	1
9	NR		NR		NR		NR		NR		NR	
Average	4.42	8	2.32	8	0.89	8	0.82	8	1.43	8	1.29	8
Median	0.45	8	0.41	8	0.74	8	0.80	8	1.30	8	1.34	8
Min	0.19	8	0.14	8	0.27	8	0.31	8	0.75	8	0.78	8
Max	31.8	8	15.0	8	2.73	8	1.21	8	2.14	8	1.96	8
SD	11.1	8	5.1	8	0.81	8	0.31	8	0.48	8	0.43	8
%RSD	251%	8	222%	8	90%	8	38%	8	34%	8	33%	8

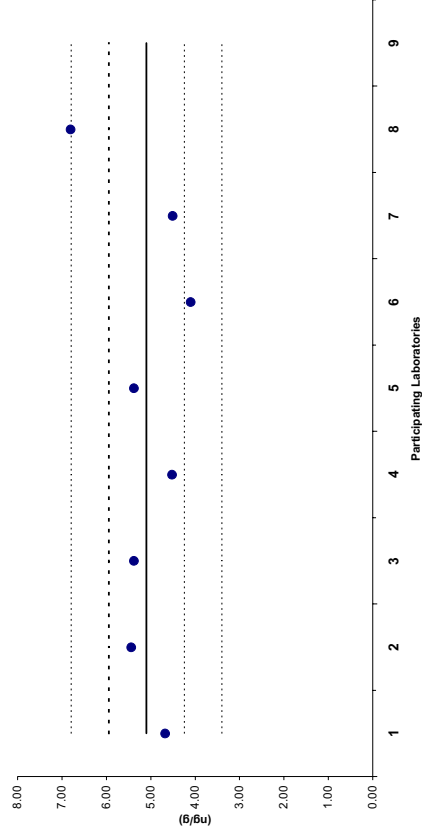
PCB #77 Ash 2 (RSD 10 %, n = 8)



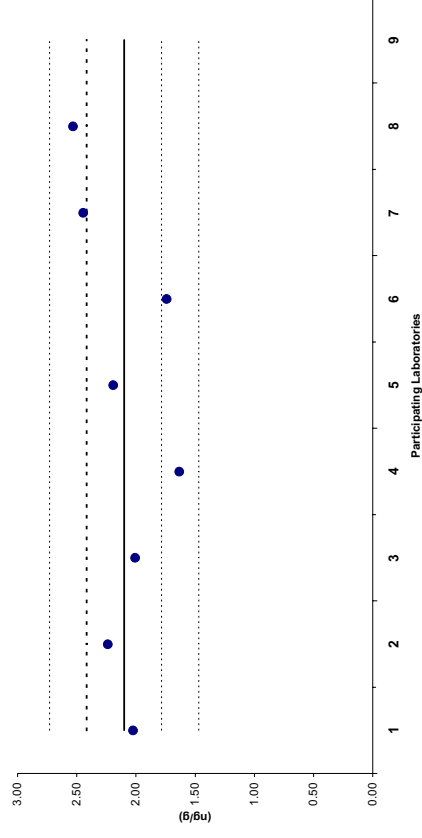
PCB #81 Ash 2 (RSD 14 %, n = 8)



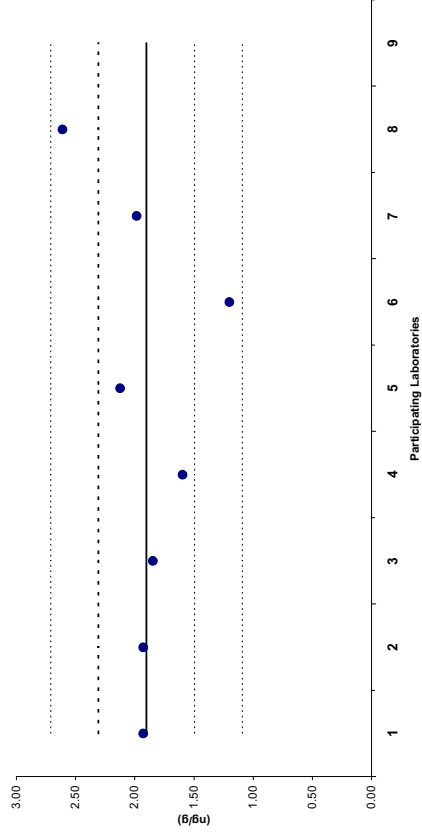
PCB #126 Ash 2 (RSD 17 %, n = 8)



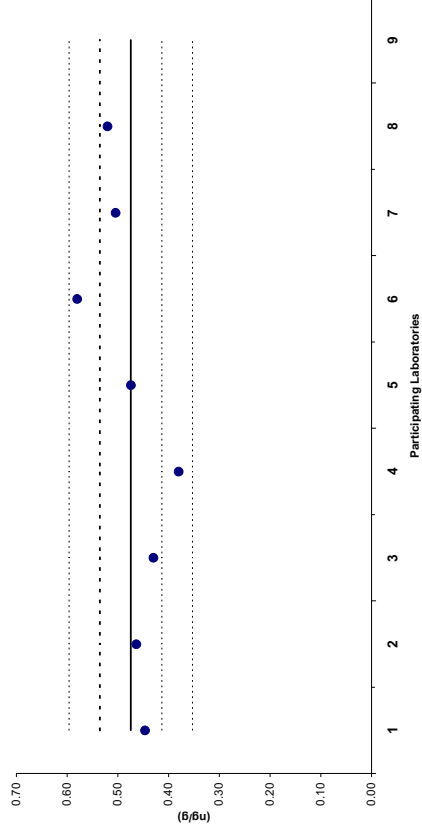
PCB #169 Ash 2 (RSD 15 %, n = 8)



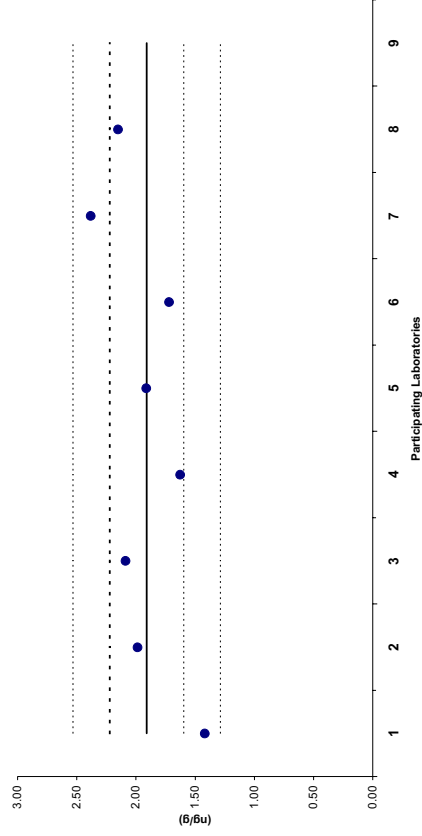
PCB #105 Ash 2 (RSD 21 %, n = 8)



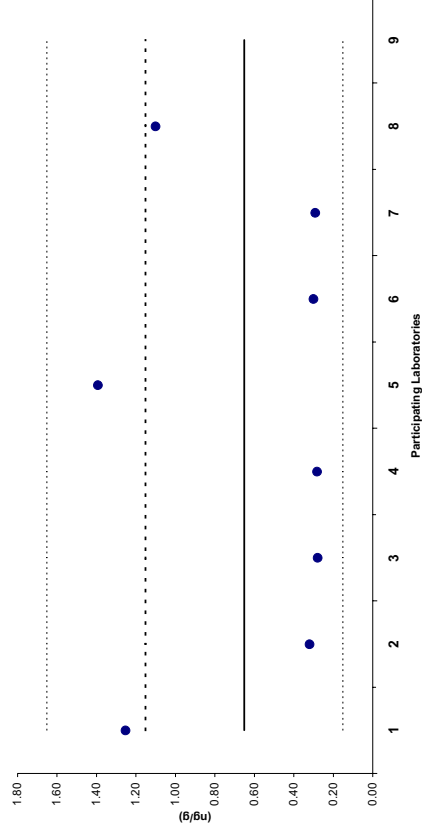
PCB #114 Ash 2 (RSD 13 %, n = 8)



PCB #118 Ash 2 (RSD 16 %, n = 8)

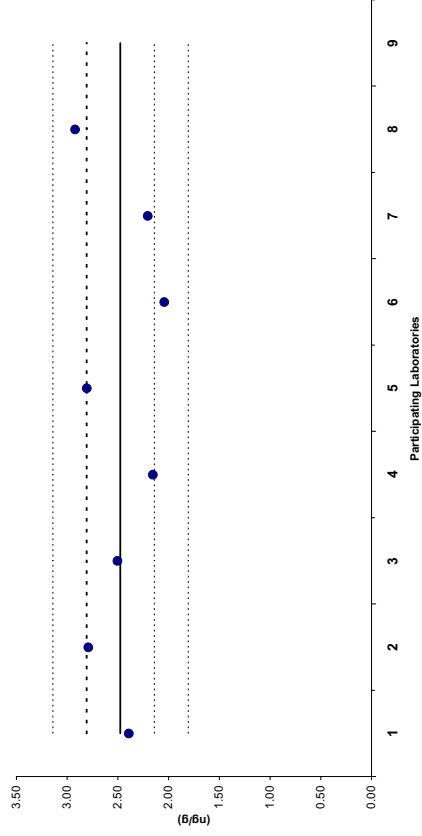


PCB #123 Ash 2 (RSD 77 %, n = 8)

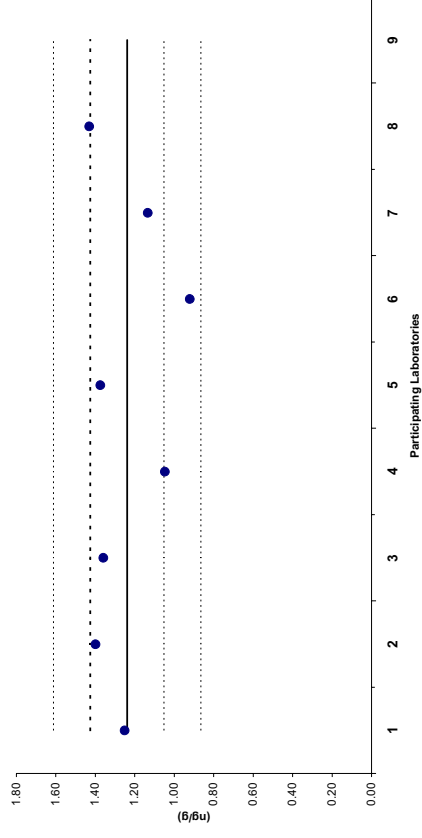




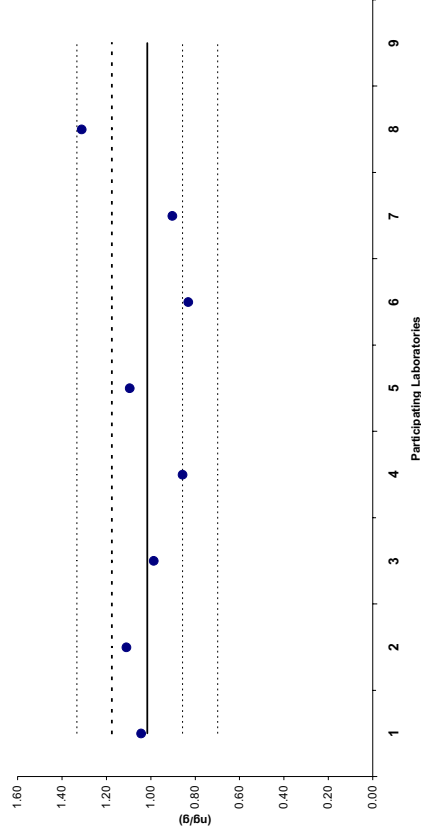
PCB #156 Ash 2 (RSD 13 %, n = 8)



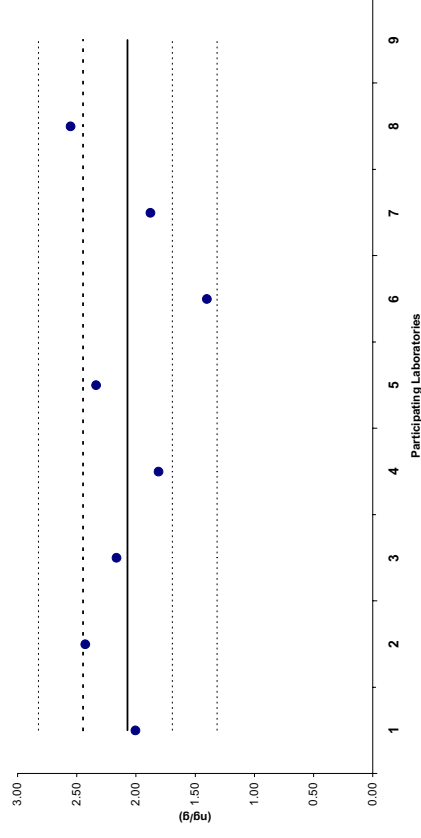
PCB #157 Ash 2 (RSD 15 %, n = 8)



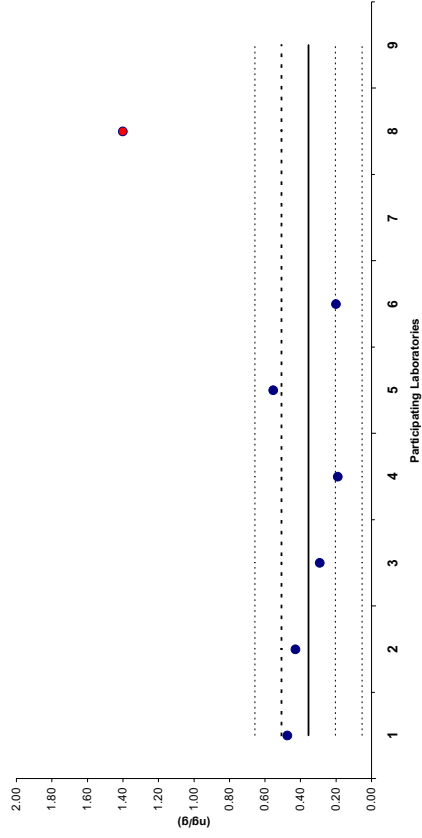
PCB #167 Ash 2 (RSD 16 %, n = 8)



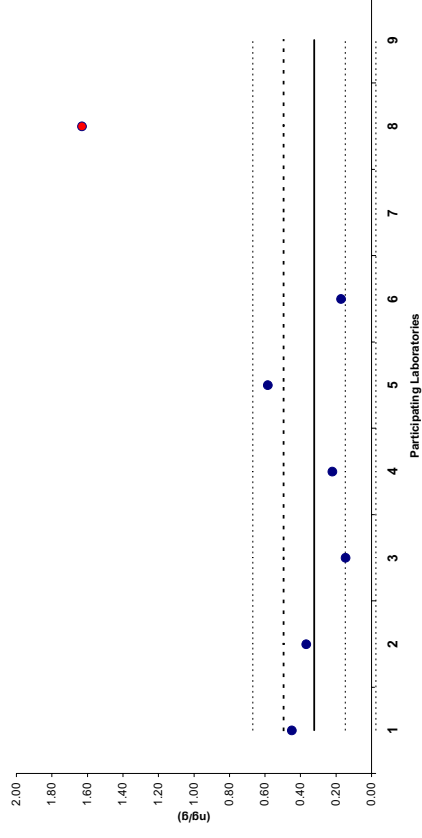
PCB #189 Ash 2 (RSD 18 %, n = 8)



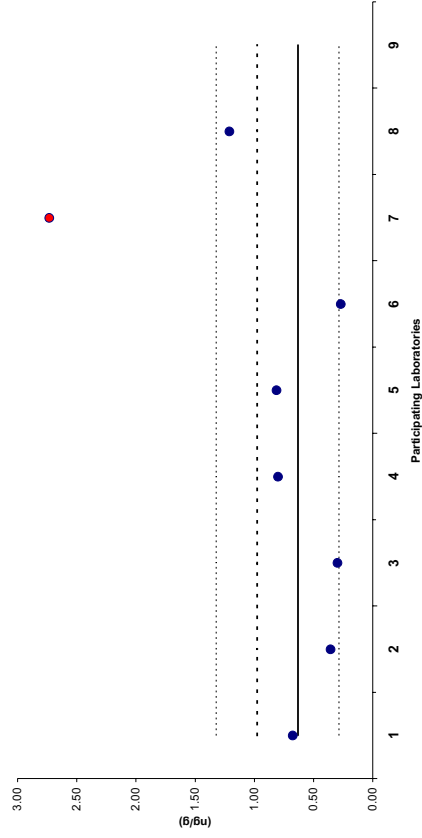
PCB #28 Ash 2 (RSD 42 %, n = 6)



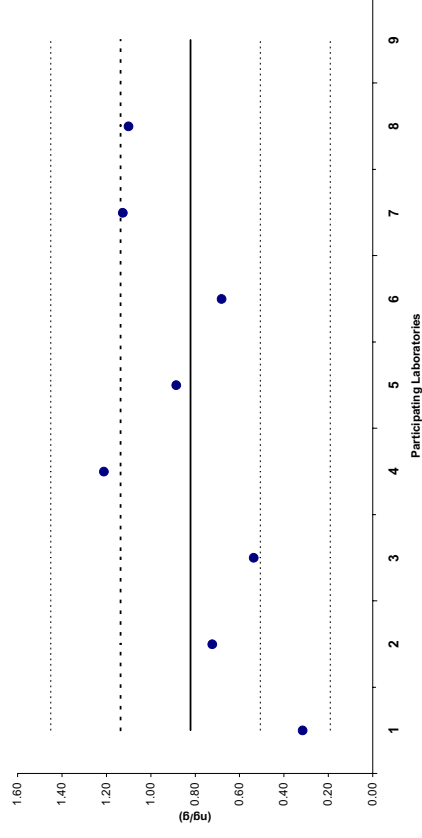
PCB #52 Ash 2 (RSD 54 %, n = 6)



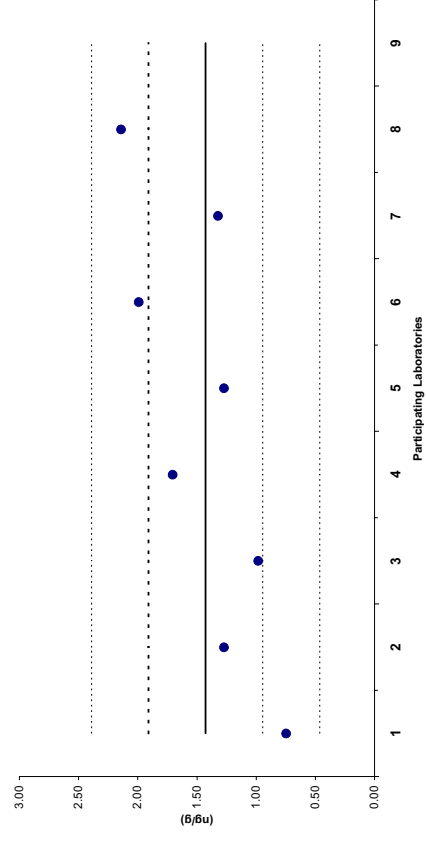
PCB #101 Ash 2 (RSD 55 %, n = 7)



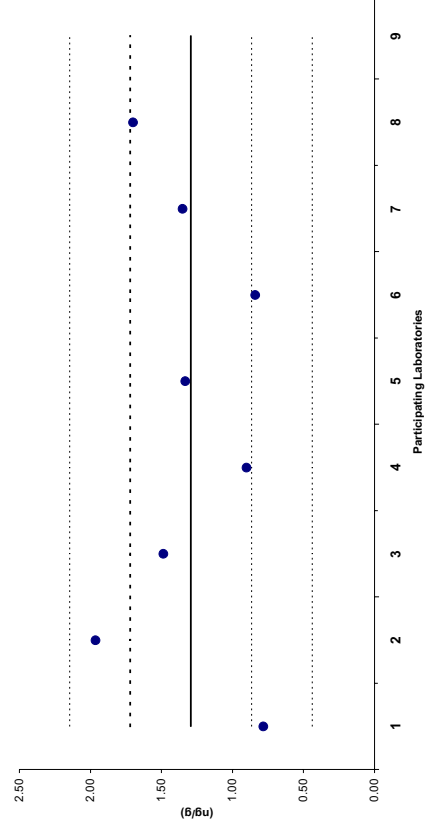
PCB #153 Ash 2 (RSD 38 %, n = 8)



PCB #138 Ash 2 (RSD 34 %, n = 8)

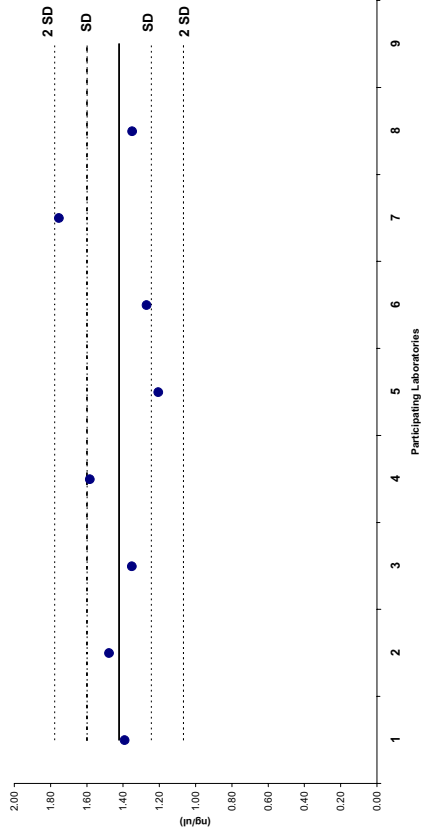


PCB #180 Ash 2 (RSD 33 %, n = 8)

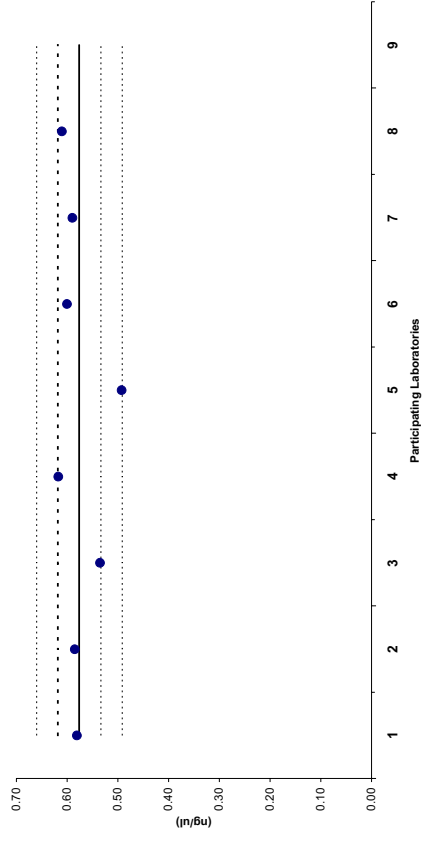




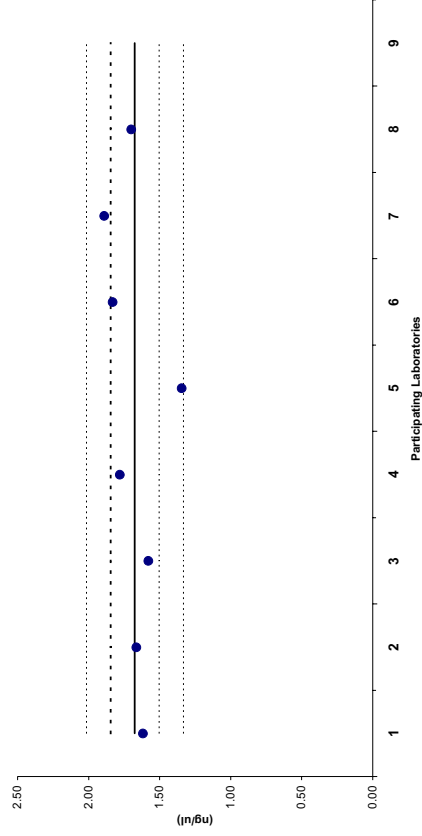
PCB #77 Extract 1 (RSD 12 %, n = 8)



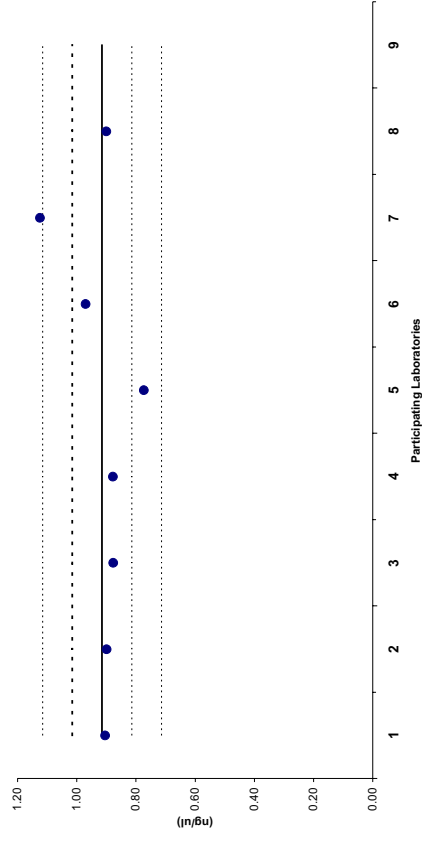
PCB #81 Extract 1 (RSD 7 %, n = 8)



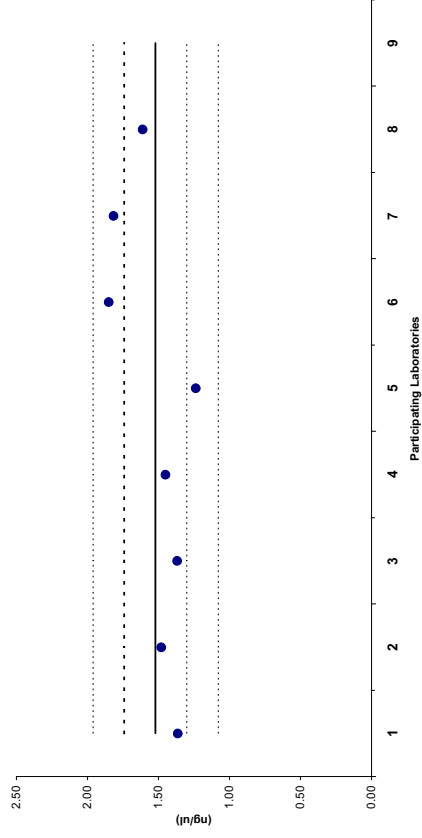
PCB #126 Extract 1 (RSD 10 %, n = 8)



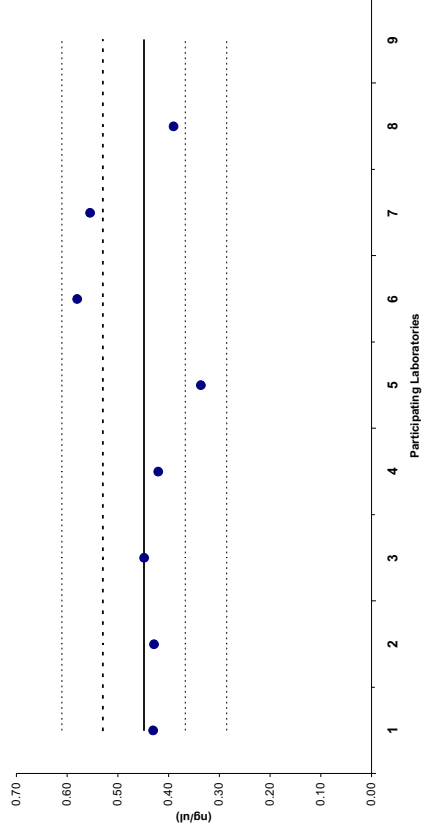
PCB #169 Extract 1 (RSD 11 %, n = 8)



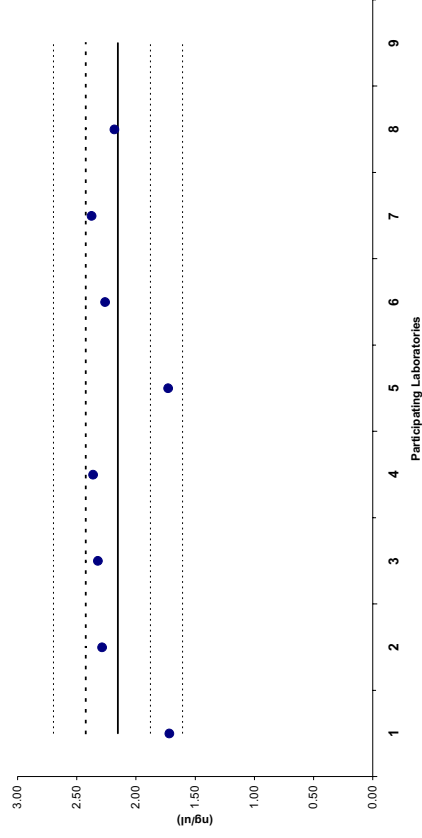
PCB #105 Extract 1 (RSD 14 %, n = 8)



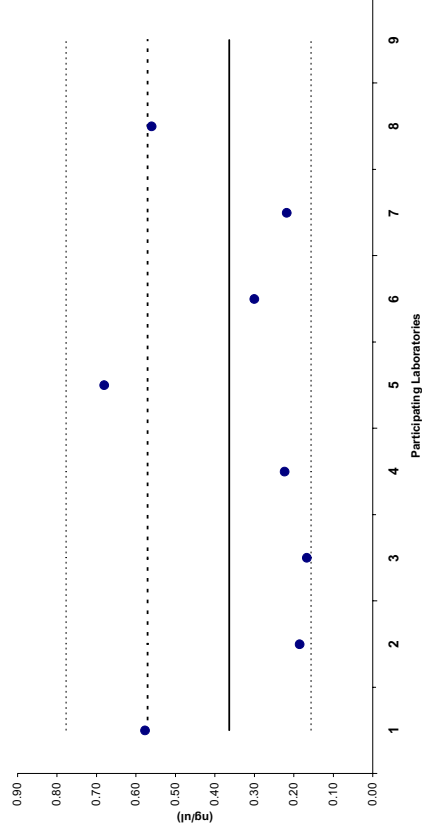
PCB #114 Extract 1 (RSD 18 %, n = 8)



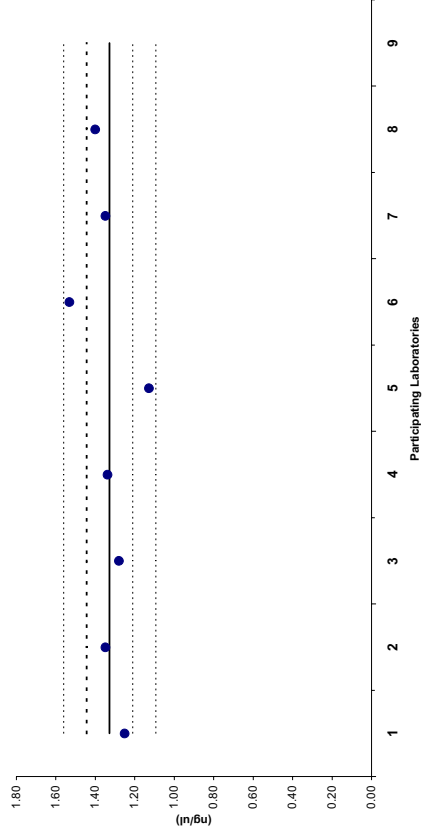
PCB #118 Extract 1 (RSD 13 %, n = 8)



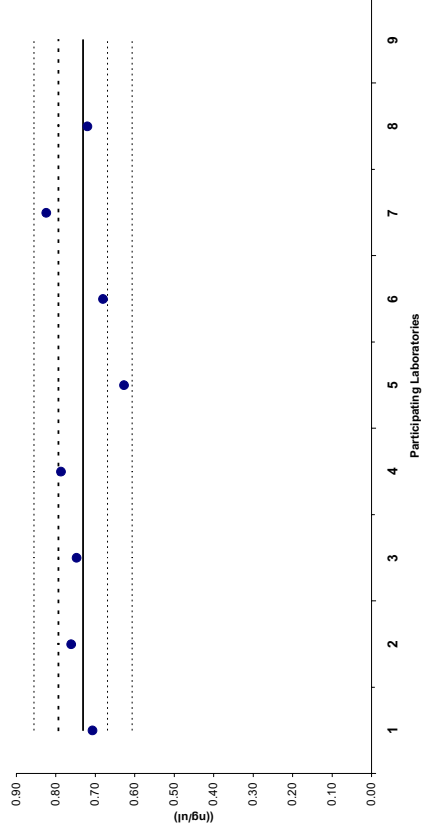
PCB #123 Extract 1 (RSD 57 %, n = 8)



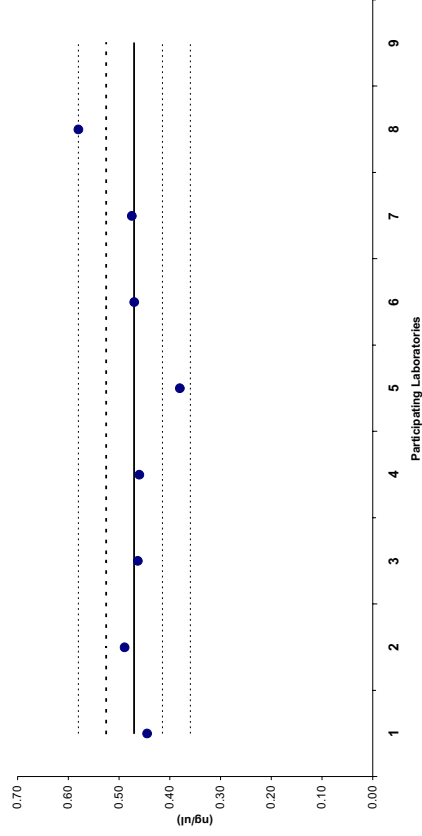
PCB #156 Extract 1 (RSD 9 %, n = 8)



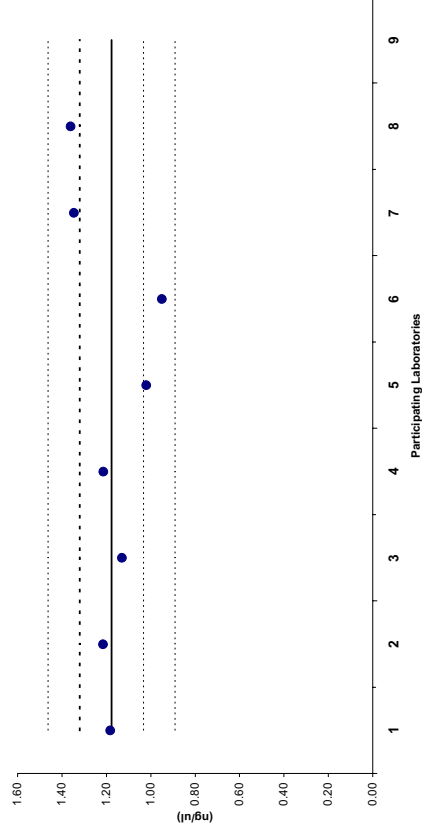
PCB #157 Extract 1 (RSD 9 %, n = 8)



PCB #167 Extract 1 (RSD 12 %, n = 8)



PCB #189 Extract 1 (RSD 12 %, n = 8)

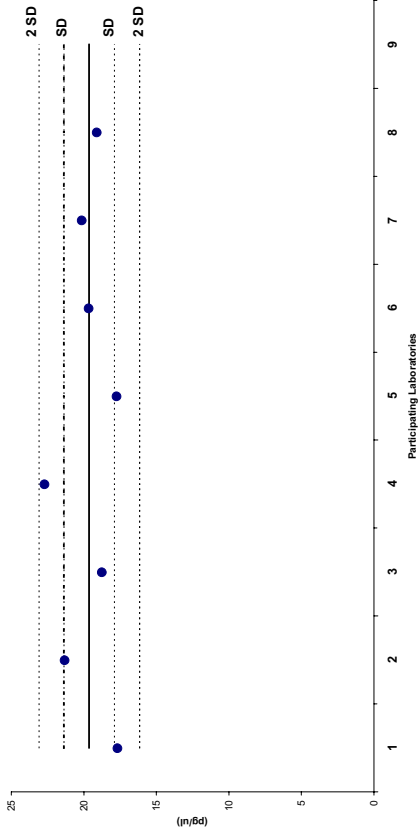


		Non-Ortho PCBs (pg/ul)									
Laboratory		PCB #77	n	PCB #81	n	PCB #126	n	PCB #169	n		
1		17.66	1	3.50	1	3.27	1	3.82	1		
2		21.32	3	4.24	3	4.32	3	4.84	3		
3		18.74	3	3.58	3	3.72	3	4.02	3		
4		22.71	3	4.42	3	4.40	3	4.41	3		
5		17.74	2	3.66	2	3.42	2	3.79	2		
6		19.67	1	3.74	1	3.71	1	3.74	1		
7		20.13	1	4.01	1	3.98	1	4.43	1		
8		19.10	1	4.70	1	4.80	1	5.60	1		
9		NR		NR		NR		NR			
Average		19.63	8	3.98	8	3.95	8	4.33	8		
Median		19.39	8	3.88	8	3.85	8	4.22	8		
Min		17.66	8	3.50	8	3.27	8	3.74	8		
Max		22.71	8	4.70	8	4.80	8	5.60	8		
SD		1.74	8	0.44	8	0.52	8	0.64	8		
%RSD		9%	8	11%	8	13%	8	15%	8		

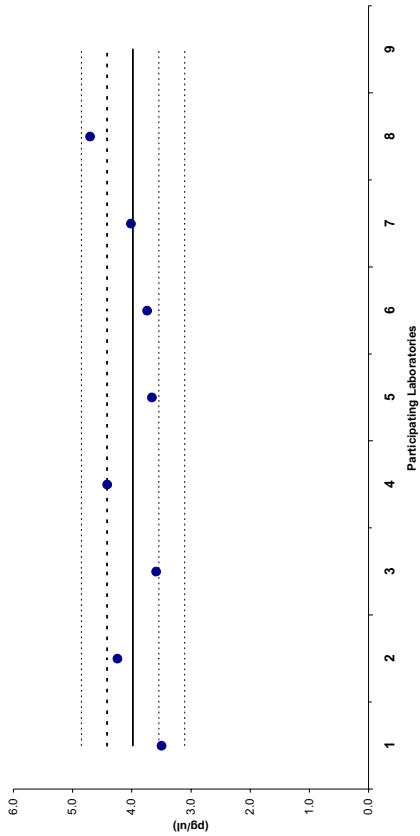
		Mono-Ortho PCBs (pg/ul)															
Laboratory		PCB #105	n	PCB #114	n	PCB #118	n	PCB #123	n	PCB #156	n	PCB #157	n	PCB #167	n	PCB #189	n
1		33.70	1	4.16	1	31.74	1	3.54	1	16.52	1	3.33	1	3.58	1	3.55	1
2		40.44	3	4.36	3	40.83	3	4.38	3	20.64	3	4.58	3	4.12	3	4.31	3
3		39.11	3	3.59	1	38.09	3	3.57	3	18.19	3	3.92	3	3.69	3	3.83	3
4		40.57	3	4.30	1	40.96	3	4.26	3	20.86	3	4.15	3	4.14	3	4.24	3
5		34.39	2	3.64	1	36.36	2	3.48	2	17.67	2	3.70	2	3.49	2	3.56	2
6		36.70	1	4.36	1	39.30	1	4.44	1	16.80	1	4.06	1	4.14	1	3.85	1
7		40.24	1	4.25	1	39.80	1	4.07	1	20.10	1	4.29	1	4.13	1	4.27	1
8		48.90	1	4.70	1	46.70	1	4.60	1	24.50	1	5.30	1	5.60	1	5.30	1
9		NR		NR		NR		NR		NR		NR		NR		NR	
Average		39.25	8	4.17	8	39.22	8	4.04	8	19.41	8	4.16	8	4.11	8	4.11	8
Median		39.67	8	4.27	8	39.55	8	4.17	8	19.14	8	4.10	8	4.13	8	4.04	8
Min		33.70	8	3.59	8	31.74	8	3.48	8	16.52	8	3.33	8	3.49	8	3.55	8
Max		48.90	8	4.70	8	46.70	8	4.60	8	24.50	8	5.30	8	5.60	8	5.30	8
SD		4.75	8	0.38	8	4.26	8	0.45	8	2.66	8	0.59	8	0.66	8	0.57	8
%RSD		12%	8	9%	8	11%	8	11%	8	14%	8	14%	8	16%	8	14%	8



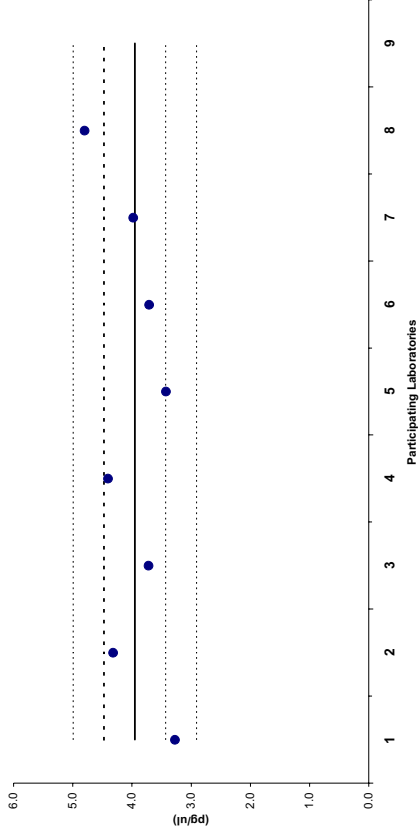
PCB #77 Standard 1 (RSD 9 %, n = 8)



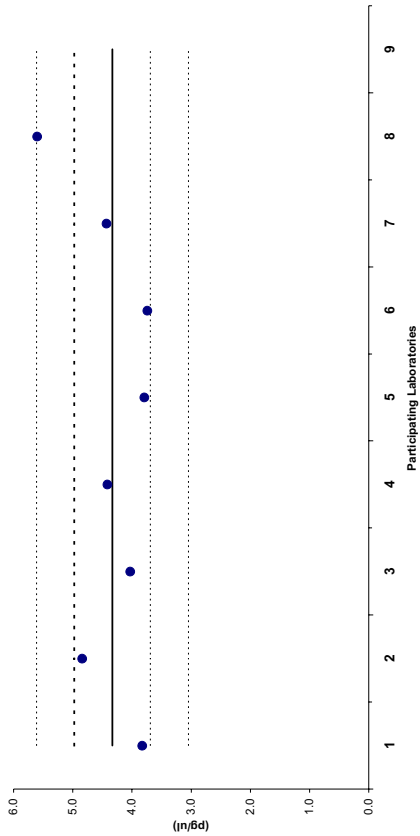
PCB #81 Standard 1 (RSD 11 %, n = 8)



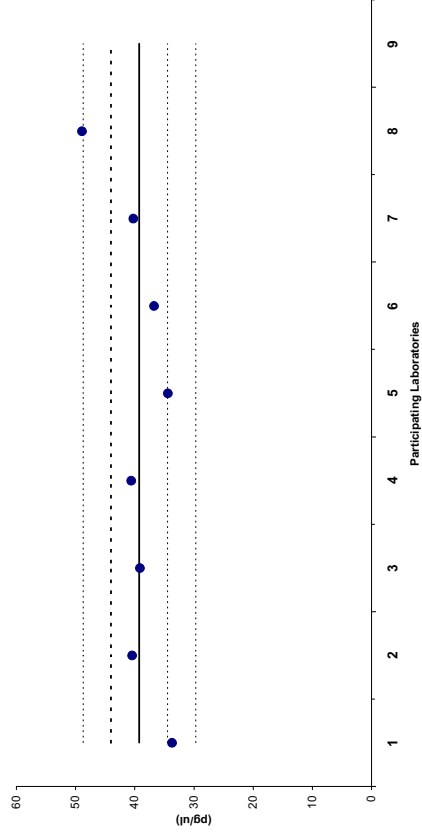
PCB #126 Standard 1 (RSD 13 %, n = 8)



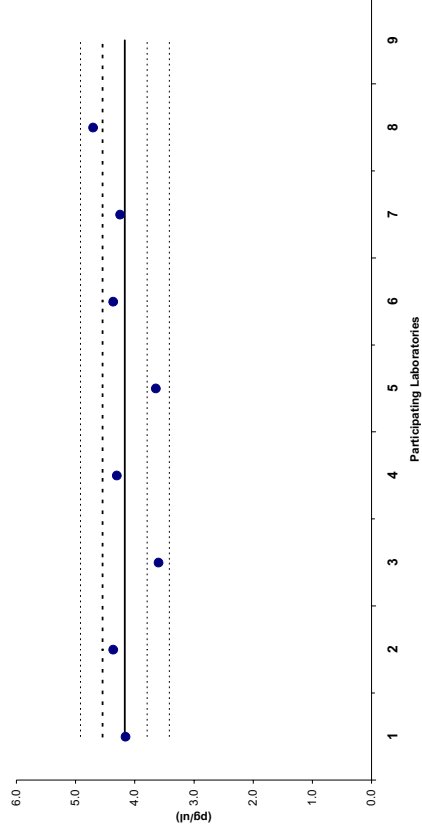
PCB #169 Standard 1 (RSD 15 %, n = 8)



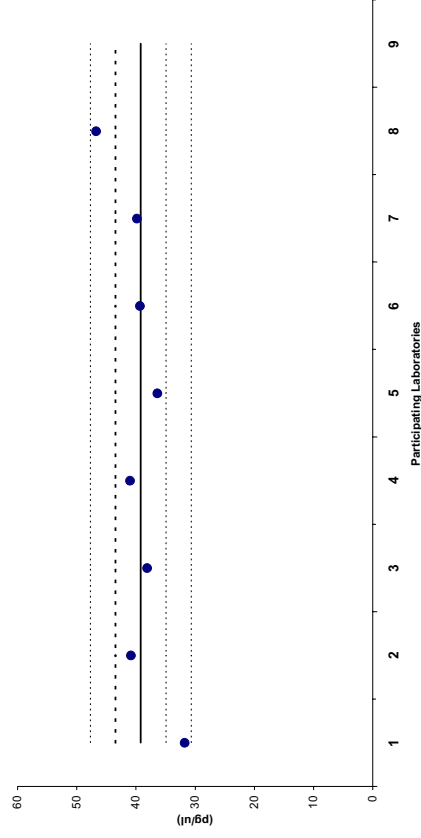
PCB #105 Standard 1 (RSD 12 %, n = 8)



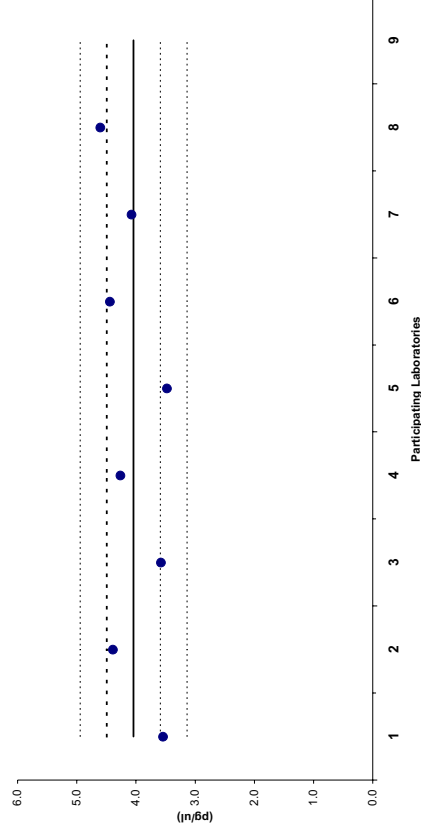
PCB #114 Standard 1 (RSD 9 %, n = 8)



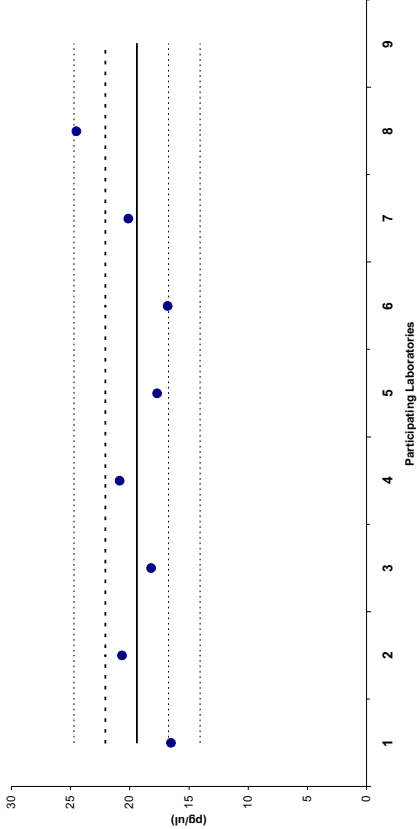
PCB #118 Standard 1 (RSD 11 %, n = 8)



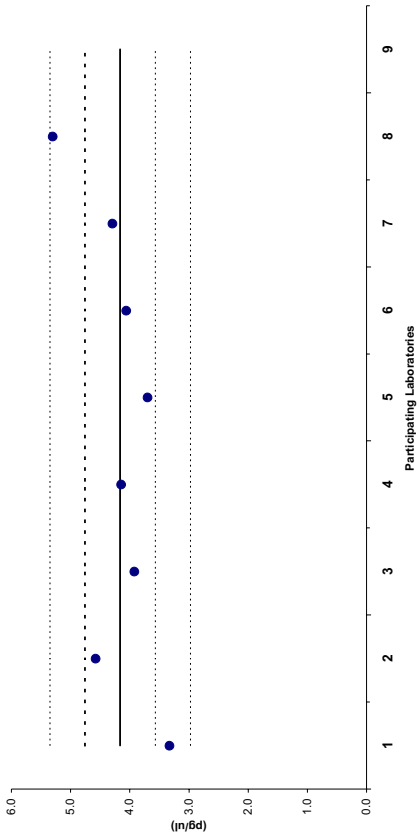
PCB #123 Standard 1 (RSD 11 %, n = 8)



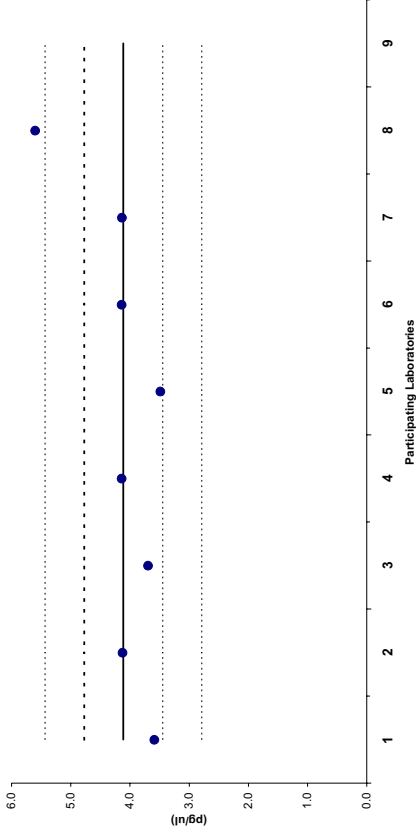
PCB #156 Standard 1 (RSD 14 %, n = 8)



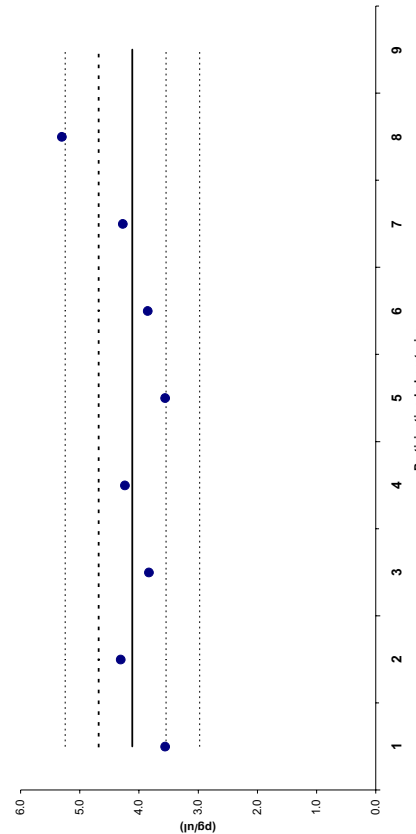
PCB #157 Standard 1 (RSD 14 %, n = 8)



PCB #167 Standard 1 (RSD 16 %, n = 8)



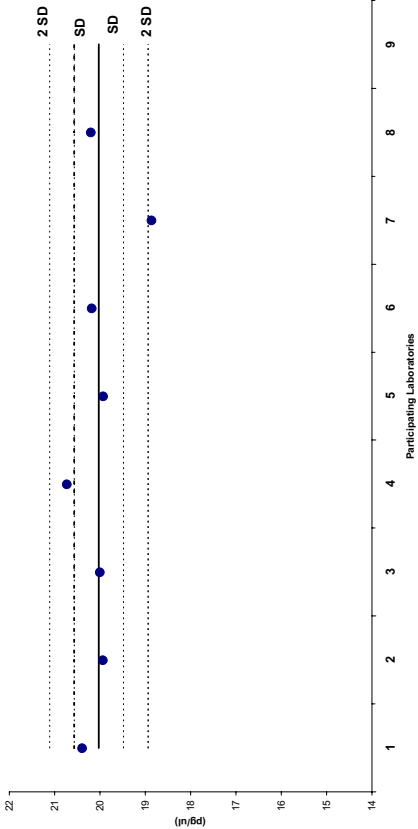
PCB #189 Standard 1 (RSD 14 %, n = 8)



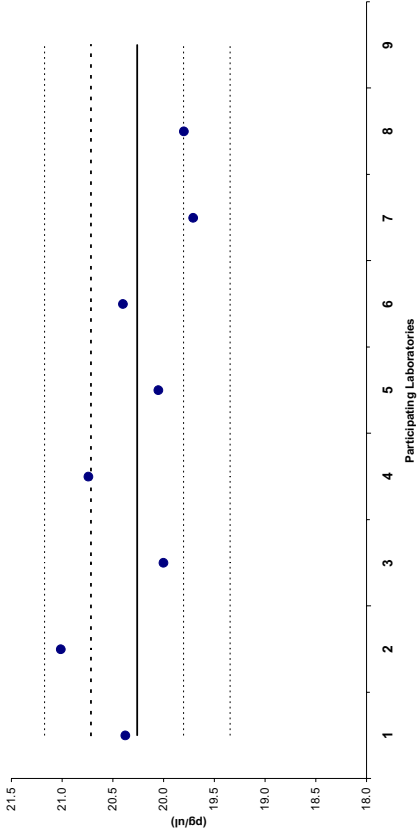
Laboratory	Non-Ortho PCBs (pg/ul)					
	PCB #77	n	PCB #81	n	PCB #126	n
1	20.4	3	20.4	3	19.7	3
2	19.9	3	21.0	3	21.7	3
3	20.0	3	20.0	3	19.0	3
4	20.7	3	20.7	3	20.2	3
5	19.9	2	20.0	2	19.3	2
6	20.2	1	20.4	1	21.0	1
7	18.9	1	19.7	1	19.7	1
8	20.2	1	19.8	1	20.4	1
9	NR		NR		NR	
Average	20.03	8	20.26	8	20.13	8
Median	20.09	8	20.21	8	19.98	8
Min	18.86	8	19.71	8	19.00	8
Max	20.73	8	21.01	8	21.67	8
SD	0.54	8	0.46	8	0.88	8
%RSD	3%	8	2%	8	4%	8

Laboratory	Mono-Ortho PCBs (pg/ul)											
	PCB #105	n	PCB #114	n	PCB #118	n	PCB #123	n	PCB #156	n	PCB #157	n
1	20.7	3	21.7	3	19.9	3	21.2	3	22.0	3	21.4	3
2	20.0	3	21.4	3	19.3	3	19.9	3	20.4	3	21.5	3
3	20.0	3	21.0	3	21.0	3	20.0	3	20.0	3	18.0	3
4	19.4	3	20.1	3	19.1	3	19.9	3	19.8	3	19.9	3
5	19.3	2	20.1	2	20.2	2	19.4	2	19.8	2	21.1	2
6	20.5	1	22.4	1	20.8	1	20.2	1	20.1	1	21.0	1
7	20.1	1	20.7	1	20.7	1	20.5	1	20.5	1	20.1	1
8	19.2	1	18.9	1	19.2	1	19.3	1	19.3	1	19.2	1
9	NR		NR		NR		NR		NR		NR	
Average	19.91	8	20.78	8	20.02	8	20.05	8	20.23	8	20.28	8
Median	20.00	8	20.85	8	20.03	8	19.97	8	20.05	8	20.57	8
Min	19.20	8	18.90	8	19.05	8	19.30	8	19.30	8	18.00	8
Max	20.74	8	22.36	8	21.00	8	21.16	8	22.00	8	21.46	8
SD	0.58	8	1.08	8	0.77	8	0.59	8	0.80	8	1.23	8
%RSD	3%	8	5%	8	4%	8	3%	8	4%	8	6%	8

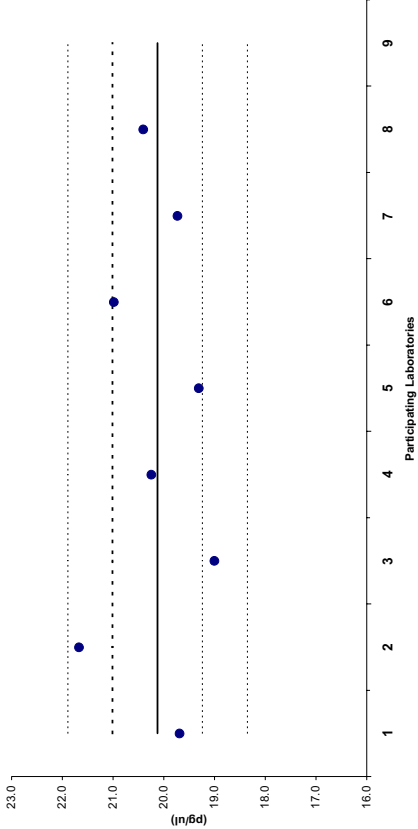
PCB #77 Standard 2 (RSD 3 %, n = 8)



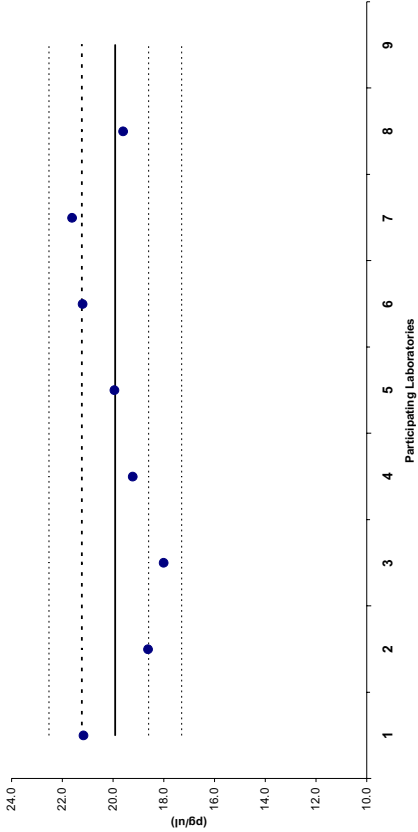
PCB #81 Standard 2 (RSD 2 %, n = 8)



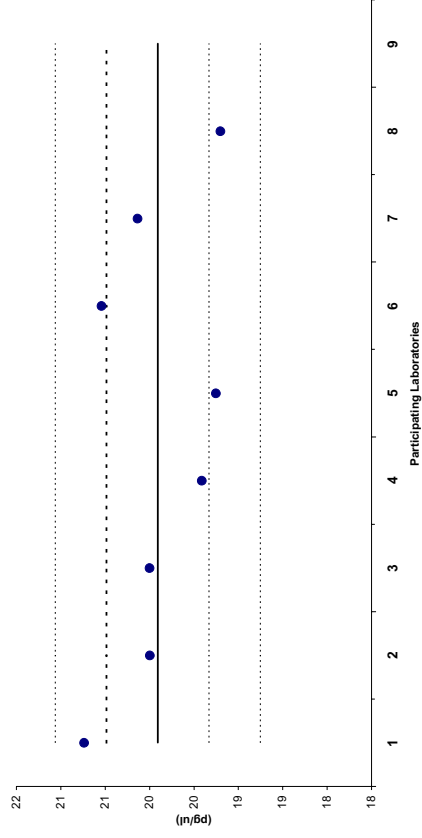
PCB #126 Standard 2 (RSD 4 %, n = 8)



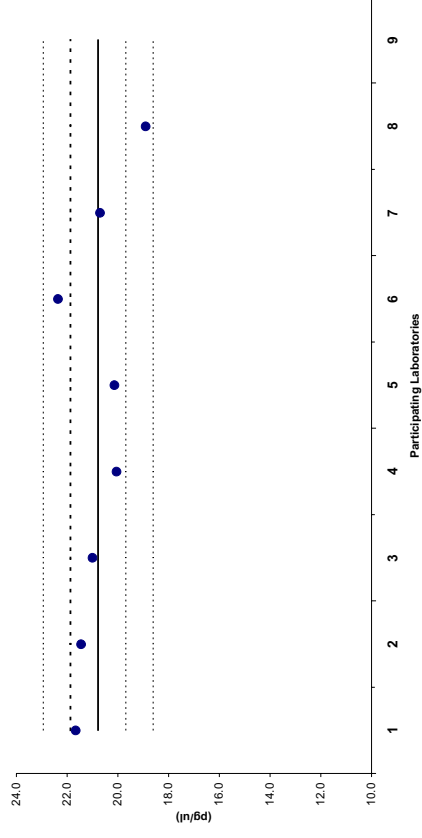
PCB #169 Standard 2 (RSD 7 %, n = 8)



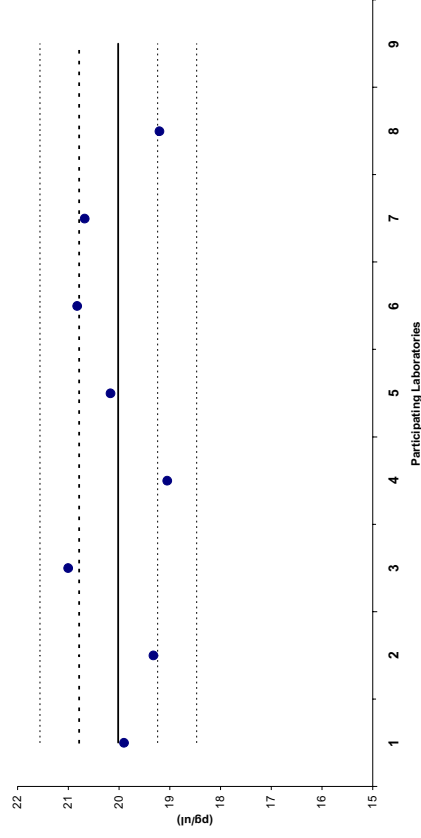
PCB #105 Standard 2 (RSD 3 %, n = 8)



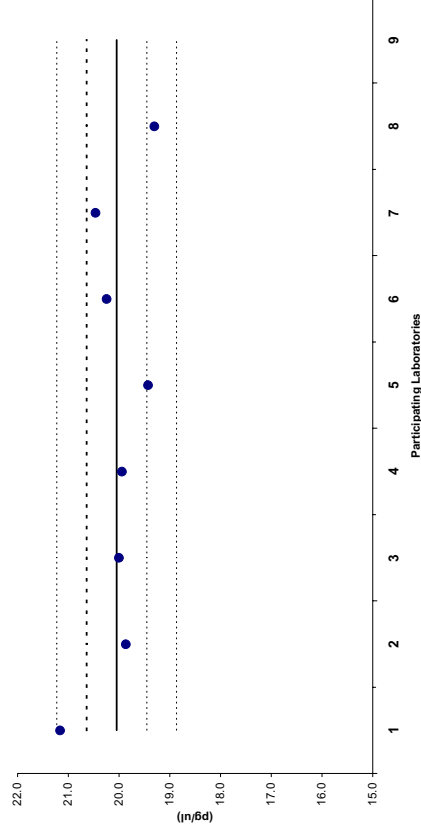
PCB #114 Standard 2 (RSD 5 %, n = 8)



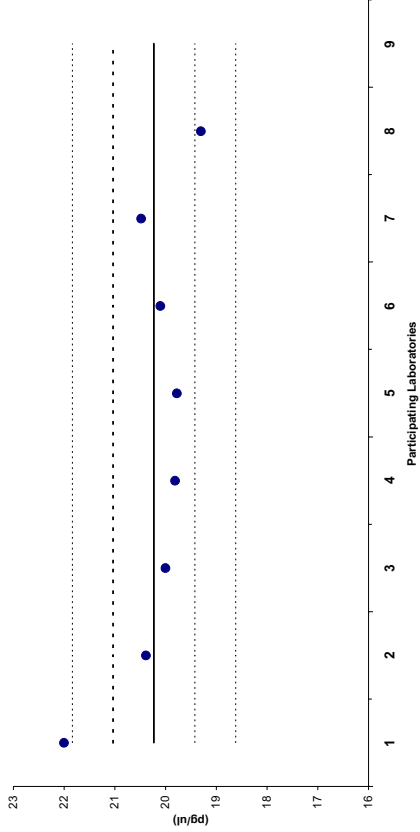
PCB #118 Standard 2 (RSD 4 %, n = 8)



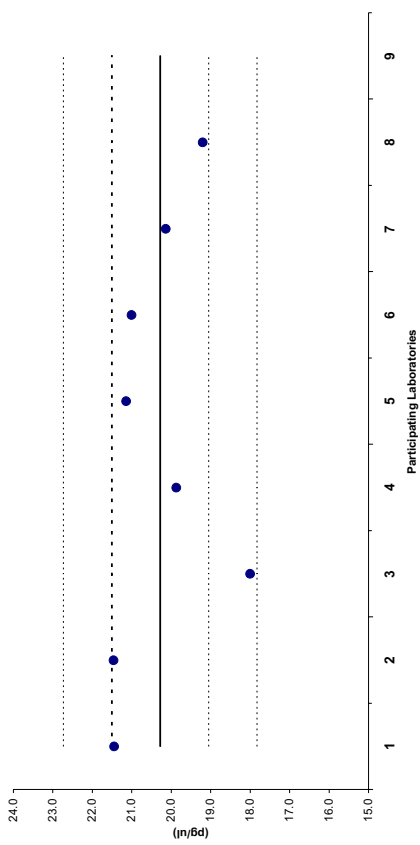
PCB #123 Standard 2 (RSD 3 %, n = 8)



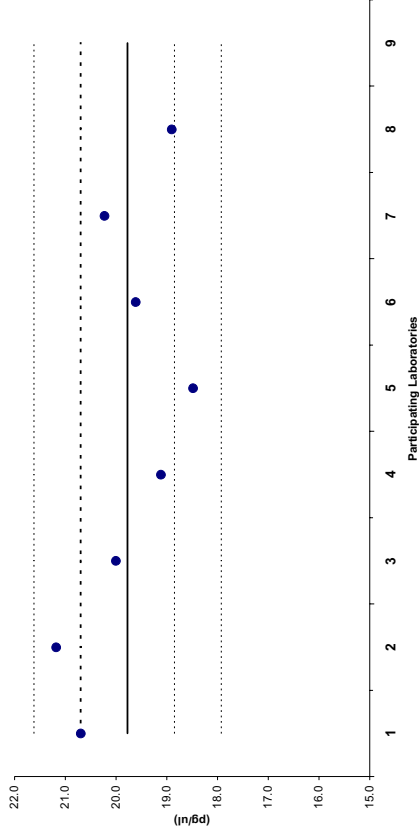
PCB #156 Standard 2 (RSD 4 %, n = 8)



PCB #157 Standard 2 (RSD 6 %, n = 8)



PCB #167 Standard 2 (RSD 5 %, n = 8)



PCB #189 Standard 2 (RSD 4 %, n = 8)

