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BCR-ringtest of individual chlorobiphenyls (1/1983) - Summary of results.

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BCR.X

Content

1. Introduction

In a meeting organized by BCR on October 21, 1982, in Brussels, the participants agreed that efforts to improve the interagreement and the quality of PCB-determinations urgently had to be made. It was decided to study step by step the PCB-determination. In the first step the basic steps of the quantitative determination, e.g. injection and (ECD) detection was studied and results are presented in this report.

2. Participants

A complete list of the 15 participating laboratories is given in Annex 1. Results were obtained from 14 laboratories.

3. Materials and method of analysis

Ampuls for the ringtest were prepared by the State Institute for Quality Control of Agricultural Products (RIKILT) Wageningen, The Netherlands and send to the participants with the following information:
All ampuls contain chlorobiphenyls in iso-octane. As internal standards 1,2,3,4-tetrachloronaphtalene (0,5 µg/ml) and methoxychlor (2 µg/ml) are used. Each laboratory receives six ampuls provided with code numbers A-F and weight of the ampul (g).
On receipt, the ampuls have to be controlled on weight. When the difference is more than 1%, ask(a) new ampul(s). In any case send the receipt/confirmation letter back to the RIKILT (Annex 2).
Each ampul contains about 5 ml solution. Dilutions have to be made with an aliquot.
Ampul A: Test solution with compound 138 (5 µg/ml) to determine capacity ratio (k') and plate number (N) under isothermal conditions at 220°C with splitter open.

Formulas:

$$N = 5{,}54 \left(\frac{tr}{W1/2} \right)^2$$

$$k' = \frac{tr}{to} - 1$$

tr = retention time from injection point (seconds)
W1/2 = peak width at half height (seconds)
to = time from injection point to appearance of solvent peak (seconds)

Ampul B: Standard solution with the chlorobiphenyls 28, 52, 101, 118, 138, 153 and 180 each with a concentration of 0,5 µg/ml. The elution pattern on suitable capillary column (CP-Sil 5, CP-Sil 7, SE-30, SE-54, or comparable) is 28, 52, 101, 118, 153, 138 and 180. We advise a slightly polar column (CP-Sil 7). On the suggested columns the internal standard 1,2,3,4-tetrachloronaphtalene elutes after compound 52 and the internal standard methoxychlor elutes before compound 180.
Ampul C: Blanc solution of iso-octane, containing 0,5 µg/ml 1,2,3,4-tetrachloronaphtalene and 2 µg/ml methoxychlor.
Ampuls D-F: Mixed chlorobiphenyl solutions. The solutions contain 0,5 µg/ml tetrachloronapthalene and 2 µg/ml methoxychlor.

Optimize flow through WCOT narrow bore columns (0,25 mm). The lineair gas velocity for helium is about 25 cm/sec.
Before starting injections use a new septum and control cleannes of the injection system.
For the analysis 4 replicates per day are requested. In a period of two or three weeks two days of analysis shall be selected, thus yielding two sets of four replicates each.
Inject the samples, according to Grob, using a temperature programme or by using solid probe injection.
Dilute the samples until the peaks are within the linear range of the detector and on the recording paper.
Use peak height or peak area for quantification. For statistical treatment report three decimal figures (for example 0,258 µg/ml) on enclosed forms (Annex 3). Report gaschromatographic conditions (Annex 4).

The identity and quantity of the mixed chlorobiphenyl solutions had not been disclosed to the participants. To control the separation on the capillary columns the analysis had been complicated by adding compound 31 (2,5-4' trichlorobiphenyl), which can interfere with compound 28 to ampul E and by adding compound 149 (2,3,6-2'4'5' hexachlorobiphenyl), which can interfere with compound 118 to ampul D.
Ampul F was a mixture of ampul D and E in a ratio 2:3. In the table given below the concentration of the chlorobiphenyls in the standard ampul B and mixed chlorobiphenyl solutions ampul D, E and F are summarized.

Ampul	PCB-compound (ng/ml)								
	28	31	52	101	149	118	153	138	180
B	500	---	500	500	---	500	500	500	500
D	200	---	---	500	200	---	200	500	---
E	---	500	500	500	---	200	---	---	500
F	80	300	300	500	80	120	80	200	300

4. Results

Several laboratories reported extra results based on analysis on a different column, different way of calculation or type of injection. From all these results a selection is made based on the following considerations:
polarity of the stationary phase, calculation with peak height and calculation with the internal standard 1,2,3,4-tetrachloronaphtalene.
Laboratory 5 reported for each sample two results based on injection in the split-mode (day 1) and two results based on splitless injection (day 2). All results have been used.
Laboratory 6 reported results on different columns and apparatus. The results on PB 419 gaschromatograph (day 1) and on PB 417 (day 2) have been used.
Laboratory 10 reported for each sample four results on capillary column (day 1) and four results on packed column (day 2). On packed column compound 180 and methoxychlor interfere, so no results have been reported. For laboratory 10 the capillary column, the injector and the syringe were new. Optimalization of all parameters could not be realised in the short time which was available for this ringtest. Though not agreed upon, these results are included in the statistical treatment. Only in this study, results from the packed column can be used, in life samples this will not be possible due to interference with other chlorobiphenyls.

The results of the gaschromatographic conditions are given in table 1. For easier comparability the reported data for the individual chlorobiphenyl compounds 28, 52, 101, 118, 153, 138 and 180 in the ampuls D, E and F have been summarized in the tables 2-8 per compound. The reported data in table 2-8 are not corrected for blanc solution of isooctane (ampul C).

Data for blanc solution of iso-octane (ampul C) are not reported. In most cases the results are below or around the detection limit which varies from 1 to 20 ng/ml.
In the tables 2-8 are also given mean values, spike level, repeatability (r) and reproducibility (R).

4.1 Remarks from participants

- Laboratory 2 reported broadening of late peaks, negative peaks and problems with the internal standard methoxychlor (not reproducable peak heights).
- Laboratory 3 reported interfering compounds, later on confirmed by injecting the solutions on a second GC column of different polarity (DB 5). For compound 118 analysis should be repeated and the temperature program for the DB 1 column should be changed because a rather high temperature program was used.
- Laboratory 4 reported more peak tailing than observed in own standard solutions and biological sample extracts. The reason for this (column or detector) could not be found out.
- Laboratory 6 reported higher variation for internal standard methoxychlor then for tetrachloronaphtalene. Automatic injections give better comparable results with a lower coëfficient of variation (max. 2%) than hand injections (max. 10%).
- Laboratory 8 reported unreproducable results for the internal standard methoxychlor.
- Laboratory 10 reported that k'-value is difficult to determine with on column injection since the solvent is not vaporized immediately.
- Laboratory 11 reported that the concentrations were approaching the lower limits of the detection range of the gaschromatograph-Mass Spectrometer, particularly evident on the data obtained. For the on-column injection the samples had to be transferred from iso-octane to octane in order to inject the samples at 130°C as part of the temperature programme used for PCB analysis. k'-value could not be measured using on column injector with an iso-octane solution at 220°C. With the internal standard tetrachloronaphtalene better results were generally obtained than with methoxychlor.
- Laboratory 12 reported problems with the internal standard methoxychlor.

4.2 Remarks to identifications

Blanc solution ampul C

Five laboratories reported sometimes interferences above 10 ng/ml.
Laboratory 7 for all compounds with a maximum of 35 ng/ml. Maybe it is a cross-contamination in the laboratory itself.
Laboratory 8 reported only an interference with compound 52 (mean 240 ng/ml) in ampul C.
Laboratory 10 reported also an interference with compound 52 (mean 31 ng/ml).
Laboratory 8 as well as laboratory 10 used the on-column injection technique.
Laboratory 13 reported only in two of the eight injections of ampul C an interference with compound 52 respectively 26 and 51 ng/ml.
Laboratory 14 reported interferences for the compounds 52, 138 and 153 (mean respectively 25, 12 and 34 ng/ml) in ampul C.

PCB compound 28

Most laboratories (with laboratory 3 and 9 as exception) reported in ampul E compound 31 as 28.
The presence of compound 31 was supposed by laboratory 9 in ampul E. It must be noticed that this supposition of compound 31 is based on a difference of only 2 seconds as indicated by the datasystem on the chromatogram.
For ampul F where a mixture of compound 28 and 31 was present, only laboratory 6 reported the presence of compound 31 beside 28.
Laboratory 3 and 9 recognized at least interference by compound 31 but not the presence of 28 and reported as zero.
Laboratory 3 plotted from raw data, stored on magnetic tape, the sample and standard solution and made visible the presence of the interfering compounds in the samples.
In the table below the separation between compound 28/31 and compound 118/149 as observed from the chromatograms of ampul F is given in relation to the used capillary column.

Lab	PCB compound 28/31			Stationary phase	PCB compound 118/149		
no.	no separation	shoulder	separation	$(GC)^2$ column	no separation	shoulder	separation
1	x			CP Sil 7			x
2	x			OV 101		x	
3		x		DB 1		x	
4		x		SE 30/52 (1:1)			x
5		x		SE 54			x
6		x		CP Sil 8 CB			x
7	x			SE 54			x
8	x			CP Sil 8		x	
9	x			CP Sil 8 CB			x
10	x			Methyl silicone	x		
11	x			CP Sil 5	x		
12	X			SE 54			x
13	x			CP Sil 5 CB	x		
14	x			BP 1	x		

PCB compound 52

In ampul D laboratory 7 reported a mean value of 12 ng/ml, laboratory 8 reported a mean value of 270 ng/ml, laboratory 13 reported in four out of eight injections compound 52 with a mean value of 15 ng/ml and laboratory 14 reported a mean value of 37 ng/ml. As in this ampul compound 52 was not present the results are not summarized in a table.
In particular for laboratory 8 we can expect more or less a correct answer if we suppose that the same interference is present in the standard B and in ampul E and F. Only when the concentration in the ampuls deviates strongly from the concentration in the standard the reliability shall be lower.

PCB compound 118

In ampul D eight laboratories (2,4,5,8,11,12,13 and 14) made a wrong identification and reported compound 149 as 118.
Laboratory 6 correctly reported the presence of compound 149 instead of 118 in ampul D and both compounds in ampul F.
For laboratory 7 a broad peak interfering with compound 118 was observed even in the standard solution B, not being compound 149. In ampul D and F the presence of a peak before compound 118 is reported.
Based on the results of the packed column laboratory 10 did not report in ampul D the presence of compound 118. On the capillary column compound 118 is not separated from 149.

In ampul F three of the above mentioned laboratories (2,4 and 5) had more or less separation and made now for compound 118 a correct identification. When these laboratories, in the case of ampul D, had used relative retention times probably they could have made a correct identification.
In the table on page 6 the observed separation between compound 118 and 149 taken from the chromatograms of ampul F in relation to the used capillary column is given.
Depending on the used column and temperature programme it is observed that with slightly polar columns separation between compound 118 and 149 can be obtained.

PCB-compounds 101, 138, 153 and 180

No identification problems. However laboratory 2 indicates a wrong identification for compound 138 and 153 (interchange) in the chromatograms of the standard ampul B. Also the results in the ampuls D and F show this interchange.

4.3 Remarks to gaschromatography

From the data summarized in table 1 the following trends can be derived:

- thirteen laboratories used an electron capture detector and one laboratory a mass spectrometer for the detection
- ten out of fourteen laboratories tested the linearity at least in the range of the concentrations in this ringtest
- five laboratories used apolair capillary columns (OV 101, DB 1, CP Sil 5 or BP 1), seven laboratories used more polair columns (CP Sil 7, SE 54 or CP Sil 8), one laboratory used a SE 30/SE 52 (1:1) column, one laboratory reported the use of a methyl silicone phase and also a packed column DC 200/QF 1
- elf laboratories used capillary columns with a length of about 25 m and three laboratories used columns with a length of 50 m, inner diameter and film thickness varies much
- temperature programmes differ strongly from laboratory to laboratory from a point of view of heating rate and more important, of starting temperature
- linear velocity of the mobile phase seems in several laboratories not optimal
- k'-value and number of plates for compound 138 at 220°C isotherm varies much, respectively changing from 1,9-23 and 24.600-177.000
- different injection techniques have been used, three laboratories used the on-column technique, five laboratories used only splitless injection, one laboratory used the split-mode and splitless injection, and two laboratories used the split-mode. One laboratory reported as injection technique solvent effect, another laboratory reported as direct, while one laboratory did not report the type of injection.

5. Statistical treatment

All results summarized in the tables 2-8 are used for the statistical treatment per compound and per sample.

With the Dixon's outliertest the mean results of each laboratory for all analysis (mostly 8) are tested. Outliers in the tables are given with a double asterisk (**). The chance that a laboratory is wrongly indicated as an outlier is lower than 1%.

The Cochran's maximum variance test on the standard deviation between days is not used. Per laboratory two standard deviations are given in the tables, which eventually could be pooled.

More interesting are the differences between the mean results of day 1 and day 2. When in day 2 many experimental circumstances have changed with regard to day 1 there can be a greater difference between both results.

Many factors are influencing the variance in an analytical method (operator, apparatus, laboratory, interval of time).

In the repeatability these factors will be held constant, while in the reproducibility these factors are variable.

Definitions (according to ISO 5725 - Precision of test methods - Determination of repeatability and reproducibility by interlaboratory tests).

The repeatability r is the value below which the absolute difference between two single test results obtained with the same method on identical test material, under the same conditions (same operator, same apparatus, same laboratory, and a short interval of time), may be expected to lie with a specified probability; in the absence of other indications, the probability is 95%.

$r = 2\sqrt{\sigma^2(r) + \sigma^2(r)} = 2{,}83 \ \sigma(r)$, in which $\sigma^2(r)$ = variance in a laboratory; all factors constant.

The reproducibility R is the value below which the absolute difference between two single test results obtained with the same method on identical test material, under different conditions (different operators, different apparatus, different laboratories and/or different time), may be expected to lie with a specified probability; in the absence of other indications, the probability is 95%.

$$R = 2\sqrt{\sigma^2(R) + \sigma^2(R)} = 2{,}83\ \sigma(R),$$

in which $\sigma^2(R)$ = variance between laboratories. Days, apparatus, operators, all factors differ.

From r and R the coëfficient of variation (CV) can be calculated.

$$CV = \frac{\sigma \times 100\%}{\text{mean value}} = \frac{R \text{ (or r)} \times 100\%}{2{,}83 \times \text{mean value}}$$

5.1 Results

Compound 28 (table 2)
On ampul D with the Dixon's test no outliers were found. The repeatability and reproducibility are not reported for compound 28 in ampul E and F, as results are based upon wrong identifications.

Compound 52 (table 3)
No outliers were found in the ampuls E and F.

Compound 101 (table 4)
For laboratory 13 an outlier was found in ampul D. Repeatability and reproducibility are given including and without laboratory 13.

Compound 118 (table 5)
In ampul E no outliers were found. The repeatability and reproducibility are not reported for compound 118 in ampul D and F, as results are based upon wrong identifications.

Compound 153/138 (table 6/7)
For laboratory 2 outliers are found for compound 153 in ampul D and F and for compound 138 in ampul D caused by interchange of compound 153 and 138. Repeatability and reproducibility are given including and without laboratory 2.
If we had interchanged the results of laboratory 2 for compound 153 and 138 before statistical treatment no outliers had been found.

Compound 180 (table 8)
No outliers were found in the ampuls E and F.

In the table below a summary is given of the coëfficient of variations after elimination of the outliers.

Ampul	PCB-compound						
	28	52	101	118	153	138	180
D	10,8	-	5,5	-	11,4	7,0	-
E	-	8,4	7,0	7,6	-	-	7,7
F	-	12,7	8,7	-	15,8	17,7	12,8

6. Conclusions

a. The internal standard methoxychlor seems to be not suitable due to changing peak height/area, as reported by several laboratories.

b. Between compound 28 and 31 with the used capillary columns and/or temperature programs separation is in general absent.

c. Between compound 118 and 149 a separation can be achieved on slightly polar columns using a suitable temperature programme.

d. The parameters k' and N, especially in combination with on column injection techniques are no good parameters for column performance.

e. The expected advantages of columns of 50 m length are not confirmed by high plate numbers or better separations.

f. The splitless injection, according to Grob and the solid probe technique were advised. The participants did not use the solid probe technique, but the on-column or split-mode technique.

g. Apart from the interferences of compound 28 and 31 and compound 118 and 149 many laboratories reported in the blanc solution and in many cases also in the samples, positive identifications of chlorobiphenyls, while these compounds were not spiked. These interferences are sometimes in the order of five percent of the standard concentration in ampul B. Only for laboratory 8 an interference for compound 52 is bigger, namely about fifty percent of the standard concentration.

h. For the compounds 28, 52, 101, 118, 153, 138 and 180 the coëfficient of variation between laboratories varies from 5,5 to 17,7%.
The VC(R) seems to be slightly influenced by the concentration of the chlorobiphenyls.

In relation to the experience of all the participating laboratories with the analysis of individual chlorobiphenyls the results are acceptable.

i. For a next ringtest attention has to be given to the following points:
   - internal standard
   - analysis only on capillary columns
   - choice of capillary columns
   - detection only by electron capture detector
   - testing parameters for characterizing capillary column e.g. separation number.

Table 1. Gaschromatographic conditions

1)	2)	3)	4)	5)	6)	7)	8)	9)	10)	11)	12)	13)	14)	15)
1	Tracor 550	Ni^{63} pulsed	yes	CP Sil 7	25	0,25	–	4 min 100°C–40°C/min–220°C	36	He	11,8	73.000	5	splitless acc. to Grob.
2	HP 5840 A	const. cur.	yes	OV 101	50	0,33	0,18	3 min 105°C–25°C/min–180°C–1,5°C/min–240°C	35,3	H_2	5,9	24.600	1,5	solvent effect
3	HP 5730 A	Ni^{63} pulsed	yes	DB 1	30	0,25	0,25	3 min 150°C–10°C/min–220°C	28	He	6,9	73.500	2	splitless
4	Varian 3700	Ni^{63}	yes	SE 30/52 1:1	50	0,245	0,06	150°C–2°C/min–250°C	22	N_2	1,93	177.000	± 2	split 1:10
5	Carlo Erba FIV 2900	Ni^{63}	yes	SE 54	29	0,25	0,30	isotherm 219°C	37	H_2	17,2	106.300	4	split 1:27
	Carlo Erba FIV 2900	Ni^{63}	yes	SE 54	29	0,25	0,30	15 min 210°C–4°C/min–220°C	37	H_2	17,2	106.300	2,5	splitless
6	PB 419	Ni^{63}	yes	CP Sil 8 CB	25	0,25	0,45	3 min 87°C–32°C/min–215°C	14	He	15,9	88.600	1	splitless acc. to Grob.
	PB 417	Ni^{63}	yes	CP Sil 8 CB	25	0,23	0,46	3 min 87°C–32°C/min–215°C	27	He	18,7	69.000	1	splitless acc. to Grob.
7	Carlo Erba FIV 4160	Ni^{63}	no	SE 54	20	0,25	0,2	150°C–5°C/min–250°C	60	H_2	7,6	51.500	1	splitless
8	Carlo Erba FIV 4160	Ni^{63}	yes	CP Sil 8	25	0,50	0,78	50°C–25°C/min–200°C–5°C/min–285°C	–	H_2	23	64.600	1	on-column
9	Varian 3700	Ni^{63}	yes	CP Sil 8 CB	25	0,25	0,12	1 min 130°C–4°C/min–250°C	50	H_2	–	–	± 1	direct
10	PB 427	Ni^{63}	yes	methyl silicone	25	0,31	0,52	70°C–70°C/min–210°C	37	N_2	11,9	61.900	0,5–0,8	on-column
	PB 423	Ni^{63}	yes	3,2% DC 200/0,8% QF1	1,8	2		isotherm 185°C		N_2	18,4	935	3,5	
11	Finnigan 3200	MS	no	CP Sil 5	25	0,23	0,12	1 min 130°C–2°C/min–190°C	25	He	6,5*	79.300*	1	on-column
12	HP 5710 A	Ni^{63}	no	SE 54	50	0,33	0,17	100°C–4°C/min–260°C	30	H_2	3,76	88.100	5–6	split-mode
13	PB 430	Ni^{63}	–	CP Sil 5 CB	25	0,23	0,114	1 min 80°C–2 min 39,9°C/min–18 min 6°C/min–2 min 16°C/min	–	N_2	3,24	113.100	0,5	splitless acc. to Grob.
14	HP 5880 A	Ni^{63}	yes	BP 1	25	0,22	0,25	7 min 90°C–30°C/min–7 min 270°C	21	Ar/CH_4	6,5	75.000	1	–

* at 190°C – = not reported

1) Lab. no
2) Apparatus (type)
3) Detector (type)
4) Linearity tested
5) Column phase
6) Length (m)
7) i.d. (mm)
8) Film thickness (µm)
9) Temp. programme
10) Mobile phase (cm/sec)
11) Type of gas
12) k' 138 (at 220°C)
13) N 138 (at 220°C)
14) Injection volume (µl)
15) Type of injection

TABLE 2 RESULTS PCB COMPOUND 28 (ng/ml) - AMPUL D

lab. no.	day 1				day 2			
1	190	186	185	202	193	195	194	193
2	270	230	240	270	270	270	270	270
3	207	199	203	204	205	202	202	205
4	191	206			214	194		
5	207	213			215	220		
6	218	221	217	220	214	217	212	210
7	195	209	180	210	193	228	251	179
8	204	201	207	200	191	188	191	208
9	230	227	230	223	223	226	222	226
10	214	221	223	223	204	202	203	203
11	201	191	203	193	175	182	164	173
12	207	203	204	204	217	217	209	216
13	185	260	226	192	247	294	224	238
14	209	210	209	210	214	208	211	210

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	191	7.8	4	194	1.0	192
2	4	253	20.6	4	270	0.0	261
3	4	203	3.3	4	204	1.7	203
4	2	199	10.6	2	204	14.1	201
5	2	210	4.2	2	218	3.5	214
6	4	219	1.8	4	213	3.0	216
7	4	199	14.1	4	213	32.8	206
8	4	203	3.2	4	195	9.1	199
9	4	228	3.3	4	224	2.1	226
10	4	220	4.3	4	203	0.8	212
11	4	197	5.9	4	174	7.4	185
12	4	205	1.7	4	215	3.9	210
13	4	216	34.5	4	251	30.3	233
14	4	210	0.6	4	211	2.5	210

spike = 200 ng/ml

total mean = 212.0 ng/ml

repeatability (r) = 35.8 ng/ml CV(r) = 6.0 %

reproducibility (R) = 64.9 ng/ml CV(R) = 10.8 %

TABLE 2 RESULTS PCB COMPOUND 28 (ng/ml) - AMPUL E

lab. no.	day 1				day 2			
1	500	502	498	501	511	502	512	483
2	400	380	400	400	400	490	440	500
4	379	411			353	316		
5	393	401			403	398		
6	447	444	444	449	455	458	454	472
7	387	378	350	411	404	374	446	411
8	432	434	438	431	436	434	445	431
10	472	473	448	460	430	432	425	435
11	617	585	613	582	537	509	548	516
12	453	446	455	451	461	466	466	465
13	466	492	492	441	474	484	423	
14	450	450	447	453	463	462	462	451

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	500	1.7	4	502	13.4	501
2	4	395	10.0	4	458	46.5	426
4	2	395	22.6	2	335	26.2	365
5	2	397	5.7	2	401	3.5	399
6	4	446	2.4	4	460	8.3	453
7	4	382	25.2	4	409	29.6	395
8	4	434	3.1	4	437	6.0	435
10	4	463	11.8	4	431	4.2	447
11	4	599	18.3	4	528	18.1	563
12	4	451	3.9	4	465	2.4	458
13	4	473	24.5	3	460	32.7	467
14	4	450	2.4	4	460	5.7	455

spike = 0 ng/ml

TABLE 2 RESULTS PCB COMPOUND 28 (ng/ml) - AMPUL F

lab. no.	day 1				day 2			
1	376	376	381	376	361	368	361	372
2	320	320	310	300	370	360	370	370
4	252	245			251	206		
5	242	236			249	245		
6	113	115	115	114	112	110	107	109
7	280	257	248	210	210	255	248	300
8	285	277	286	285	283	272	268	272
10		329	292	332	330	331	330	
11	451	428	463	439	374	381	399	399
12	295	287	291	290	292	299	300	299
13	282	339	268	294	209	256	284	
14	318	324	326	325	332	331	328	327

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	377	2.5	4	366	5.4	371
2	4	313	9.6	4	368	5.0	340
4	2	249	4.9	2	229	31.8	239
5	2	239	4.2	2	247	2.8	243
6	4	114	1.0	4	110	2.1	112
7	4	249	29.1	4	253	36.9	251
8	4	283	4.2	4	274	6.4	279
10	3	318	22.3	3	330	0.6	324
11	4	445	15.1	4	388	12.7	417
12	4	291	3.3	4	298	3.7	294
13	4	296	30.7	3	250	37.9	273
14	4	323	3.6	4	330	2.4	326

spike = 80 ng/ml

TABLE 3 RESULTS PCB COMPOUND 52 (ng/ml) - AMPUL E

lab. no.	day 1				day 2			
1	500	501	500	502	510	506	492	521
2	510	450	480	470	470	570	550	610
3	501	499	489	495	502	501	502	504
4	511	655			453	453		
5	502	518			449	432		
6	500	500	498	503	486	490	486	509
7	494	500	491	430	478	480	526	519
8	525	520	528	524	535	526	533	529
9	499	500	499	500	485	489	503	494
10	515	505	502	527	495	501	499	495
11	478	492	486	500	487	494	498	438
12	504	501	485	490	479	478	472	485
13	525	562	489	544	506	521	434	
14	476	468	464	475	420	410	408	425

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	501	1.0	4	507	12.0	504
2	4	478	25.0	4	550	58.9	514
3	4	496	5.3	4	502	1.3	499
4	2	583	101.8	2	453	0.0	518
5	2	510	11.3	2	441	12.0	475
6	4	500	2.1	4	493	11.0	497
7	4	479	32.7	4	501	25.3	490
8	4	524	3.3	4	531	4.0	528
9	4	500	0.6	4	493	7.8	496
10	4	512	11.3	4	498	3.0	505
11	4	489	9.3	4	479	27.9	484
12	4	495	9.0	4	479	5.3	487
13	4	530	31.2	3	487	46.5	509
14	4	471	5.7	4	416	8.1	443

spike = 500 ng/ml

total mean = 496.3 ng/ml

repeatability (r) = 77.8 ng/ml CV(r) = 5.5 %

reproducibility (R) = 118.4 ng/ml CV(R) = 8.4 %

TABLE 3 RESULTS PCB COMPOUND 52 (ng/ml) - AMPUL F

lab. no.	day 1				day 2			
1	303	306	291	307	288	313	304	306
2	390	390	370	350	410	400	400	400
3	322	317	315	314	319	317	318	323
4	340	388			311	293		
5	312	304			268	268		
6	312	311	314	318	313	315	307	308
7	300	284	268	275	260	293	290	336
8	409	400	391	398	396	392	420	416
9	327	338	329	326	318	325	326	320
10	309	318	314	324	302	302	302	
11	313	322	314	323	266	283	294	288
12	332	324	324	321	318	310	320	311
13	304	365	304	313	232	272	300	
14	296	292	317	303	266	264	269	270

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	302	7.4	4	303	10.6	302
2	4	375	19.1	4	403	5.0	389
3	4	317	3.6	4	319	2.6	318
4	2	364	33.9	2	302	12.7	333
5	2	308	5.7	2	268	0.0	288
6	4	314	3.1	4	311	3.9	312
7	4	282	13.8	4	295	31.3	288
8	4	400	7.4	4	406	14.0	403
9	4	330	5.5	4	322	3.9	326
10	4	316	6.3	3	302	0.0	309
11	4	318	5.2	4	283	12.0	300
12	4	325	4.7	4	315	5.0	320
13	4	322	29.3	3	268	34.2	295
14	4	302	11.0	4	267	2.8	285

spike = 300 ng/ml

total mean = 319.2 ng/ml

repeatability (r) = 40.8 ng/ml CV(r) = 4.5 %

reproducibility (R) = 114.9 ng/ml CV(R) = 12.7 %

TABLE 4 RESULTS PCB COMPOUND 101 (ng/ml) - AMPUL D

lab. no.	day 1				day 2			
1	484	500	509	510	476	485	482	507
2	480	430	450	470	480	520	560	560
3	483	503	491	492	504	500	500	492
4	468	541			550	472		
5	508	503			513	523		
6	498	502	502	502	475	487	479	472
7	461	451	450	460	504	473	456	415
8	471	473	483	488	501	492	497	490
9	505	503	504	497	507	506	492	515
10	457	486	471	495	489	485	480	485
11	458	432	506	477	431	478	510	489
12	500	480	491	481	507	509	500	517
13	523	762	538	523	568	689	601	587
14	473	481	480	482	471	458	465	459

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	501	12.0	4	488	13.5	494
2	4	458	22.2	4	530	38.3	494
3	4	492	8.2	4	499	5.0	496
4	2	505	51.6	2	511	55.2	508
5	2	506	3.5	2	518	7.1	512
6	4	501	2.0	4	478	6.5	490
7	4	456	5.8	4	462	37.1	459
8	4	479	8.1	4	495	5.0	487
9	4	502	3.6	4	505	9.6	504
10	4	477	16.7	4	485	3.7	481
11	4	468	31.2	4	477	33.4	473
12	4	488	9.4	4	508	7.0	498
13	4	587	117.2	4	611	53.6	599 **
14	4	479	4.1	4	463	6.0	471

spike = 500 ng/ml

total mean = 497.4 ng/ml

repeatability (r) = 91.0 ng/ml CV(r) = 6.5 %

reproducibility (R) = 126.2 ng/ml CV(R) = 9.0 %

without laboratory 13

total mean = 489.6 ng/ml

repeatability (r) = 61.7 ng/ml CV(r) = 4.5 %

reproducibility (R) = 76.6 ng/ml CV(R) = 5.5 %

TABLE 4 RESULTS PCB COMPOUND 101 (ng/ml) - AMPUL E

lab. no.	day 1				day 2			
1	513	507	509	507	501	518	498	505
2	480	440	470	470	450	530	560	580
3	481	500	495	493	513	506	500	499
4	532	587			475	407		
5	500	511			521	494		
6	493	496	494	496	485	484	480	444
7	512	512	460	508	506	466	469	472
8	484	485	491	479	505	485	485	498
9	477	489	489	518	489	506	506	499
10	489	534	493	510	488	487	491	489
11	497	468	479	452	474	478	495	549
12	501	493	481	494	480	487	484	485
13	481	536	550	536	527	506	443	
14	479	474	471	476	454	445	442	435

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	509	2.8	4	506	8.8	507
2	4	465	17.3	4	530	57.2	498
3	4	492	8.1	4	505	6.5	498
4	2	560	38.9	2	441	48.1	500
5	2	506	7.8	2	508	19.1	507
6	4	495	1.5	4	473	19.6	484
7	4	498	25.4	4	478	18.7	488
8	4	485	4.9	4	493	9.9	489
9	4	493	17.4	4	500	8.0	497
10	4	507	20.5	4	489	1.7	498
11	4	474	18.9	4	499	34.6	487
12	4	492	8.3	4	484	2.9	488
13	4	526	30.6	3	492	43.7	509
14	4	475	3.4	4	444	7.9	460

spike = 500 ng/ml

total mean = 493.4 ng/ml

repeatability (r) = 65.2 ng/ml CV(r) = 4.7 %

reproducibility (R) = 98.1 ng/ml CV(R) = 7.0 %

TABLE 4 RESULTS PCB COMPOUND 101 (ng/ml) - AMPUL F

lab. no.	day 1				day 2			
1	508	506	489	511	487	489	490	491
2	510	490	500	500	570	560	560	530
3	481	500	497	493	510	501	500	497
4	547	559			541	352		
5	508	512			509	497		
6	502	497	496	495	489	490	466	467
7	500	469	402	440	542	515	422	434
8	500	496	497	500	483	483	501	482
9	498	498	498	484	505	502	498	524
10	490	480	466	496	491	497	489	
11	498	467	536	505	472	467	487	495
12	508	494	499	495	492	480	491	489
13	523	585	477	486	357	437	466	
14	471	476	498	476	438	442	437	434

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	504	9.9	4	489	1.7	496
2	4	500	8.2	4	555	17.3	528
3	4	493	8.3	4	502	5.6	497
4	2	553	8.5	2	447	133.6	500
5	2	510	2.8	2	503	8.5	507
6	4	498	3.1	4	478	13.3	488
7	4	453	41.8	4	478	59.3	466
8	4	498	2.1	4	487	9.2	493
9	4	495	7.0	4	507	11.5	501
10	4	483	13.1	3	492	4.2	488
11	4	502	28.3	4	480	13.0	491
12	4	499	6.4	4	488	5.5	494
13	4	518	49.1	3	420	56.5	469
14	4	480	12.1	4	438	3.3	459

spike = 500 ng/ml

total mean = 491.0 ng/ml

repeatability (r) = 94.6 ng/ml CV(r) = 6.8 %

reproducibility (R) = 121.4 ng/ml CV(R) = 8.7 %

TABLE 5 RESULTS PCB COMPOUND 118 (ng/ml) - AMPUL D

lab. no.	day 1				day 2			
2	270	200	270	270	210	250	270	270
4	97	97			108	105		
5	121	117			131	134		
7	19	13	16	10	25	31	24	23
8	181	182	188	188	184	198	204	191
11	160	148	158	146	70	88	101	116
12	250	245	249	247	255	255	256	259
13	129	163	129	116	138	171	144	144
14	185	191	186	193	279	265	265	261

no.	n	mean	s(r)	n	mean	s(r)	mean
2	4	253	35.0	4	250	28.3	251
4	2	97	0.0	2	107	2.1	102
5	2	119	2.8	2	133	2.1	126
7	4	15	3.9	4	26	3.6	20
8	4	185	3.8	4	194	8.7	190
11	4	153	7.0	4	94	19.5	123
12	4	248	2.2	4	256	1.9	252
13	4	134	20.1	4	149	14.8	142
14	4	189	3.9	4	268	7.9	228

spike = 0 ng/ml

TABLE 5 RESULTS PCB COMPOUND 118 (ng/ml) - AMPUL E

lab. no.	day 1				day 2			
1	182	200	192	187	211	184	191	186
2	230	220	240	240	240	260	280	280
3	206	204	214	209	203	206	202	205
4	229	235			193	201		
5	197	213			207	214		
6	228	222	220	224	206	200	208	210
7	133	150	220	182	187	161	197	196
8	186	193	199	187	181	190	185	193
9	229	222	218	230	227	233	228	229
10	235	222	219	238	197	196	206	202
11	198	183	223	206	181	182	186	190
12	219	213	220	215	223	216	227	222
13	153	182	175	189	177	165	154	
14	210	209	208	210	223	217	219	215

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	190	7.7	4	193	12.4	192
2	4	233	9.6	4	265	19.1	249
3	4	208	4.3	4	204	1.8	206
4	2	232	4.2	2	197	5.7	215
5	2	205	11.3	2	211	4.9	208
6	4	224	3.4	4	206	4.3	215
7	4	171	38.3	4	185	16.8	178
8	4	191	6.0	4	187	5.3	189
9	4	225	5.7	4	229	2.6	227
10	4	229	9.4	4	200	4.6	214
11	4	203	16.7	4	185	4.1	194
12	4	217	3.3	4	222	4.5	219
13	4	175	15.6	3	165	11.5	170
14	4	209	1.0	4	219	3.4	214

spike = 200 ng/ml

total mean = 206.4 ng/ml

repeatability (r) = 32.1 ng/ml CV(r) = 5.5 %

reproducibility (R) = 44.4 ng/ml CV(R) = 7.6 %

TABLE 5 RESULTS PCB COMPOUND 118 (ng/ml) - AMPUL F

lab. no.	day 1				day 2			
1	115	122	115	118	123	119	127	126
2	170	170	180	200	200	200	200	200
4	153	142			137	109		
5	130	124			130	128		
6	145	142	147	147	132	129	123	121
7	87	81	85	98	113	125	103	108
8	145	143	140	145	148	148	148	143
9	146	149	148	147	147	150	150	150
10	192	184	176	186	124	126	121	
11	182	168	184	170	166	175	169	160
12	139	135	137	135	138	141	146	149
13	141	184	151	119	89	119	119	
14	189	191	188	189	221	224	223	221

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	118	3.3	4	124	3.6	121
2	4	180	14.1	4	200	0.0	190
4	2	148	7.8	2	123	19.8	135
5	2	127	4.2	2	129	1.4	128
6	4	145	2.4	4	126	5.1	136
7	4	88	7.3	4	112	9.4	100
8	4	143	2.4	4	147	2.5	145
9	4	148	1.3	4	149	1.5	148
10	4	185	6.6	3	124	2.5	154
11	4	176	8.2	4	168	6.2	172
12	4	137	1.9	4	144	4.9	140
13	4	149	27.0	3	109	17.3	129
14	4	189	1.3	4	222	1.5	206

spike = 120 ng/ml

TABLE 6 RESULTS PCB COMPOUND 153 (ng/ml) - AMPUL D

lab. no.	day 1				day 2			
1	190	178	182	196	190	191	204	202
2	530	510	400	480	470	560	670	670
3	219	224	223	223	216	219	222	215
4	196	217			186	202		
5	215	214			219	211		
6	225	229	225	230	216	222	219	207
7	173	171	230	200	188	183	181	150
8	208	204	216	210	207	218	221	210
9	254	246	229	220	251	241	241	246
10	244	241	240	197	206	204	201	204
11	186	162	209	182	127	166	179	195
12	235	230	225	226	235	237	228	235
13	181	272	189	173	204	263	209	201
14	220	228	222	229	225	216	217	218

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	187	8.1	4	197	7.3	192
2	4	480	57.2	4	593	96.7	536**
3	4	222	2.2	4	218	3.2	220
4	2	207	14.8	2	194	11.3	200
5	2	215	0.7	2	215	5.7	215
6	4	227	2.6	4	216	6.5	222
7	4	194	27.7	4	176	17.3	185
8	4	210	5.0	4	214	6.6	212
9	4	237	15.5	4	245	4.8	241
10	4	231	22.4	4	204	2.1	217
11	4	185	19.3	4	167	29.0	176
12	4	229	4.5	4	234	3.9	231
13	4	204	46.0	4	219	29.4	212
14	4	225	4.4	4	219	4.1	222

spike = 200 ng/ml

total mean = 234.3 ng/ml

repeatability (r) = 74.4 ng/ml CV(r) = 11.2 %

reproducibility (R) = 263.3 ng/ml CV(R) = 39.7 %

without laboratory 2

total mean = 211.0 ng/ml

repeatability (r) = 45.5 ng/ml CV(r) = 7.6 %

reproducibility (R) = 68.1 ng/ml CV(R) = 11.4 %

TABLE 6 RESULTS PCB COMPOUND 153 (ng/ml) - AMPUL F

lab. no.	day 1				day 2			
1	77	71	79	78	85	79	86	71
2	160	160	160	190	200	210	210	160
3	95	94	94	94	93	93	92	92
4	94	100			89	81		
5	85	86			94	86		
6	100	97	99	97	103	114	95	94
7	79	76	62	81	85	98	73	82
8	93	92	88	93	87	94	87	90
9	109	105	106	102	109	104	106	113
10	119	114	103	115	84	95	84	
11	93	81	85	74	67	69	69	67
12	106	104	105	103	110	112	112	109
13	90	100	81	76	56	66	69	
14	115	114	108	117	106	109	108	107

no.	n	mean	s(r)	n	mean	s(r)	mean	
1	4	76	3.6	4	80	6.9	78	
2	4	168	15.0	4	195	23.8	181	**
3	4	94	0.5	4	93	0.6	93	
4	2	97	4.2	2	85	5.7	91	
5	2	86	0.7	2	90	5.7	88	
6	4	98	1.5	4	102	9.3	100	
7	4	75	8.6	4	85	10.3	80	
8	4	92	2.4	4	90	3.3	91	
9	4	106	2.9	4	108	3.9	107	
10	4	113	6.8	3	88	6.4	100	
11	4	83	7.9	4	68	1.2	76	
12	4	105	1.3	4	111	1.5	108	
13	4	87	10.6	3	64	6.8	75	
14	4	114	3.9	4	108	1.3	111	

spike = 80 ng/ml

total mean = 98.4 ng/ml

repeatability (r) = 21.2 ng/ml CV(r) = 7.6 %

reproducibility (R) = 80.0 ng/ml CV(R) = 28.7 %

without laboratory 2

total mean = 92.0 ng/ml

repeatability (r) = 15.5 ng/ml CV(r) = 6.0 %

reproducibility (R) = 41.1 ng/ml CV(R) = 15.8 %

TABLE 7 RESULTS PCB COMPOUND 138 (ng/ml) - AMPUL D

lab. no.	day 1				day 2			
1	486	473	485	491	467	481	476	496
2	270	200	210	270	230	240	270	250
3	477	514	511	509	472	513	502	496
4	427	484			466	454		
5	504	521			512	528		
6	489	510	510	510	480	508	500	492
7	496	468	420	460	450	413	410	376
8	481	483	494	484	498	502	508	494
9	511	507	502	486	504	523	498	517
10	492	490	433	499	482	477	476	476
11	490	425	513	445	464	498	562	538
12	513	508	491	514	480	491	474	488
13	461		469	453	538	648	523	536
14	477	493	486	491	490	492	494	489

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	484	7.6	4	480	12.1	482**
2	4	238	37.7	4	248	17.1	243
3	4	503	17.3	4	496	17.3	499
4	2	456	40.3	2	460	8.5	458
5	2	513	12.0	2	520	11.3	516
6	4	505	10.5	4	495	11.9	500
7	4	461	31.4	4	412	30.2	437
8	4	486	5.8	4	501	6.0	493
9	4	502	11.0	4	511	11.5	506
10	4	479	30.6	4	478	2.9	478
11	4	468	40.4	4	516	43.3	492
12	4	507	10.7	4	483	7.7	495
13	3	461	8.0	4	561	58.2	511
14	4	487	7.1	4	491	2.2	489

spike = 500 ng/ml

total mean = 471.3 ng/ml

repeatability (r) = 65.7 ng/ml CV(r) = 4.9 %

reproducibility (R) = 209.1 ng/ml CV(R) = 15.7 %

without laboratory 2

total mean = 488.9 ng/ml

repeatability (r) = 64.1 ng/ml CV(r) = 4.6 %

reproducibility (R) = 96.5 ng/ml CV(R) = 7.0 %

TABLE 7 RESULTS PCB COMPOUND 138 (ng/ml) - AMPUL F

lab. no.	day 1				day 2			
1	185	183	190	185	177	192	191	178
2	120	120	110	110	120	130	130	110
3	203	211	215	211	199	214	206	205
4	233	229			232	201		
5	213	214			208	200		
6	222	215	215	215	252	274	228	225
7	163	147	176	149	189	205	157	173
8	210	214	209	210	198	198	198	202
9	245	257	247	235	255	259	253	256
10	275	257	205	229	206	210	207	
11	205	178	201	174	190	183	193	187
12	229	220	227	223	227	220	226	221
13	232	261	212	176	136	165	176	
14	200	208	204	212	205	211	208	209

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	186	3.0	4	185	8.1	185
2	4	115	5.8	4	123	9.6	119
3	4	210	5.0	4	206	6.2	208
4	2	231	2.8	2	217	21.9	224
5	2	214	0.7	2	204	5.7	209
6	4	217	3.5	4	245	22.9	231
7	4	159	13.5	4	181	20.7	170
8	4	211	2.2	4	199	2.0	205
9	4	246	9.0	4	256	2.5	251
10	4	242	30.8	3	208	2.1	225
11	4	190	15.8	4	188	4.3	189
12	4	225	4.0	4	224	3.5	224
13	4	220	35.7	3	159	20.7	190
14	4	206	5.2	4	208	2.5	207

spike = 200 ng/ml

total mean = 202.5 ng/ml

repeatability (r) = 37.9 ng/ml CV(r) = 6.6 %

reproducibility (R) = 101.4 ng/ml CV(R) = 17.7 %

TABLE 8 RESULTS PCB COMPOUND 180 (ng/ml) - AMPUL E

lab. no.	day 1				day 2			
1	439	453	443	459	497	501	486	482
2	430	450	470	470	450	310	420	360
3	497	486	529	524	499	499	509	490
4	577	488			474	407		
5	529	496			500	486		
6	496	517	506	505	524	550	548	633
7	489	485	506	490	492	511	523	494
8	493	492	489	484	486	479	484	491
9	499	503	486	512	498	506	504	493
10	510	526	487	484				
11	508	466	567	521	531	551	591	567
12	516	501	498	510	512	473	498	508
13	412	514	480		456	442	387	
14	482	481	481	481	489	493	487	484

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	449	9.1	4	492	9.0	470
2	4	455	19.1	4	385	62.4	420
3	4	509	20.8	4	499	7.8	504
4	2	533	62.9	2	441	47.4	487
5	2	513	23.3	2	493	9.9	503
6	4	506	8.6	4	564	47.7	535
7	4	493	9.3	4	505	14.7	499
8	4	490	4.0	4	485	5.0	487
9	4	500	10.8	4	500	5.9	500
10	4	502	19.9				502
11	4	516	41.6	4	560	25.4	538
12	4	506	8.3	4	498	17.5	502
13	3	469	51.9	3	428	36.5	448
14	4	481	0.5	4	488	3.8	485

spike = 500 ng/ml

total mean = 491.4 ng/ml

repeatability (r) = 79.7 ng/ml CV(r) = 5.7 %

reproducibility (R) = 106.4 ng/ml CV(R) = 7.7 %

TABLE 8 RESULTS PCB COMPOUND 180 (ng/ml) - AMPUL F

lab. no.	day 1				day 2			
1	255	279	253	265	261	259	273	265
2	290	280	270	330	370	310	280	210
3	309	306	319	321	312	317	305	297
4	417	324			305	275		
5	312	311			290	295		
6	315	309	309	309	359	389	316	319
7	294	255	290	278	296	313	257	289
8	320	328	317	320	320	320	320	320
9	368	360	345	341	354	362	365	367
10		326	304	317				
11	323	297	364	334	300	314	325	345
12	333	314	321	320	316	328	332	336
13	310	396	324	255	168	211	255	
14	303	301	309	298	307	305	303	304

no.	n	mean	s(r)	n	mean	s(r)	mean
1	4	263	11.9	4	265	6.2	264
2	4	293	26.3	4	293	66.5	293
3	4	314	7.4	4	308	8.7	311
4	2	371	65.8	2	290	21.2	330
5	2	312	0.7	2	293	3.5	302
6	4	311	3.0	4	346	34.9	328
7	4	279	17.5	4	289	23.4	284
8	4	321	4.7	4	320	0.0	321
9	4	354	12.7	4	362	5.7	358
10	3	316	11.1				316
11	4	330	27.7	4	321	19.0	325
12	4	322	8.0	4	328	8.6	325
13	4	321	58.1	3	211	43.5	266
14	4	303	4.6	4	305	1.7	304

spike = 300 ng/ml

total mean = 309.0 ng/ml

repeatability (r) = 74.2 ng/ml CV(r) = 8.5 %

reproducibility (R) = 111.5 ng/ml CV(R) = 12.8 %

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BCR-ringtest of individual chlorobiphenyls (2/1983)

Receipt/Confirmation letter

I declare herewith the receipt of a set ampuls for the BCR ringtest.
The ampuls have been received in good condition, yes/no.
Damaged: ampul no ....., ..., ...
Loss of weight: ampul no ....., ..., ...

I request for new ampuls coded with letter ....., ..., ...

Date: Signature:

Name of Institute:

BCR-ringtest of individual chlorobiphenyls (1/1983)

Results AMPUL C Institute:

For quantification is used: peak height/peak area *)

PCB-compound (IUPAC number)	Date of analysis: 1st results				Date of analysis: 2nd results			
28								
52								
101								
118								
153								
138								
180								

Results of ampuls C are reported in µg/ml and calculated on standard solution ampul B.
Results are not corrected for blanc ampul C.

*) delete as necessary.

BCR-ringtest of individual chlorobiphenyls (1/1983)

Results AMPUL D Institute:

For quantification is used: peak height/peak area *)

PCB-compound (IUPAC number)	Date of analysis: 1st results				Date of analysis: 2nd results			
28								
52								
101								
118								
153								
138								
180								

Results of ampuls D are reported in µg/ml and calculated on standard solution ampul B.
Results are not corrected for blanc ampul C.

*) delete as necessary.

BCR-ringtest of individual chlorobiphenyls (1/1983)

Results AMPUL E Institute:

For quantification is used: peak height/peak area *)

PCB-compound (IUPAC number)	Date of analysis: 1st results				Date of analysis: 2nd results			
28								
52								
101								
118								
153								
138								
180								

Results of ampuls E are reported in µg/ml and calculated on standard solution ampul B.
Results are not corrected for blanc ampul C.

*) delete as necessary.

BCR-ringtest of individual chlorobiphenyls (1/1983)

Results AMPUL F Institute:

For quantification is used: peak height/peak area *)

PCB-compound (IUPAC number)	Date of analysis: 1st results				Date of analysis: 2nd results			
28								
52								
101								
118								
153								
138								
180								

Results of ampuls F are reported in µg/ml and calculated on standard solution ampul B.
Results are not corrected for blanc ampul C.

*) delete as necessary.

BCR-ringtest of individual chlorobiphenyls (1/1983)

Gaschromatographic conditions

Apparatus (type)
ECD (type)
Column phase , chemical bonded yes/no.
length (m)
inner diameter (mm)
film thickness (µm)
Temperature (°C) column isothermal
temp. programme
injector
detector
Mobile phase (cm/sec)
type of gas
Purge/bypass (ml/min)
type of gas
Attenuation amplifier
Recorder paperspeed (cm/min)
range (mV)
Injectionvolume (µl)
type of injection Grob/Falling needle/...../.....

Linearity for PCB's tested recent yes/no Result: .....
k' 138 (isothermal at 220°C)
N 138 (isothermal at 220°C)

Which problems by $(GC)^2$ analysis have been met?

Report 1983-05-26

BCR-ringtest of individual chlorobiphenyls (1/1983) - Summary of results.

by L.G.M.Th. Tuinstra, A.H. Roos and G.A. Werdmuller.

State Institute for Quality Control of Agricultural Products, Bornsesteeg 45, 6708 PD Wageningen, The Netherlands.

This report has been written for information to the EC-Community Bureau of Reference, Brussels, as described in contract 1/9/000/83/ / dated april.