Analytische Qualitätssicherung Baden-Württemberg

Proficiency Tests UKWIR 1/21 to 4/21
priority substances in surface water -

benzo[a]pyrene, fluoranthene, perfluorooctane sulfonic acid,
perfluorooctanoic acid, cypermethrin, hexabromocyclodecane

Stuttgart, May 2021

provided by
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c/o Institute for Sanitary Engineering, Water Quality and Solid Waste Management,
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General

These PT were provided by AQS Baden-Württemberg as a subcontractor for wca environment limited, Brunel House, Volunteer Way, Faringdon, Oxfordshire SN7 7YR, United Kingdom on behalf of United Kingdom Water Industry Research (UKWIR).

In four rounds the following determinands were to be measured:

- UKWIR 1/21
  - benzo[a]pyrene
  - fluoranthene
- UKWIR 2/21
  - perfluorooctane sulfonic acid (PFOS)
  - perfluorooctanoic acid (PFOA)
- UKWIR 3/21
  - cypermethrin
- UKWIR 4/21
  - hexabromocyclododecane (HBCDD)

The PTs were executed and evaluated according to the requirements of ISO 13528: 2015.

PT design

Each participant received the following samples for the PT rounds:

- 3 spiked samples for the determination of the respective determinands based on a filtered surface water sample in 1000 ml glass bottles with ground glass plug
- 1 blank sample of the filtered surface water

The concentrations of the analytes of the spiked samples were chosen according to the requirements of UKWIR based on the European Regulation for Environmental Quality Standard (Directive 2008/105/EG on environmental quality standards in the field of water policy).

The samples were cooled directly after preparation and dispatched with freezer packs added to the packages by express service (GoExpress). Participants were requested to start with the analysis one day after receipt of the samples at the latest.

Analytical methods

The participants were free to choose a suitable method, but the following limits of quantification were required:

Determinand	**Required LOQ**
benzo[a]pyrene	0.5 ng/l
fluoranthene	1.8 ng/l
PFOS	2 ng/l
PFOA	2 ng/l
cypermethrin	0.0004 µg/l
HBCDD	0.0092 µg/l

The samples had to be analysed in duplicate over the complete method (sample preparation and measurement). The participants were asked to submit the results as average values with three significant digits.

Evaluation procedure

The statistical evaluation was executed according to ISO 13528:2015 with the combined estimator Hampel/Q-method, a method of robust statistics.

The uncertainty of the assigned value was calculated acccording to ISO 13528:

$$u(x_{pt}) = \frac{1{,}25\ x\ s^*}{\sqrt{p}}$$

s*: standard deviation calculated from the results using the Q-method
p: number of results

The standard deviation for proficiency assessment σ_{pt} was calculated in accordance with the European QA/QC Directive: $\sigma_{pt} = 0{,}25 * x_{pt}$.

A z-score was calculated for each measurement result derived from the assigned value x_{pt} and the standard deviation for proficiency assessment σ_{pt}:

$$z = \frac{x - x_{pt}}{\sigma_{pt}}$$

The assessment of the results was as follows:

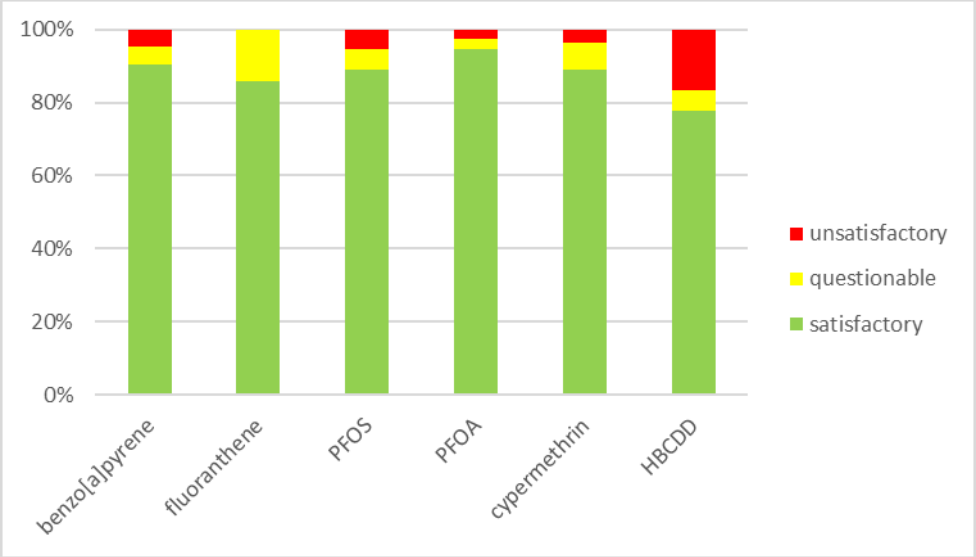
$\|z\| \leq 2.0$	satisfactory
$2.0 < \|z\| < 3.0$	questionable
$\|z\| \geq 3.0$	unsatisfactory

Results of evaluation

Number of participants:

PT round	determinands	number of participants	number of participants reporting results
UKWIR 1/21	benzo[a]pyrene fluoranthene	8	7
UKWIR 2/21	perfluorooctane sulfonic acid (PFOS) perfluorooctanoic acid (PFOA)	15	12
UKWIR 3/21	cypermethrin	9	9
UKWIR 4/21	HBCDD	7	6

In the following figure the percentage of satisfactory, questionable and unsatisfactory results are illustrated.



Explanation of tables and graphs in the appendix

The appendix contains the PT data for all parameters and all samples in tables and graphs. For each parameter the following illustrations are given:

Parameter table

In these tables the following values for each concentration level are listed:

- assigned value in ng/l or µg/l
- expanded uncertainty of the assigned value in %
- standard deviation of the data set in ng/l or µg/l, calculated using the Q-method (due to the often low number of participants this standard deviation estimate is not very reliable)
- standard deviation for proficiency assessment in ng/l or µg/l for the calculation of z-scores (25 % of the assigned value)
- rel. standard deviation for proficiency assessment in %
- tolerance limits above and below in ng/l or µg/l and % (limit for assessment as 'satisfactory')
- number of values in this level
- number of not satisfactory values ('questionable' or unsatisfactory') below and above the assigned value and the percentage of these values in total

Relative standard deviation

The diagrams for the rel. standard deviation vs. the assigned value show the values compared to the fixed standard deviation for proficiency assessment (horizontal line at 25%) and the concentration dependence.

Sample table

In this table all results of the participants are noted together with uncertainties (where reported). For these uncertainties ζ-scores (zeta-scores) are calculated according to the formula

$$\zeta = \frac{x - x_{pt}}{\sqrt{{u_{lab}}^2 + {u_{x_{pt}}}^2}}$$

with

x = result of the participant
x_{pt} = assigned value
u_{lab} = participant's standard uncertainty
$u_{x,pt}$ = standard uncertainty of the assigned value

ζ-scores can be used for the plausibility check of measurement uncertainties. The type of assessment is equivalent to that of z-scores, i.e. an absolute value of ≤ 2,0 can be regarded as 'satisfactory'.
ζ-scores above this value indicate an underestimation of the measurement uncertainty.
This table also contains the assigned value and its uncertainty as well as the tolerance limits (z = ± 2,0).

Sample graphs of concentrations

All participants' results, sorted for values, are shown here versus the laboratory codes. The assigned value and its uncertainty as well as the tolerance limits are also included.

z-score graphs

In a similar way the z-scores attributed to the participants' results are shown here versus the laboratory codes.

Graphs of expanded uncertainty

The expanded uncertainty is shown if laboratories reported uncertainties.

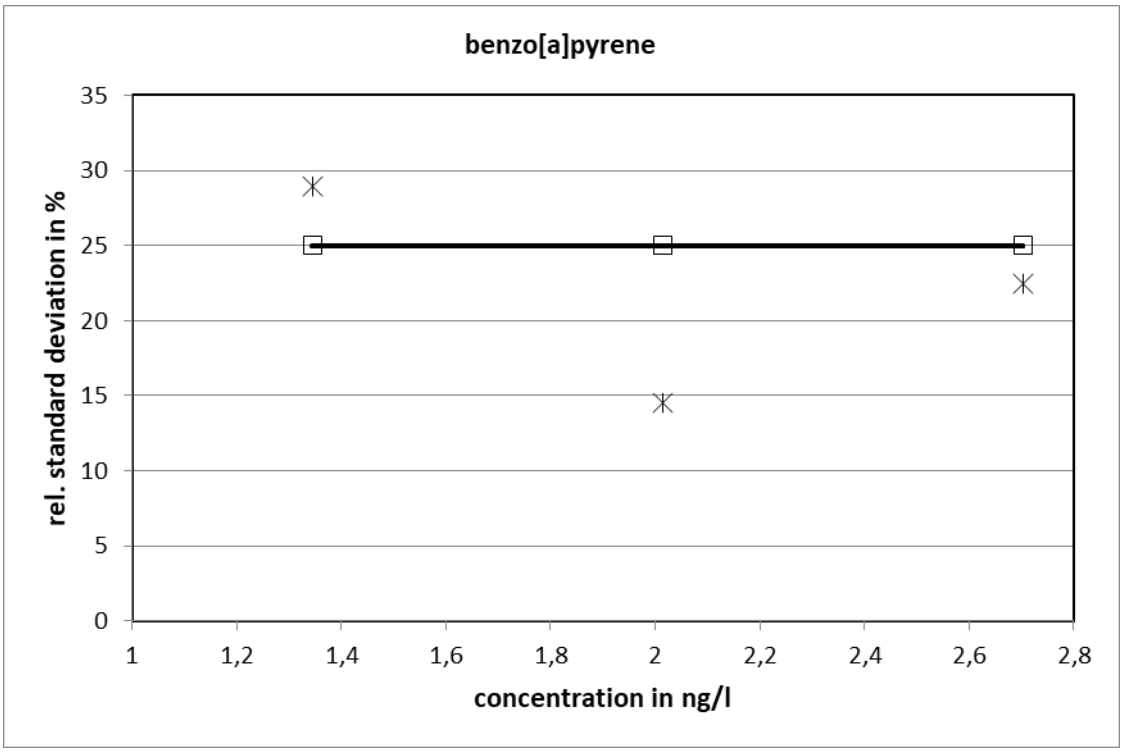
ζ-score graphs

If laboratories reported uncertainties, ζ-scores were calculated and are shown versus the laboratory codes.

UKWIR 1/21

benzo[a]pyrene													
level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [ng/l]	standard deviation for proficiency assessment [ng/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [ng/l]	lower tolerance limit [ng/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]
1	1,344	27,38	0,3895	0,3361	25	2,016	0,6722	50	-50	7	1	0	14,3
2	2,014	14,82	0,2924	0,5034	25	3,020	1,007	50	-50	6	1	0	14,3
3	2,703	21,21	0,6069	0,6758	25	4,055	1,352	50	-50	7	0	0	0,0
									sum	20	2	0	10,0

Relative standard deviation

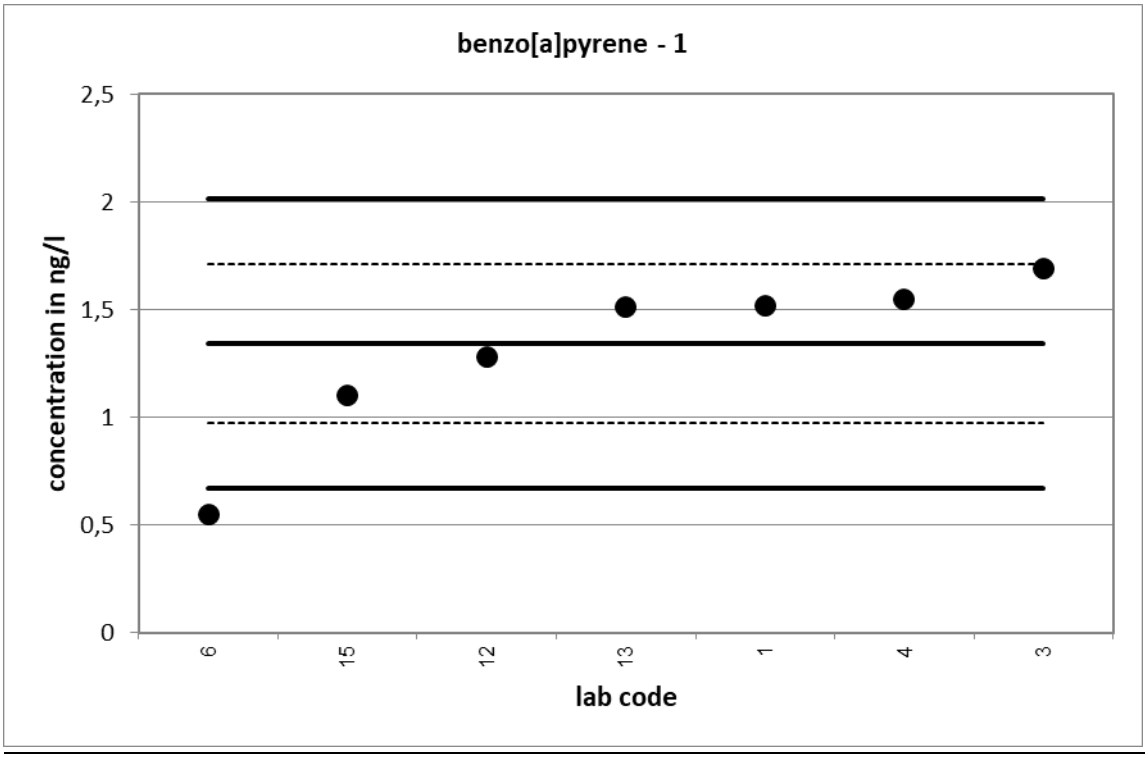


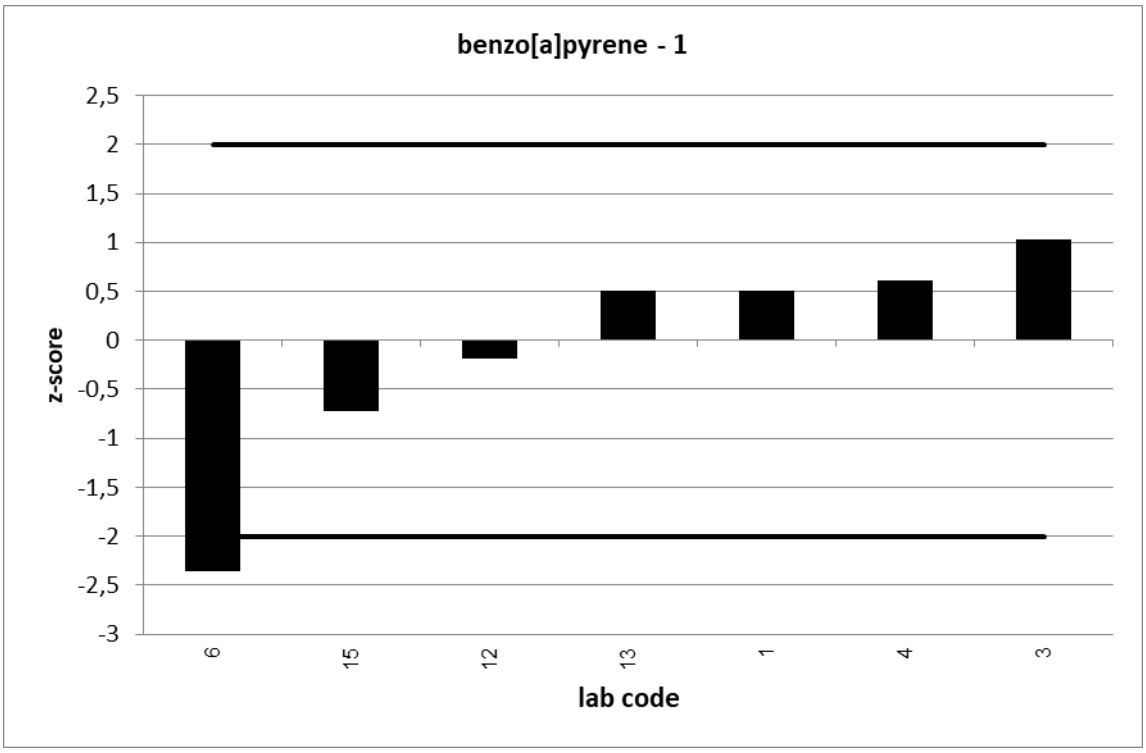
25 % is the value used as standard deviation for proficiency assessment.

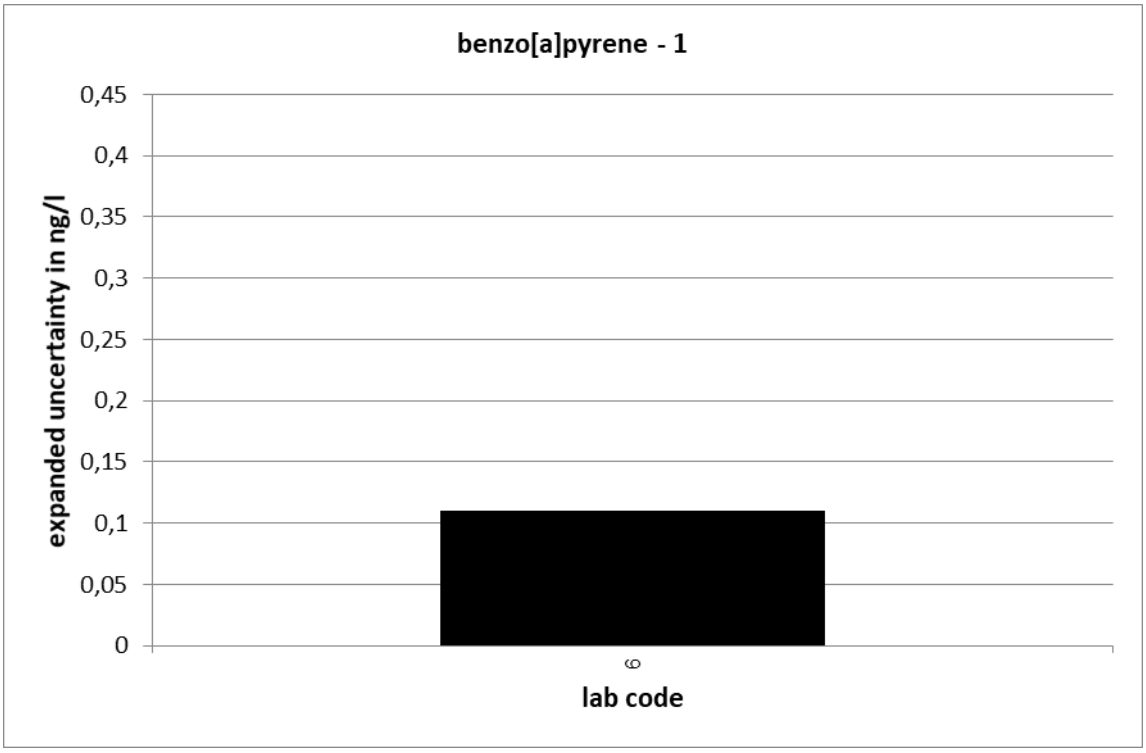
UKWIR PT 1/21		benzo[a]pyrene - 1			
assigned value [ng/l]*			1,344	± 0,368	
upper tolerance limit [ng/l]			2,016		
lower tolerance limit [ng/l]			0,6722		
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
12	1,28			-0,2	s
1	1,516			0,5	s
13	1,514			0,5	s
4	1,55			0,6	s
15	1,1			-0,7	s
6	0,55	0,11	-4,1	-2,4	q
3	1,69			1,0	s

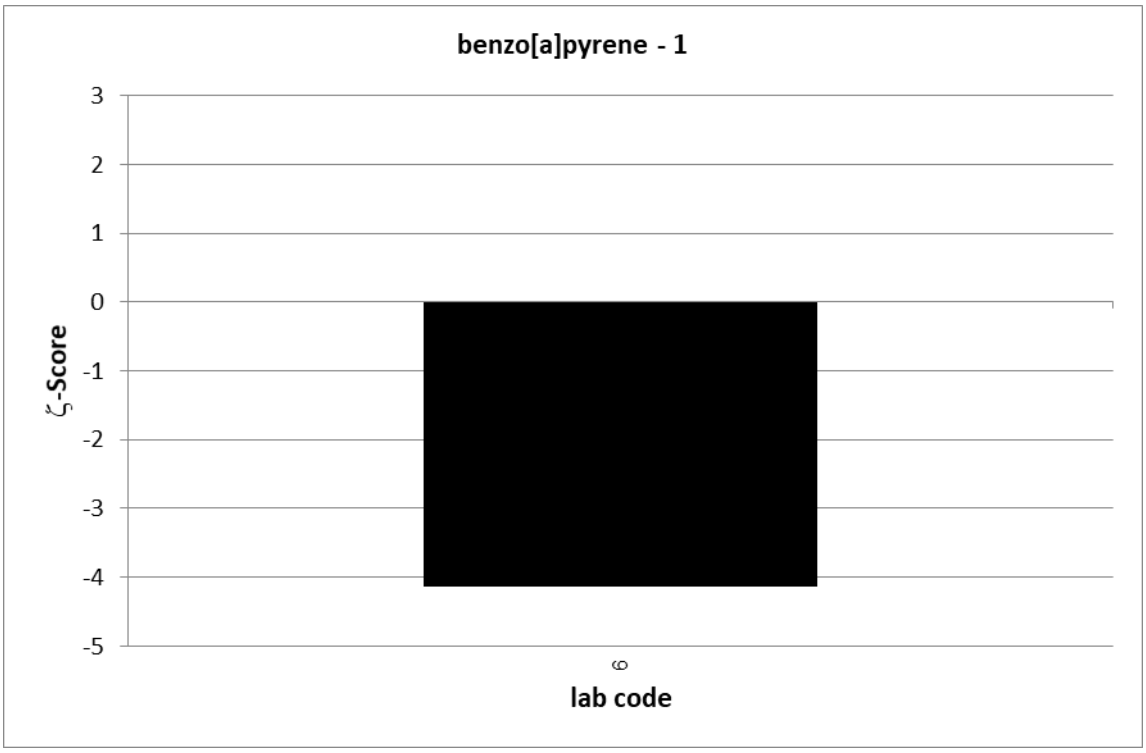
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




benzo[a]pyrene - 1
z-score
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
-3
6
15
12
13
1
4
3
lab code

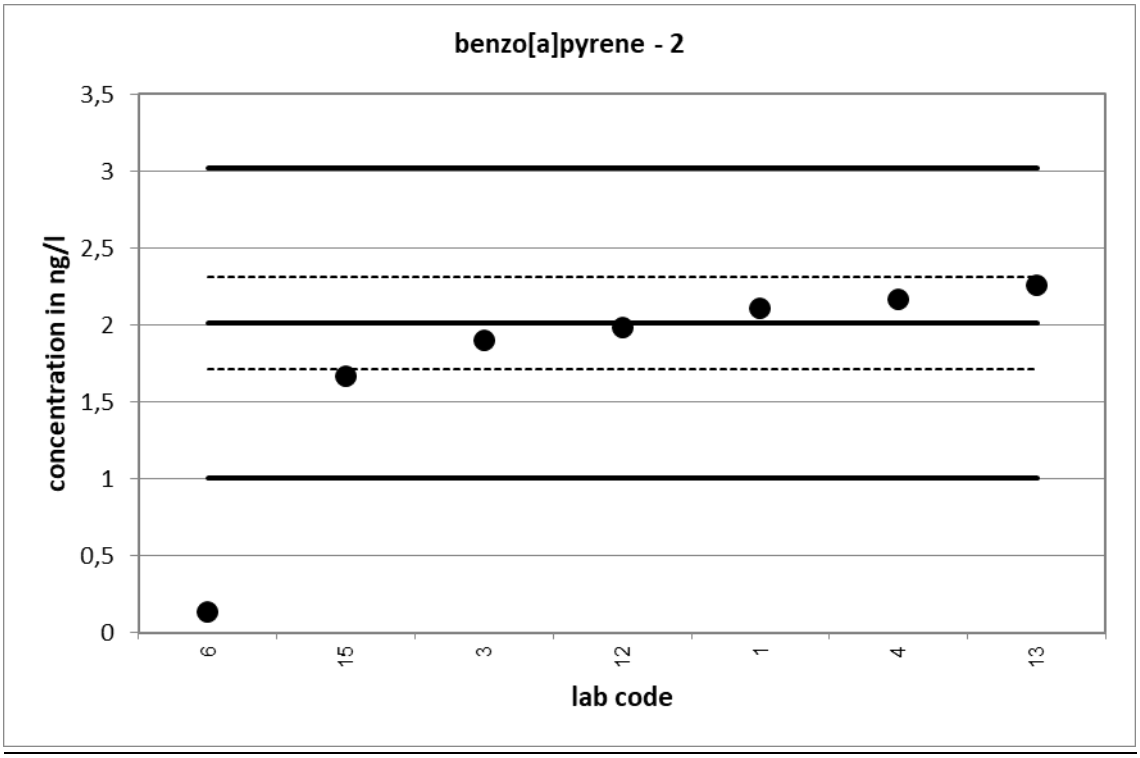

benzo[a]pyrene - 1
expanded uncertainty in ng/l
0,45
0,4
0,35
0,3
0,25
0,2
0,15
0,1
0,05
0
6
lab code

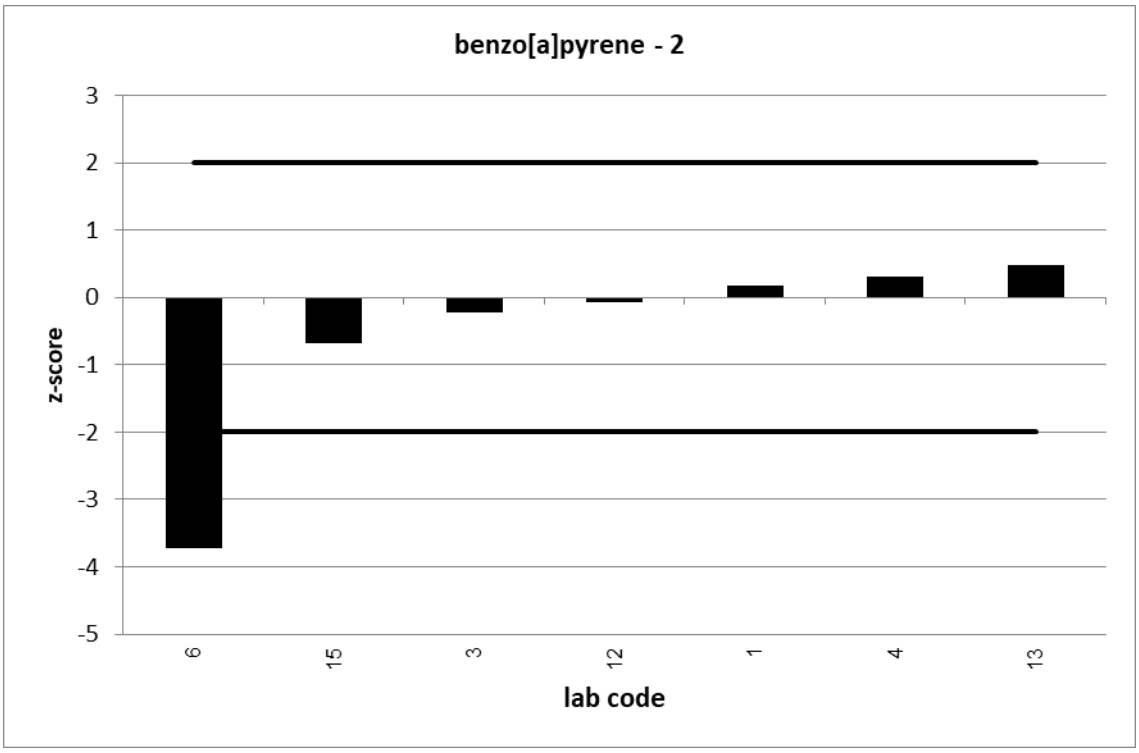

benzo[a]pyrene - 1
3
2
1
0
-1
-2
-3
-4
-5
ζ-Score
6
lab code

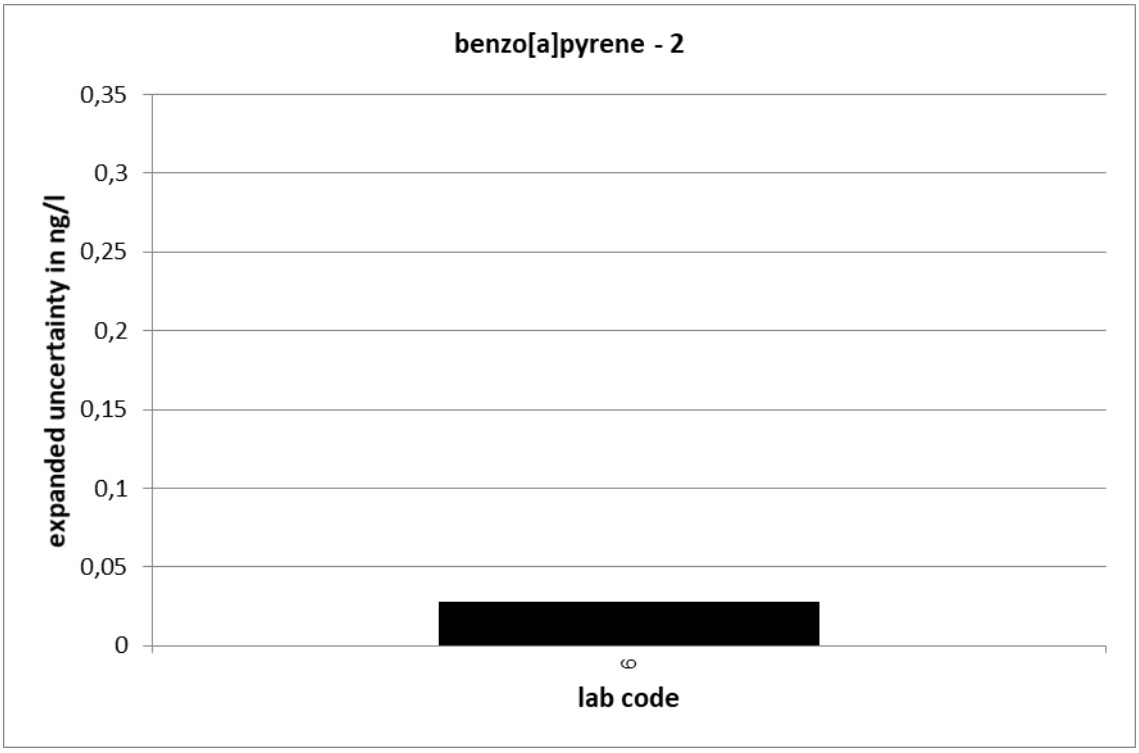
UKWIR PT 1/21		benzo[a]pyrene - 2			
assigned value [ng/l]*		2,014	± 0,298		
upper tolerance limit [ng/l]		3,02			
lower tolerance limit [ng/l]		1,007			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
6	0,14	0,028	-12,5	-3,7	u
12	1,98			-0,1	s
1	2,106			0,2	s
13	2,255			0,5	s
4	2,17			0,3	s
15	1,67			-0,7	s
3	1,9			-0,2	s

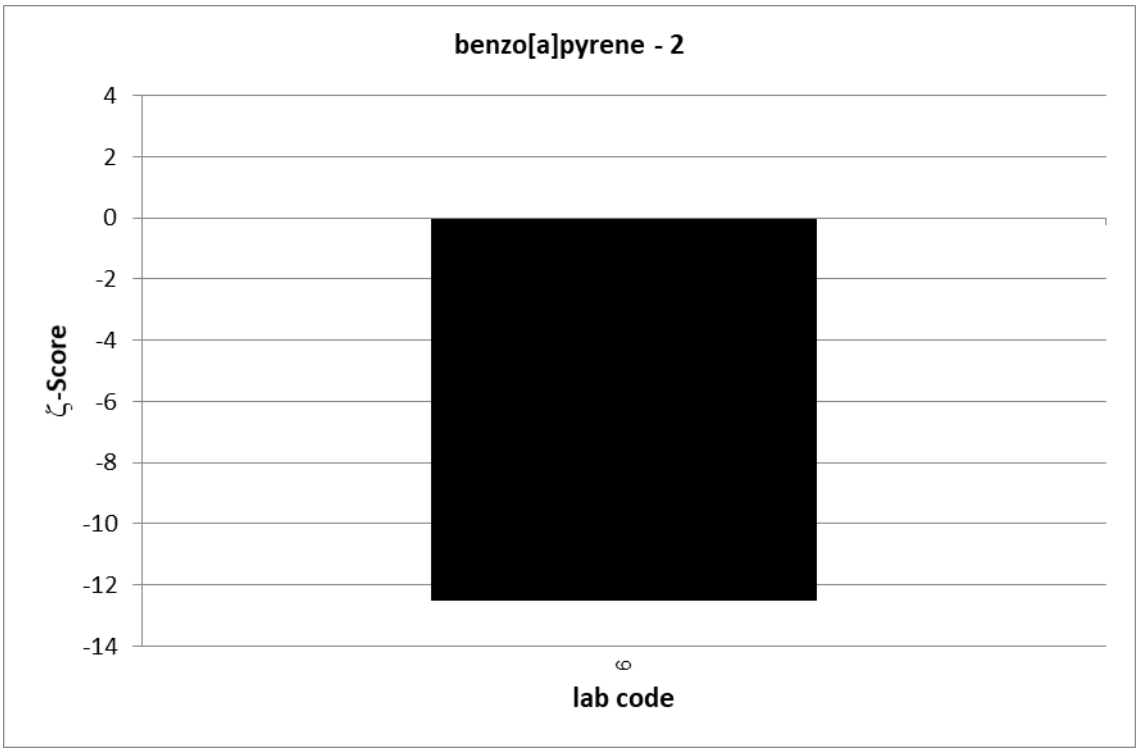
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




benzo[a]pyrene - 2
z-score
3
2
1
0
-1
-2
-3
-4
-5
6
15
3
12
1
4
13
lab code

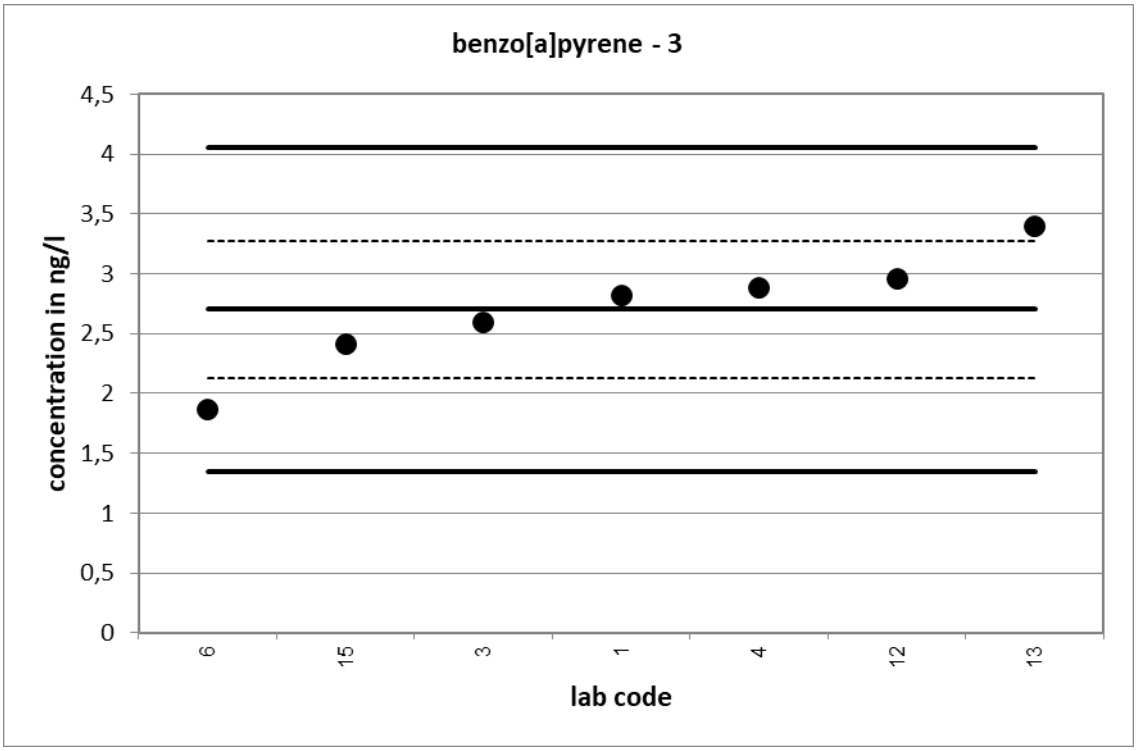

benzo[a]pyrene - 2
expanded uncertainty in ng/l
0,35
0,3
0,25
0,2
0,15
0,1
0,05
0
6
lab code

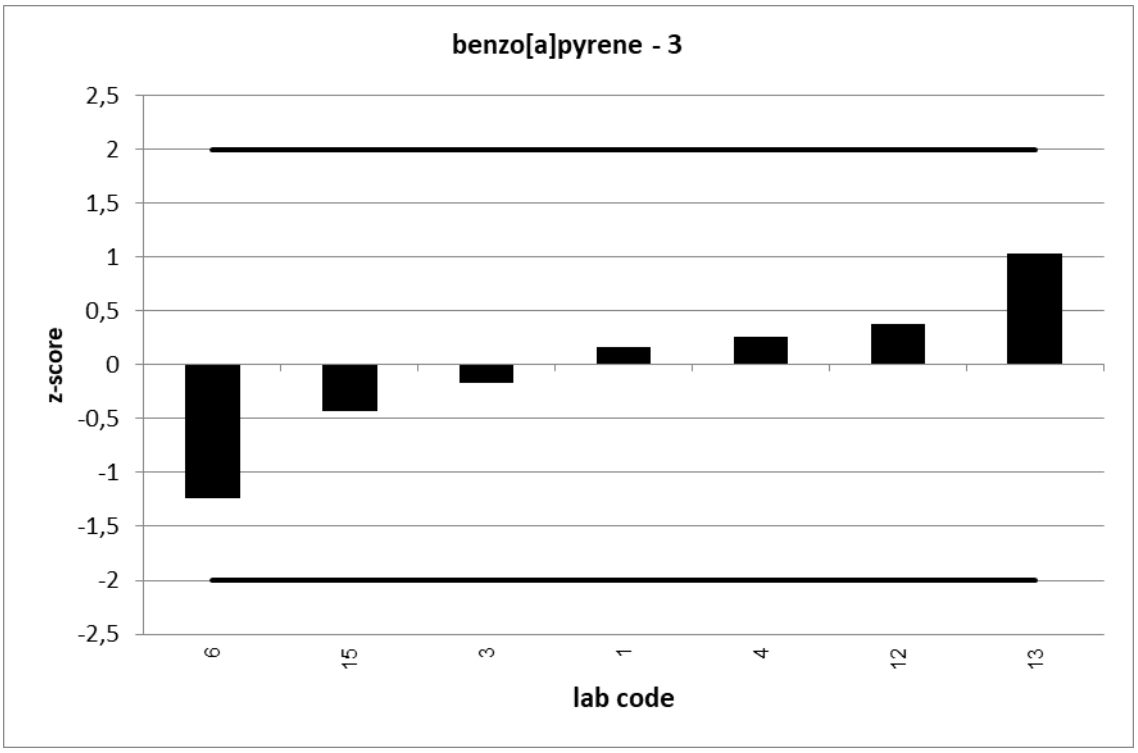

benzo[a]pyrene - 2
4
2
0
-2
-4
-6
-8
-10
-12
-14
ζ-Score
9
lab code

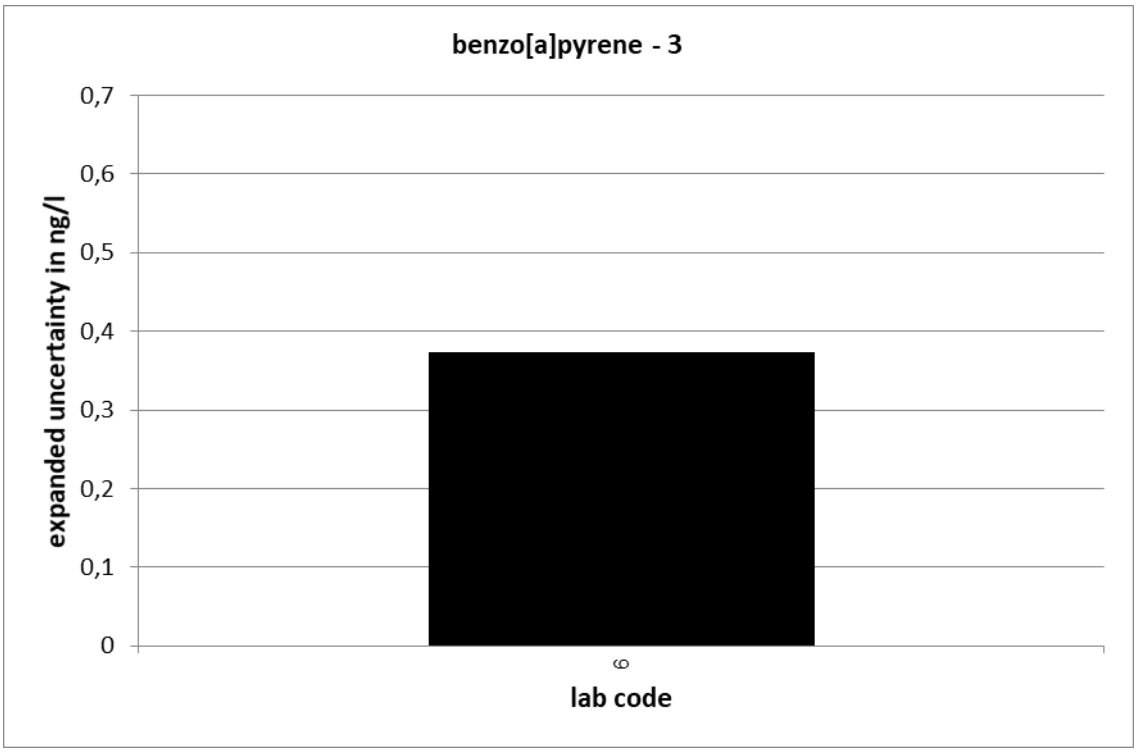
UKWIR PT 1/21		benzo[a]pyrene - 3			
assigned value [ng/l]*		2,703	± 0,574		
upper tolerance limit [ng/l]		4,055			
lower tolerance limit [ng/l]		1,352			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
12	2,96			0,4	s
1	2,814			0,2	s
13	3,399			1,0	s
4	2,88			0,3	s
15	2,41			-0,4	s
6	1,87	0,374	-2,4	-1,2	s
3	2,59			-0,2	s

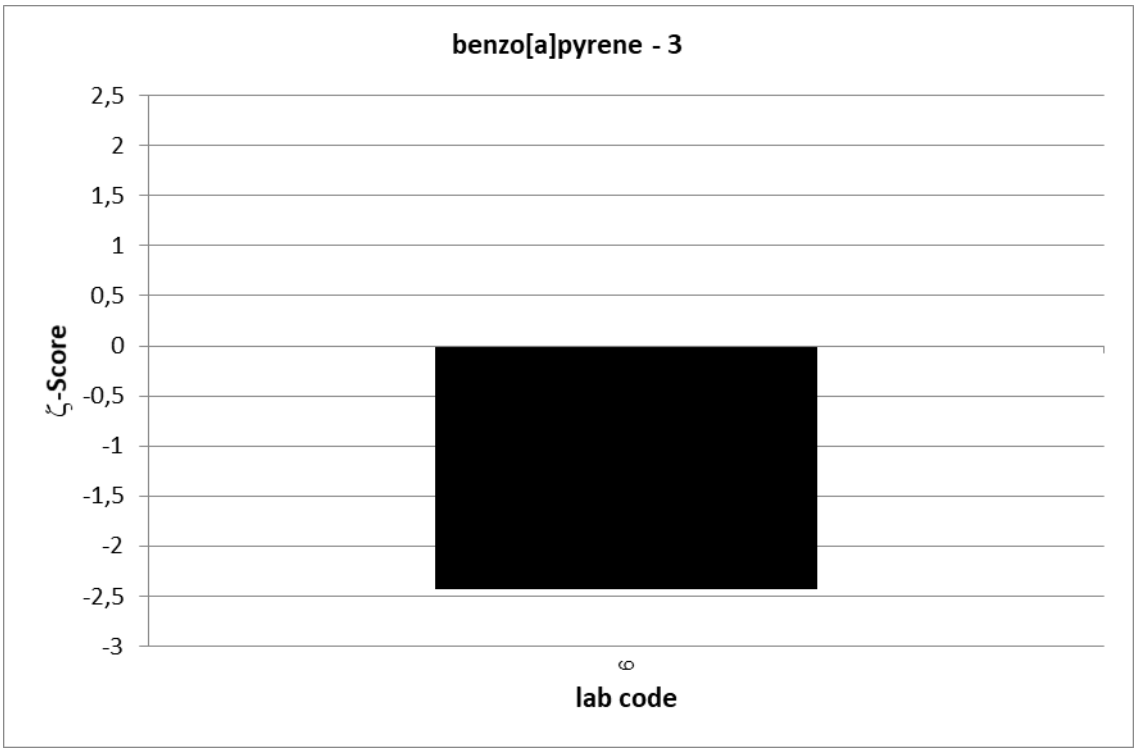
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




benzo[a]pyrene - 3
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
z-score
6
15
3
1
4
12
13
lab code

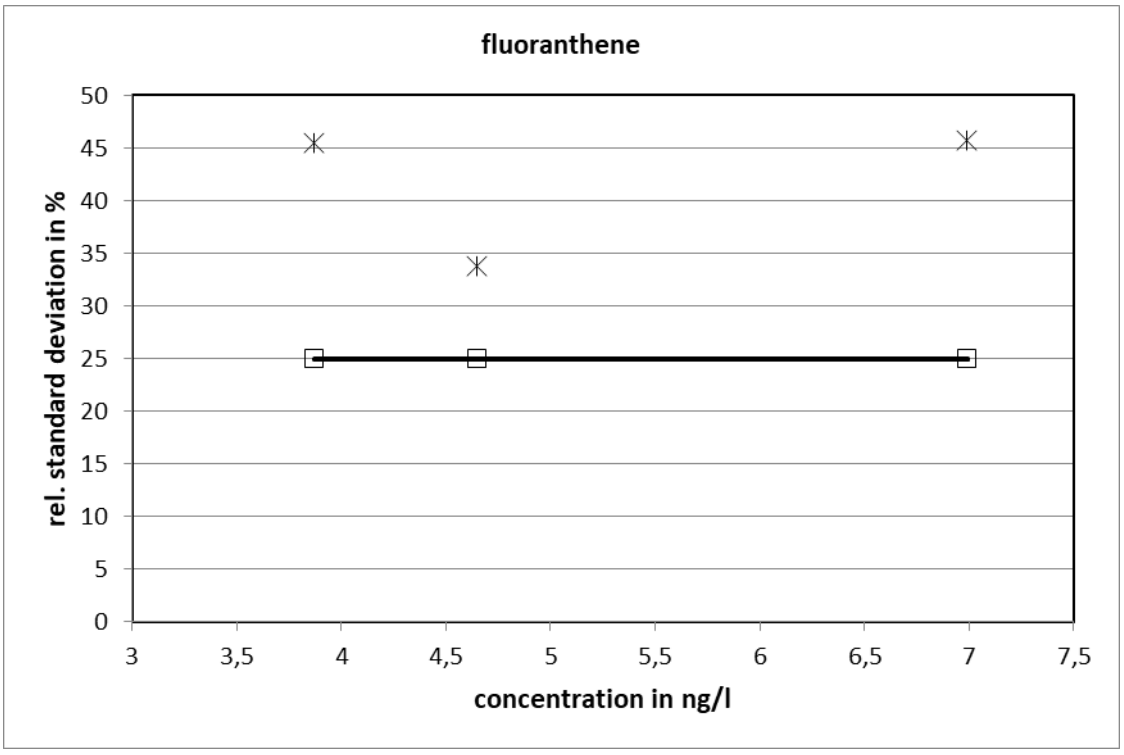

benzo[a]pyrene - 3
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0
expanded uncertainty in ng/l
6
lab code


benzo[a]pyrene - 3
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
-3
ζ-Score
6
lab code

fluoranthene

level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [ng/l]	standard deviation for proficiency assessment [ng/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [ng/l]	lower tolerance limit [ng/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]
1	3,870	42,94	1,759	0,9675	25	5,805	1,935	50	-50	7	0	0	0,0
2	4,648	31,92	1,570	1,162	25	6,971	2,324	50	-50	7	0	0	0,0
3	6,991	43,19	3,196	1,748	25	10,49	3,495	50	-50	7	1	1	28,6
									sum	21	1	1	9,5

Relative standard deviation

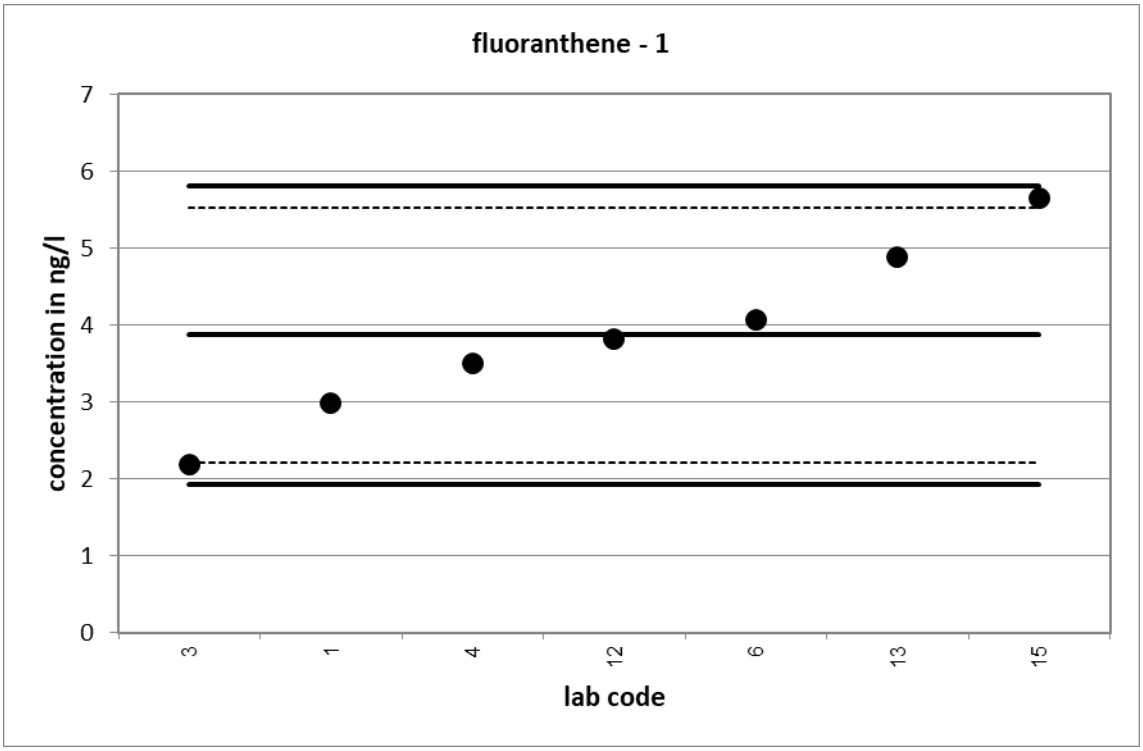


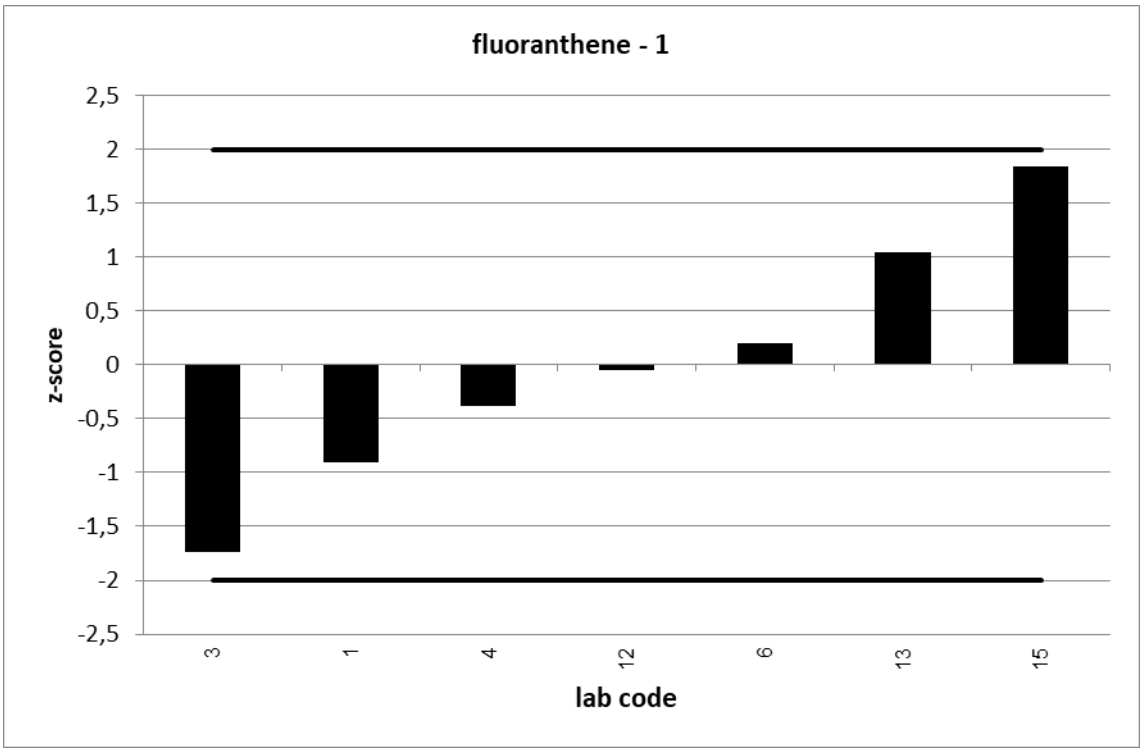
25 % is the value used as standard deviation for proficiency assessment.

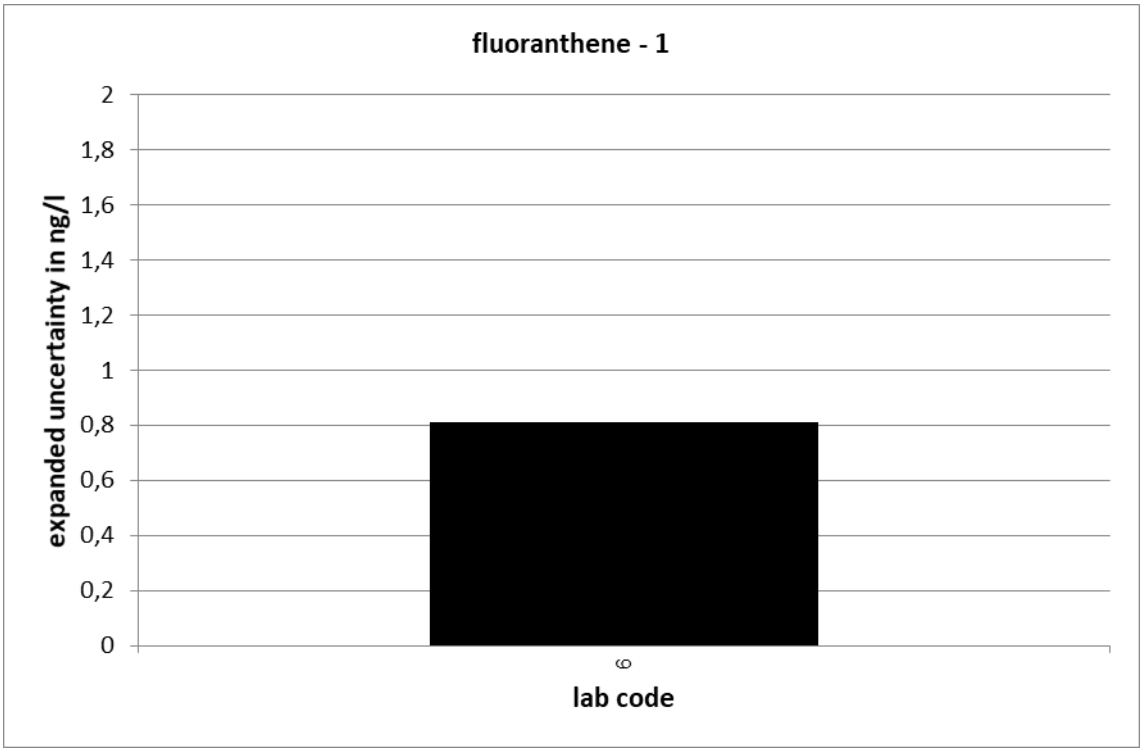
UKWIR PT 1/21		fluoranthene - 1			
assigned value [ng/l]*			3,87	± 1,662	
upper tolerance limit [ng/l]			5,805		
lower tolerance limit [ng/l]			1,935		
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
12	3,82			-0,1	s
1	2,99			-0,9	s
13	4,88			1,0	s
4	3,5			-0,4	s
15	5,65			1,8	s
6	4,06	0,812	0,2	0,2	s
3	2,19			-1,7	s

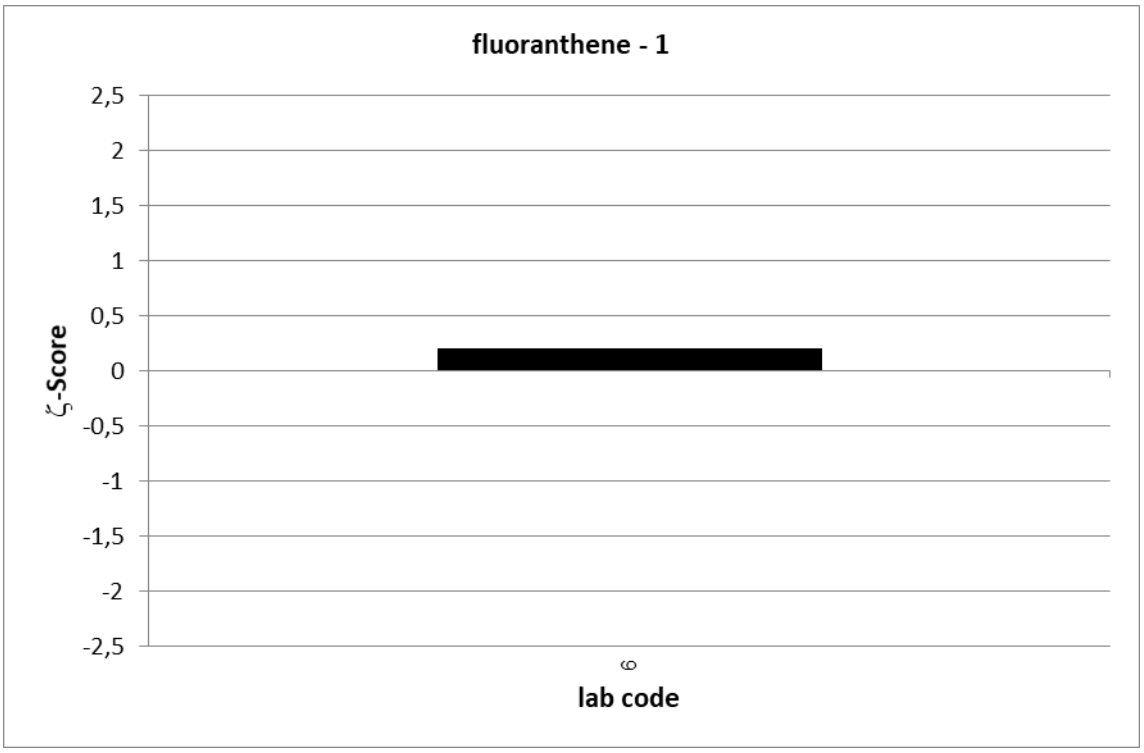
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




fluoranthene - 1
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
z-score
3
1
4
12
6
13
15
lab code

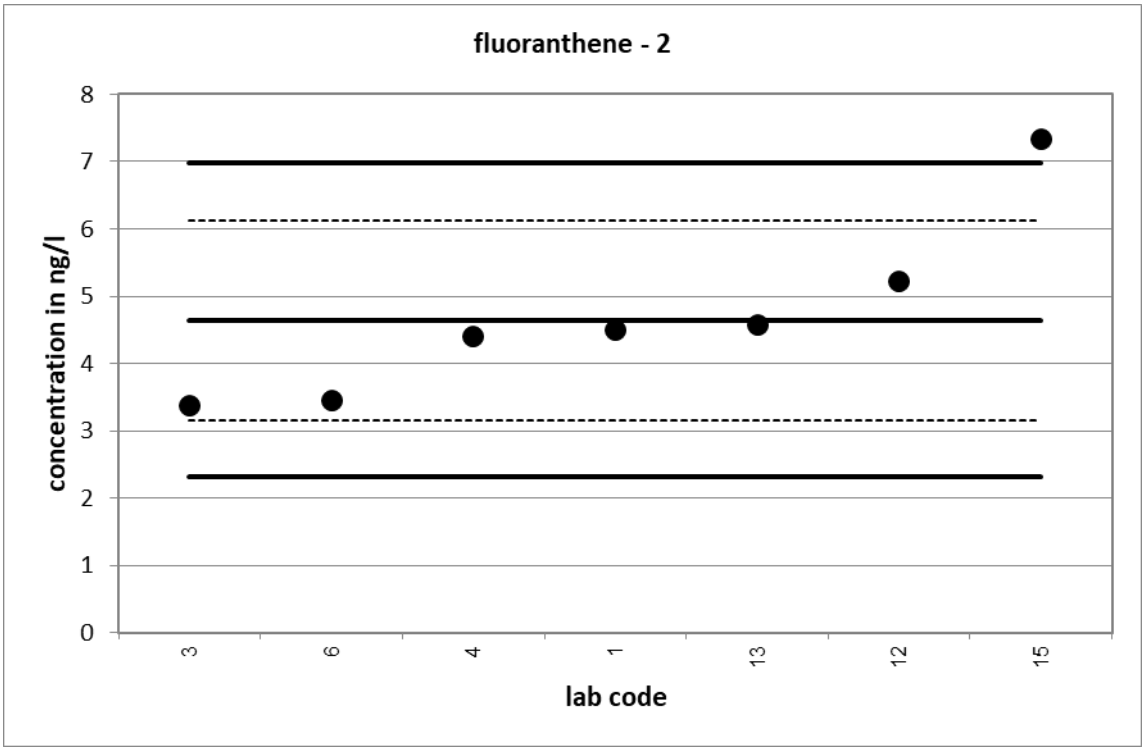

fluoranthene - 1
2
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
expanded uncertainty in ng/l
6
lab code

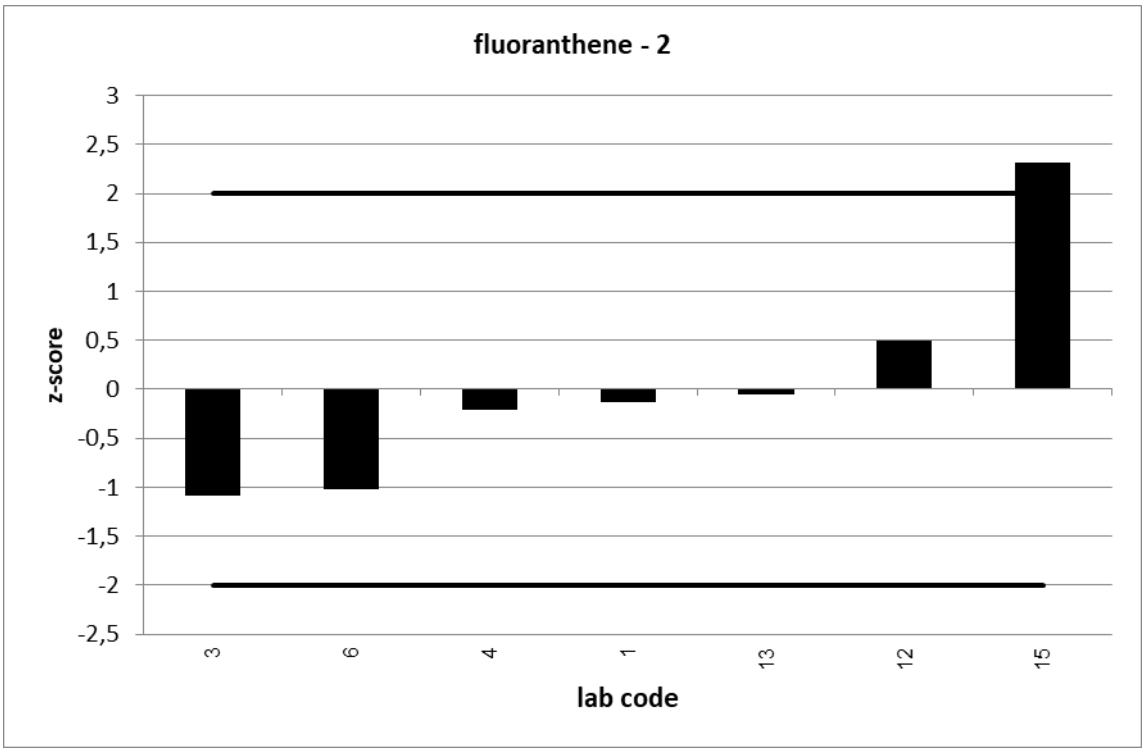

fluoranthene - 1
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
ζ-Score
6
lab code

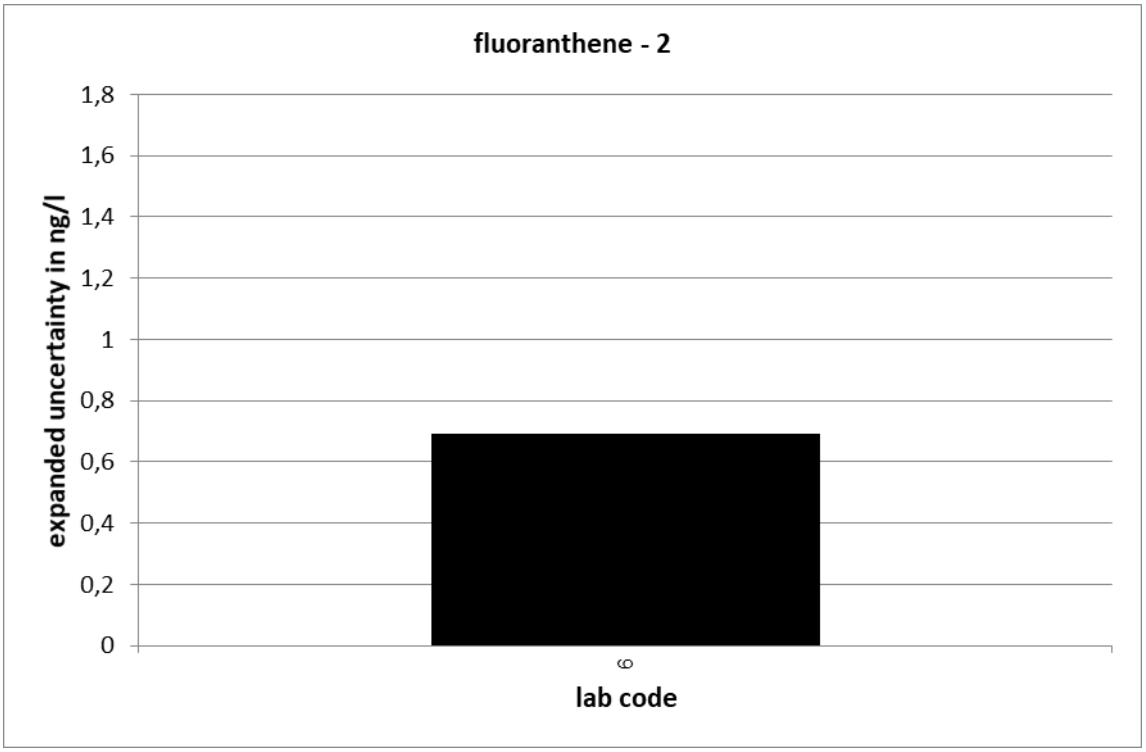
UKWIR PT 1/21		fluoranthene - 2			
assigned value [ng/l]*			4,648	± 1,484	
upper tolerance limit [ng/l]			6,971		
lower tolerance limit [ng/l]			2,324		
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
12	5,22			0,5	s
1	4,49			-0,1	s
13	4,58			-0,1	s
4	4,4			-0,2	s
15	7,33			2,3	q
6	3,46	0,692	-1,5	-1,0	s
3	3,38			-1,1	s

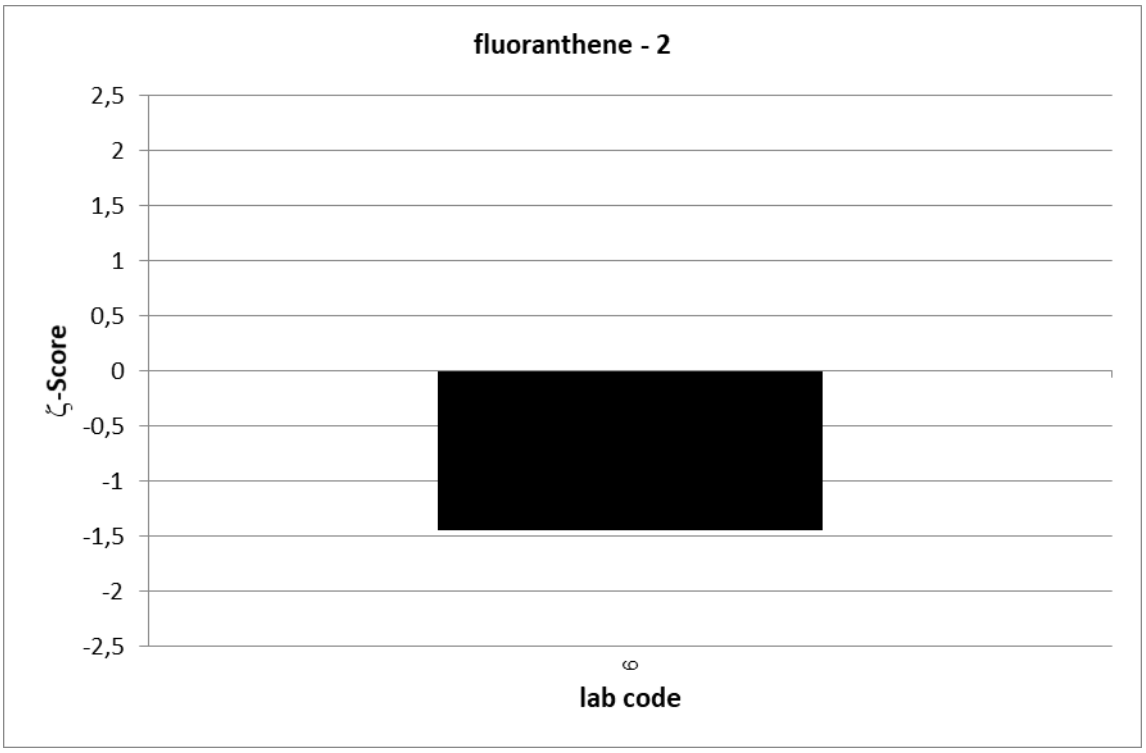
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




fluoranthene - 2
z-score
3
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
3
6
4
1
13
12
15
lab code

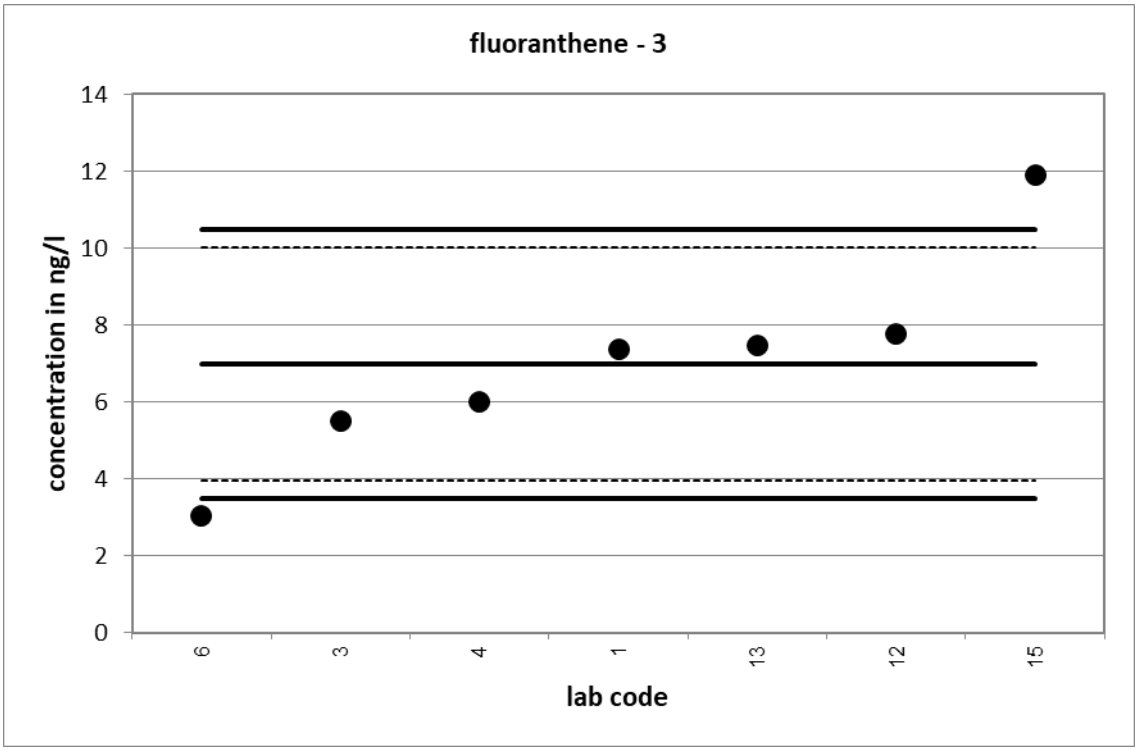

fluoranthene - 2
expanded uncertainty in ng/l
1,8
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
6
lab code

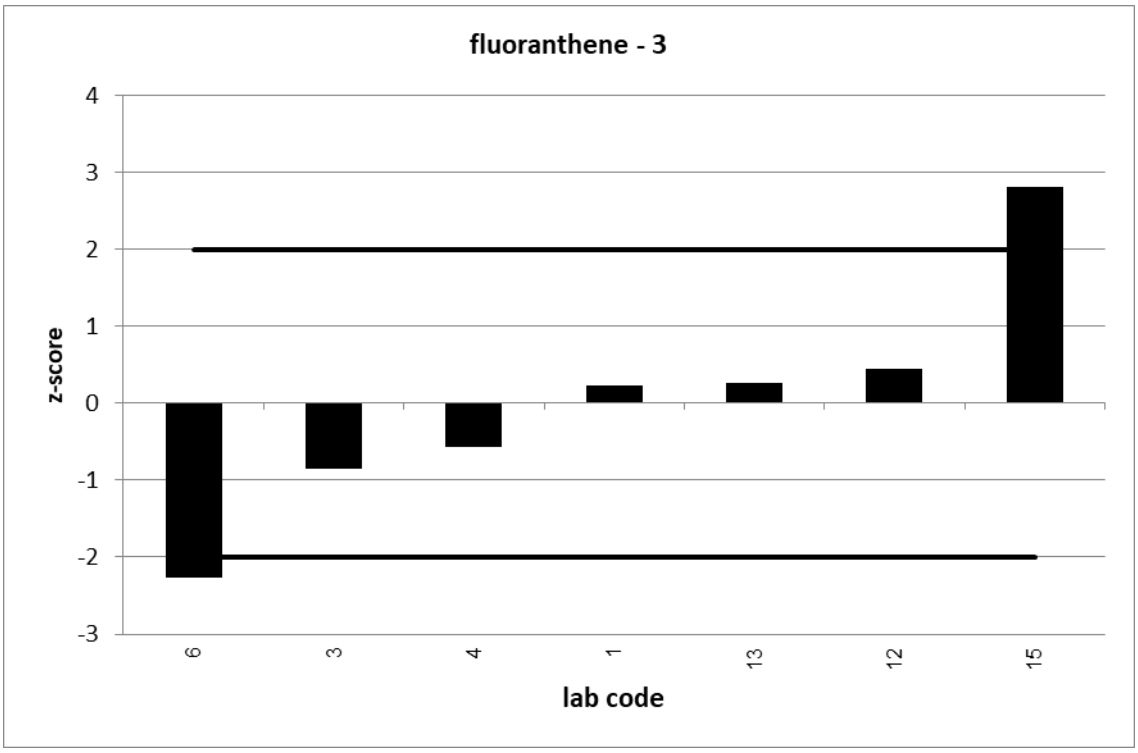

fluoranthene - 2
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
ζ-Score
6
lab code

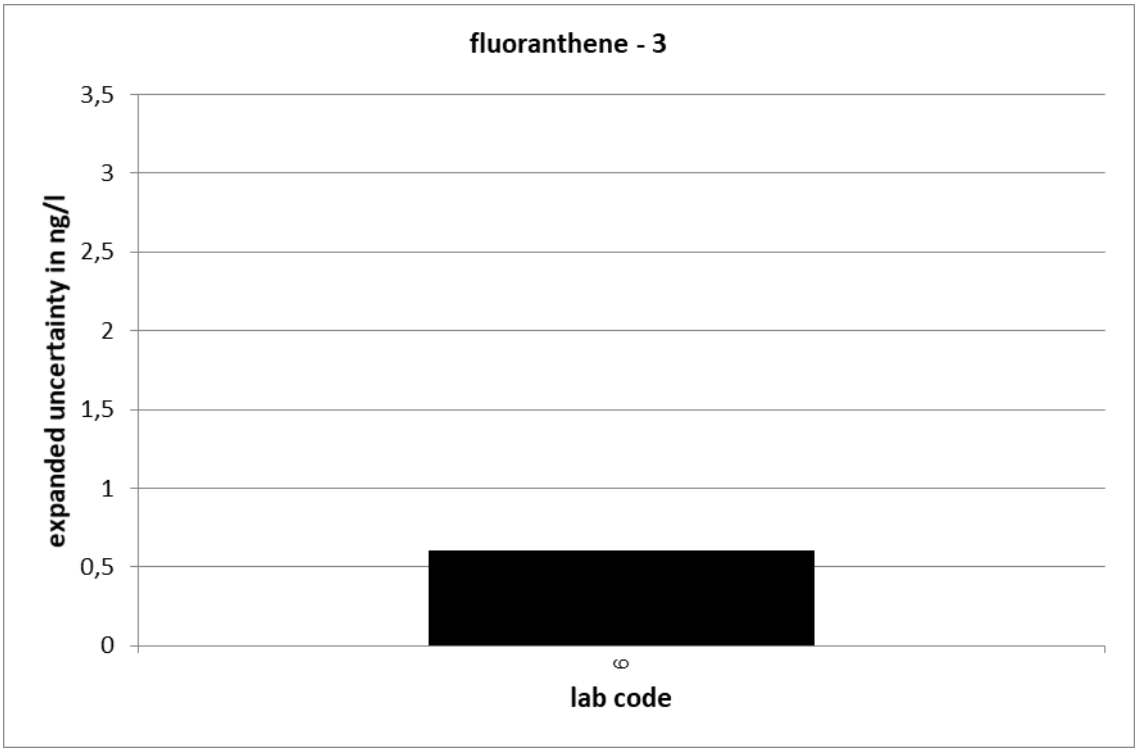
UKWIR PT 1/21		fluoranthene - 3			
assigned value [ng/l]*			6,991	± 3,02	
upper tolerance limit [ng/l]			10,49		
lower tolerance limit [ng/l]			3,495		
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
12	7,78			0,5	s
1	7,38			0,2	s
13	7,46			0,3	s
4	6			-0,6	s
6	3,04	0,608	-2,6	-2,3	q
15	11,9			2,8	q
3	5,49			-0,9	s

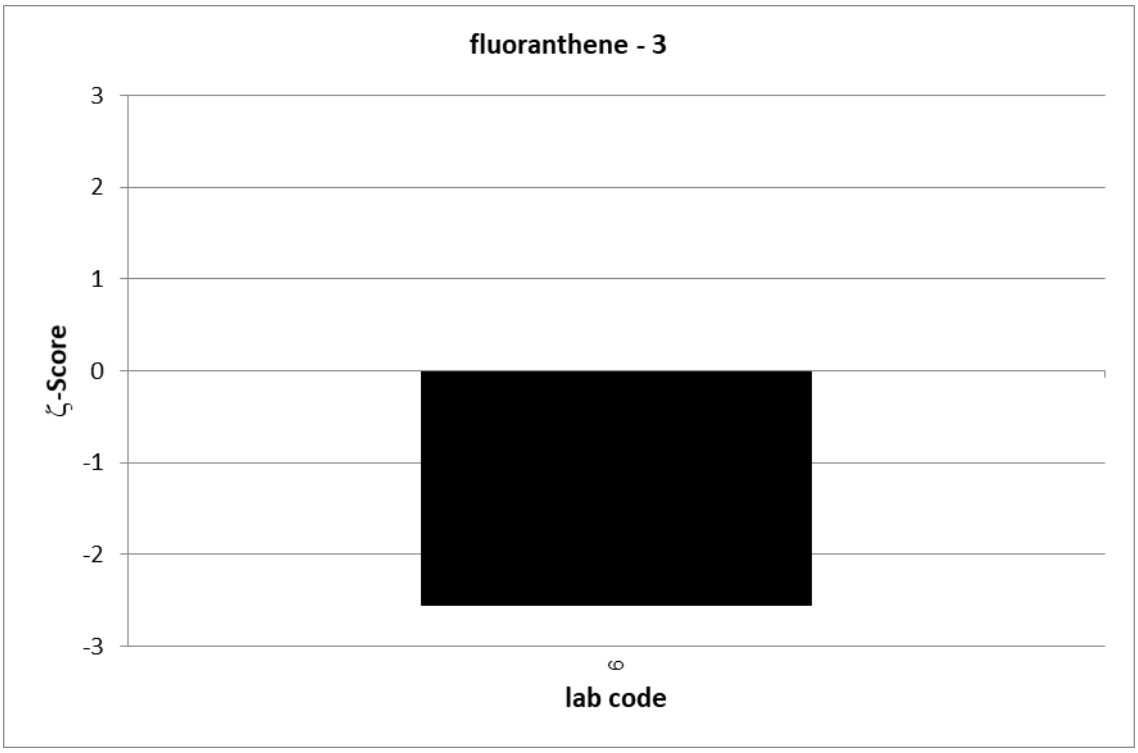
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




fluoranthene - 3
4
3
2
1
0
-1
-2
-3
z-score
6
3
4
1
13
12
15
lab code

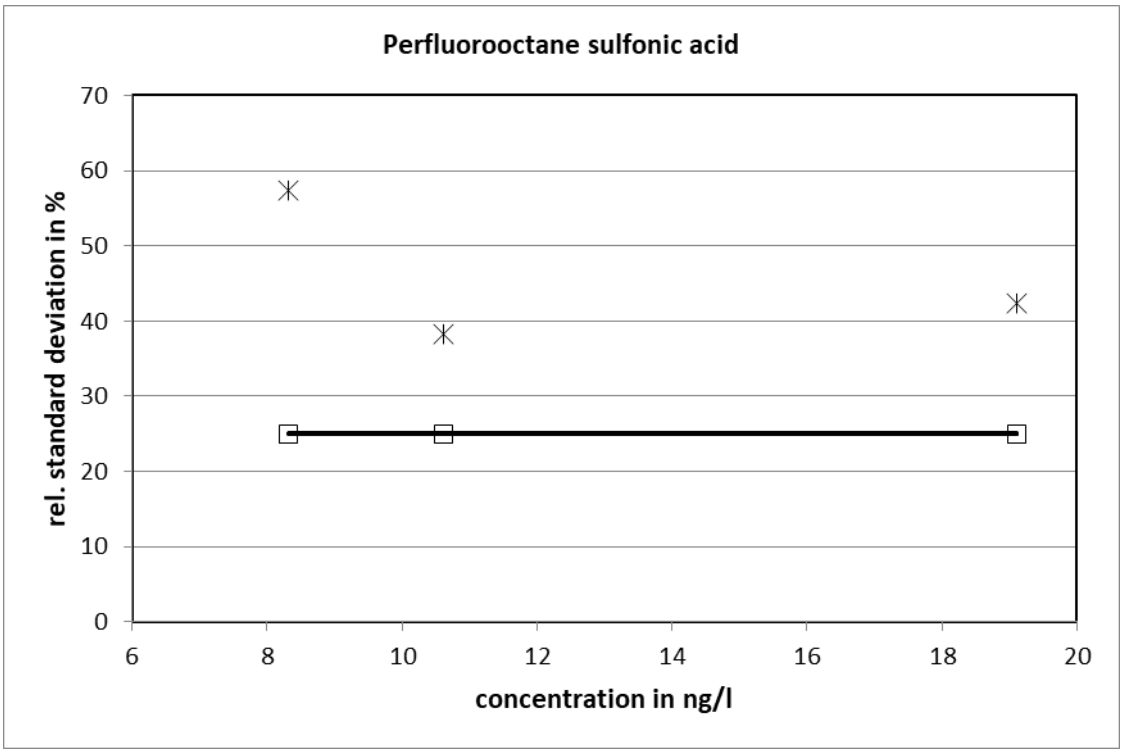

fluoranthene - 3
3,5
3
2,5
2
1,5
1
0,5
0
expanded uncertainty in ng/l
6
lab code


fluoranthene - 3
3
2
1
0
-1
-2
-3
ζ-Score
6
lab code

UKWIR 2/21:

Perfluorooctane sulfonic acid													
level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [ng/l]	standard deviation for proficiency assessment [ng/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [ng/l]	lower tolerance limit [ng/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]
1	8,324	41,37	4,771	2,081	25	12,49	4,162	50	-50	12	1	2	25,0
2	10,62	27,67	4,072	2,656	25	15,93	5,311	50	-50	12	0	0	0,0
3	19,10	30,62	8,104	4,776	25	28,65	9,551	50	-50	12	1	0	8,3
									sum	36	2	2	11,1

Relative standard deviation

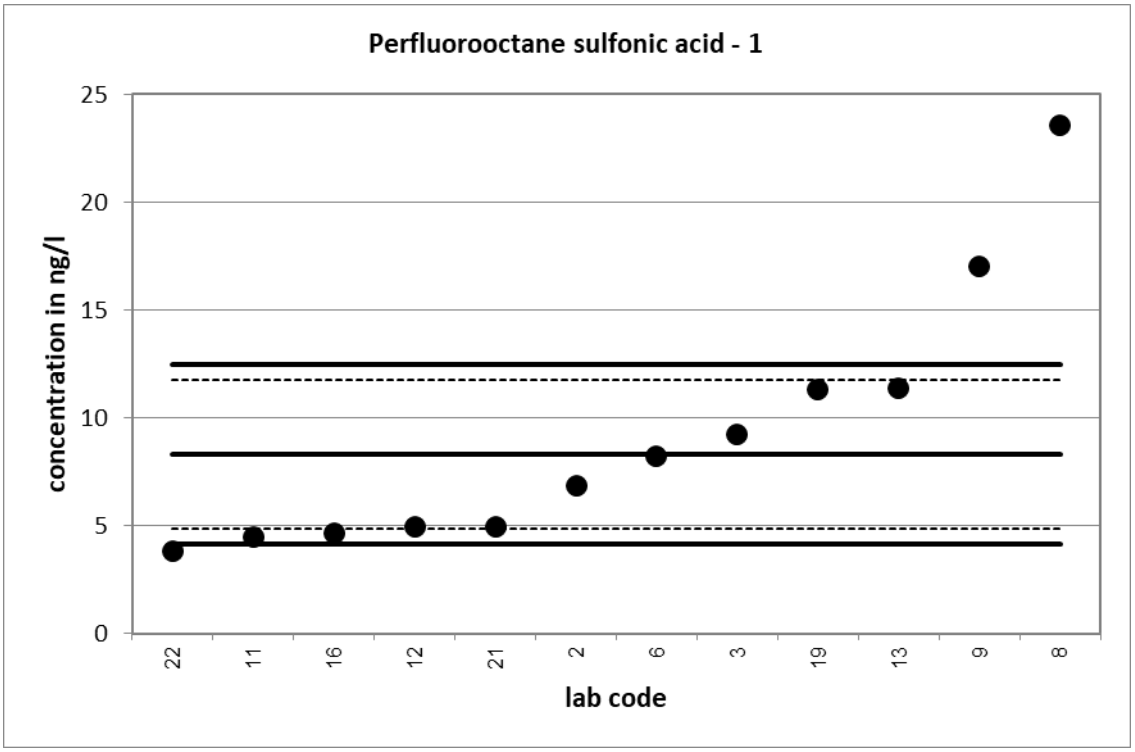


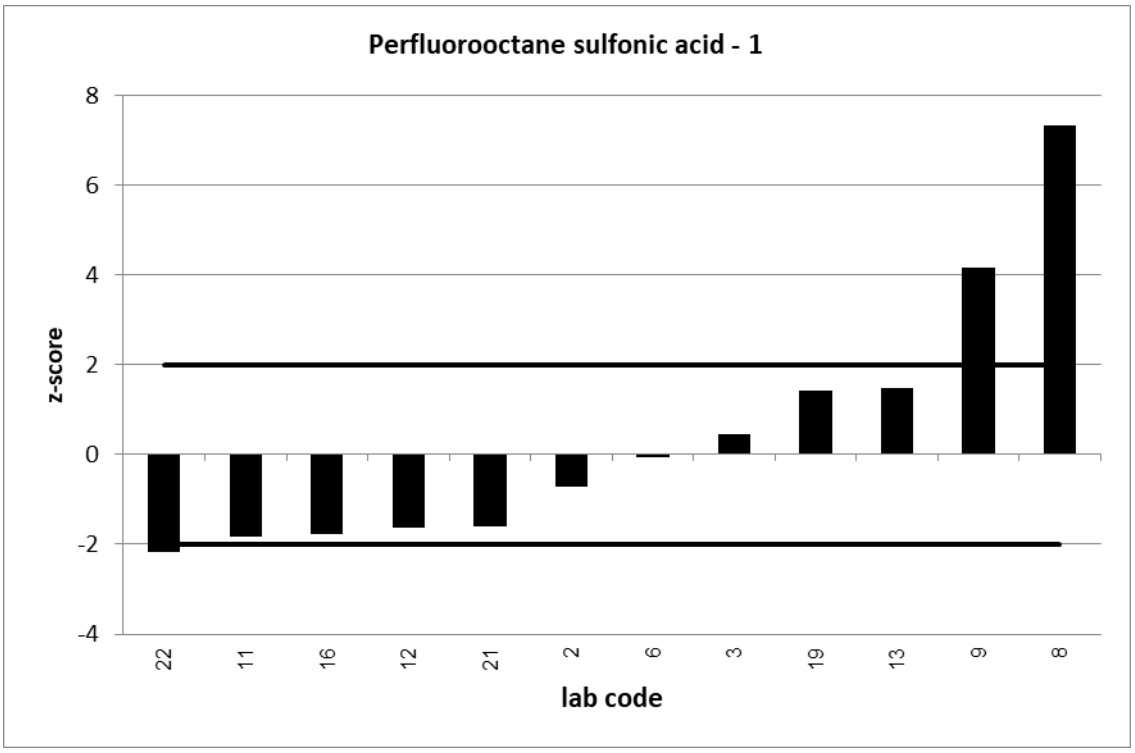
25 % is used as standard deviation for proficiency assessment.

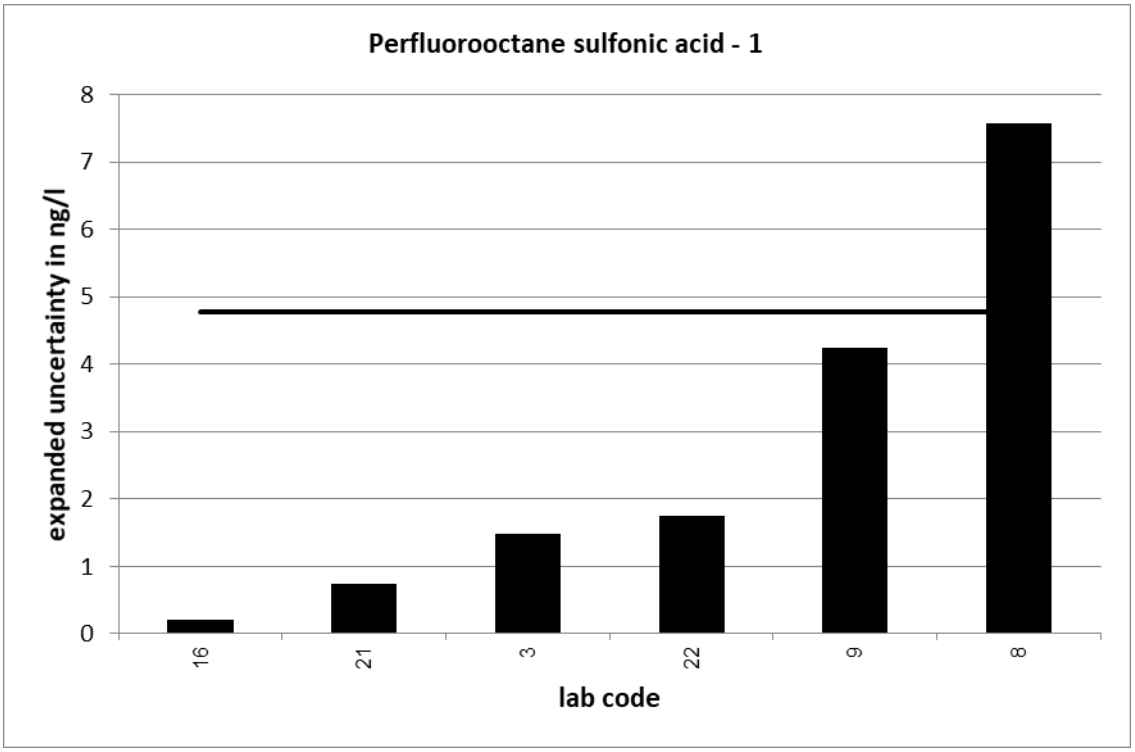
UKWIR PT 2/21		Perfluorooctane sulfonic acid - 1			
assigned value [ng/l]*		8,324	± 3,443		
upper tolerance limit [ng/l]		12,49			
lower tolerance limit [ng/l]		4,162			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	6,84			-0,7	s
3	9,25	1,48	0,5	0,4	s
6	8,22			0,0	s
8	23,594	7,567	3,7	7,3	u
9	17	4,25	3,2	4,2	u
11	4,49			-1,8	s
12	4,95			-1,6	s
13	11,4			1,5	s
16	4,64	0,2	-2,1	-1,8	s
19	11,3			1,4	s
21	4,98	0,75	-1,9	-1,6	s
22	3,81	1,75	-2,3	-2,2	q

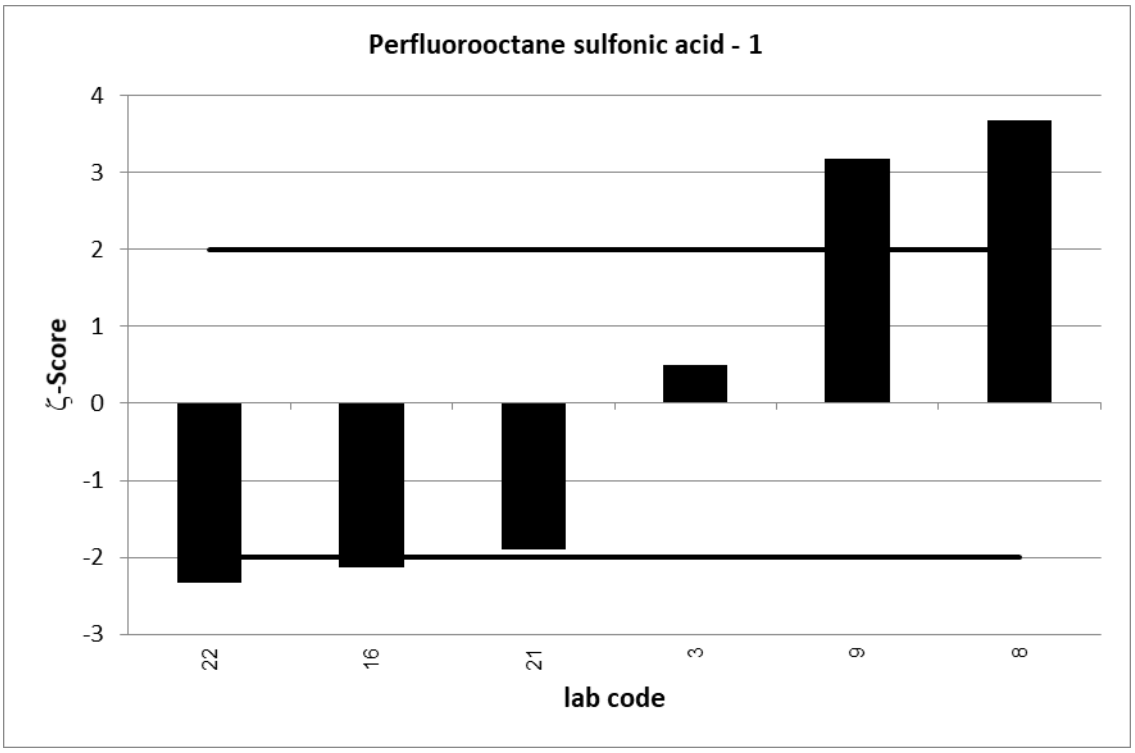
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Perfluorooctane sulfonic acid - 1
z-score
8
6
4
2
0
-2
-4
22
11
16
12
21
2
6
3
19
13
9
8
lab code

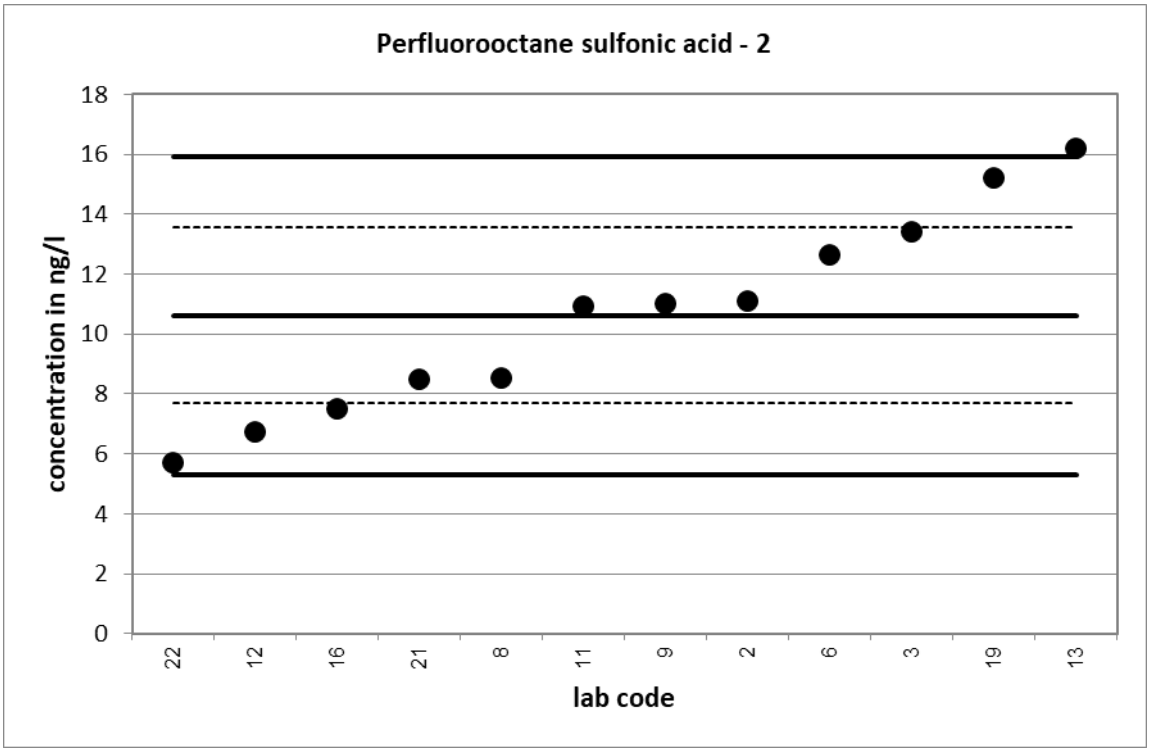

Perfluorooctane sulfonic acid - 1
expanded uncertainty in ng/l
8
7
6
5
4
3
2
1
0
16
21
3
22
9
8
lab code

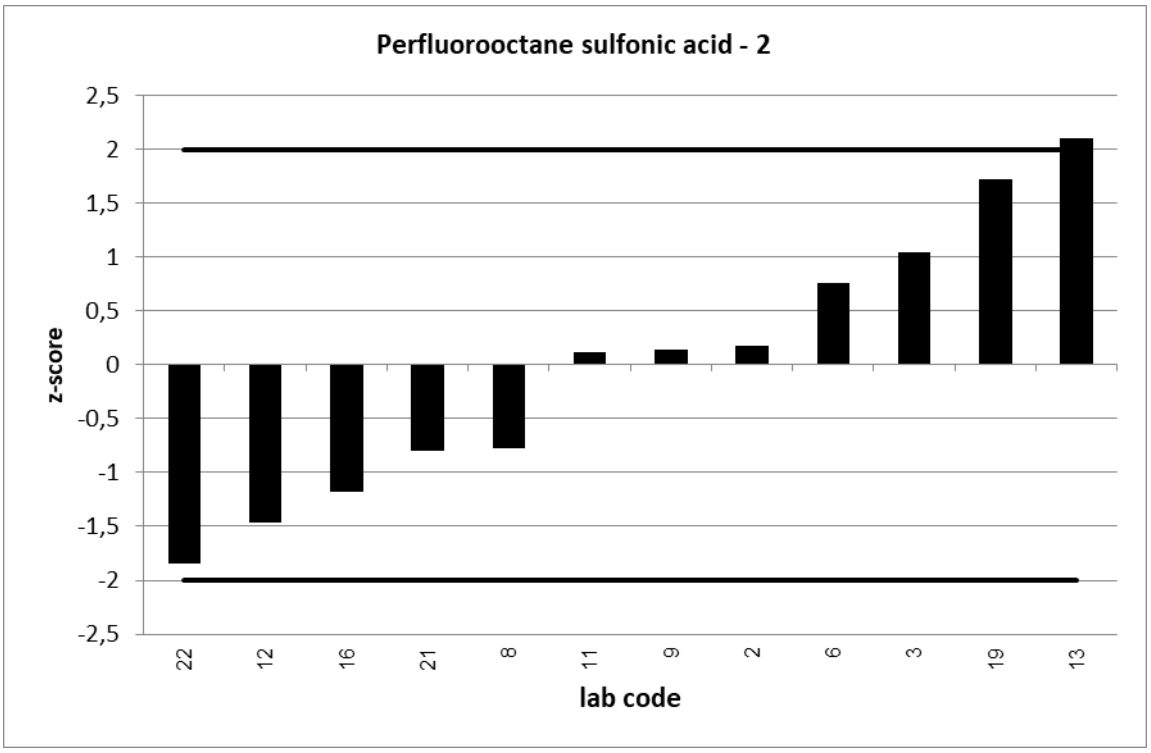

Perfluorooctane sulfonic acid - 1
4
3
2
1
0
-1
-2
-3
ζ-Score
22
16
21
3
9
8
lab code

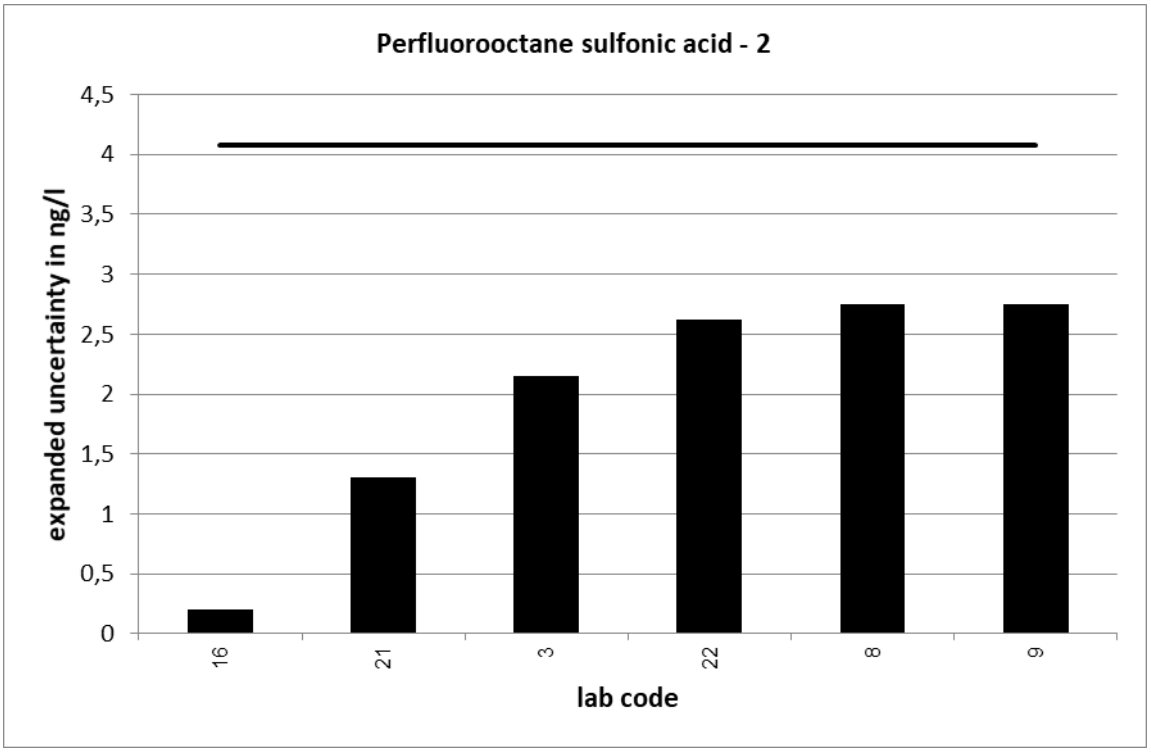
UKWIR PT 2/21		Perfluorooctane sulfonic acid - 2			
assigned value [ng/l]*		10,62	± 2,94		
upper tolerance limit [ng/l]		15,93			
lower tolerance limit [ng/l]		5,311			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	11,1			0,2	s
3	13,4	2,15	1,5	1,0	s
6	12,64			0,8	s
8	8,555	2,745	-1,0	-0,8	s
9	11	2,75	0,2	0,1	s
11	10,94			0,1	s
12	6,72			-1,5	s
13	16,2			2,1	q
16	7,5	0,2	-2,1	-1,2	s
19	15,2			1,7	s
21	8,5	1,3	-1,3	-0,8	s
22	5,71	2,62	-2,5	-1,8	s

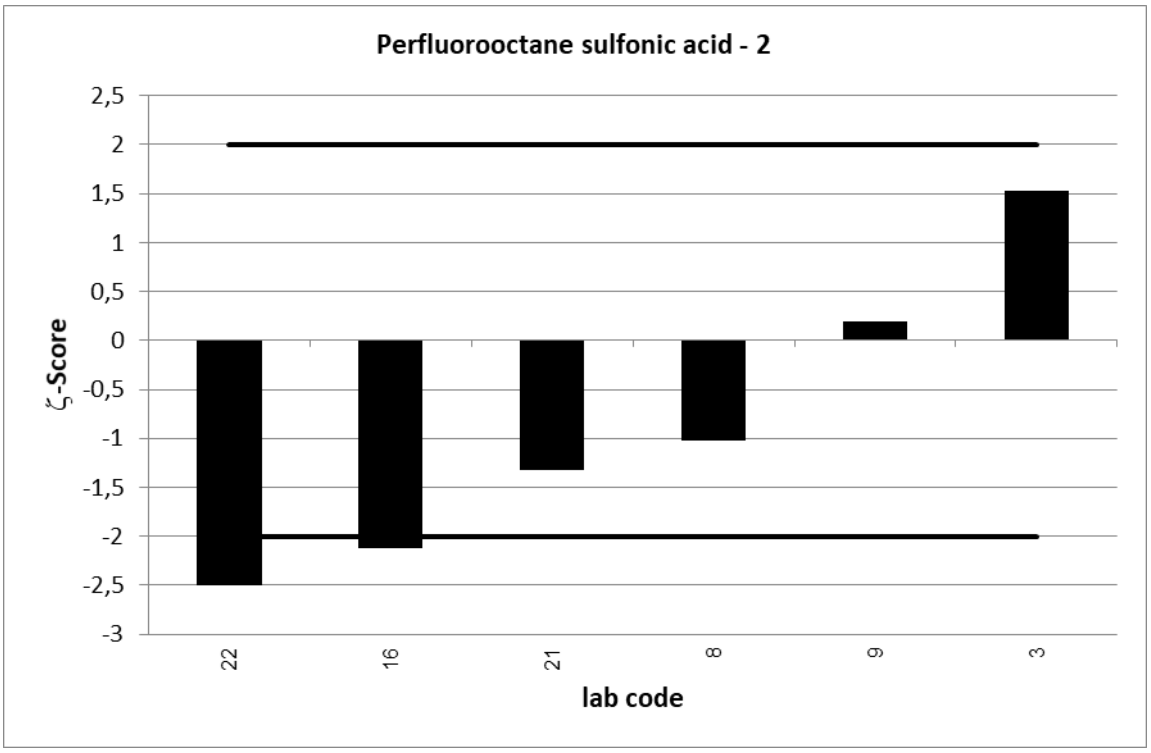
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Perfluorooctane sulfonic acid - 2
z-score
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
22
12
16
21
8
11
9
2
6
3
19
13
lab code

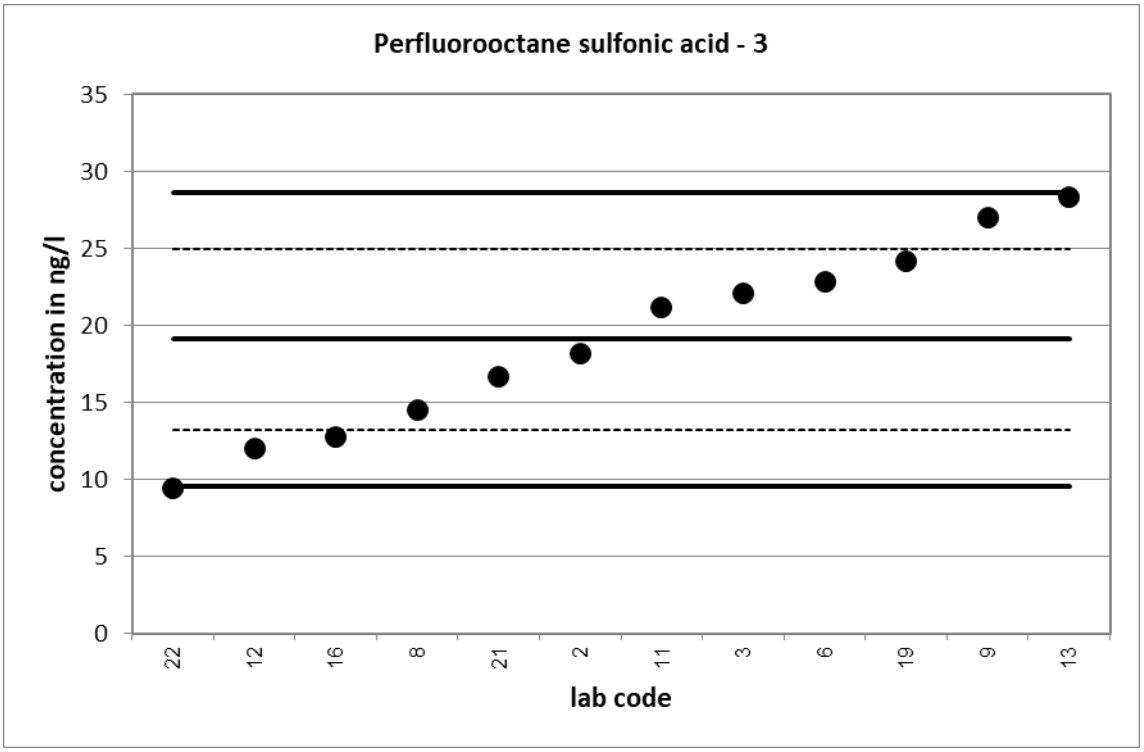

Perfluorooctane sulfonic acid - 2
expanded uncertainty in ng/l
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
16
21
3
22
8
9
lab code

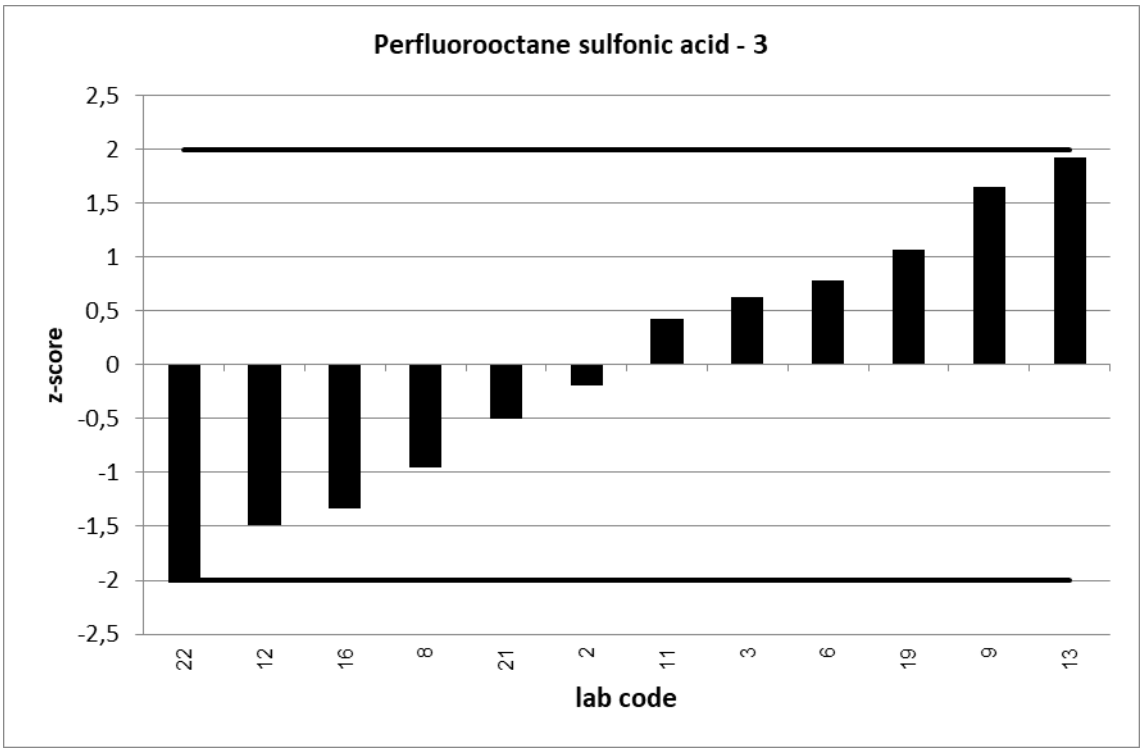

Perfluorooctane sulfonic acid - 2
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
-3
ζ-Score
22
16
21
8
9
3
lab code

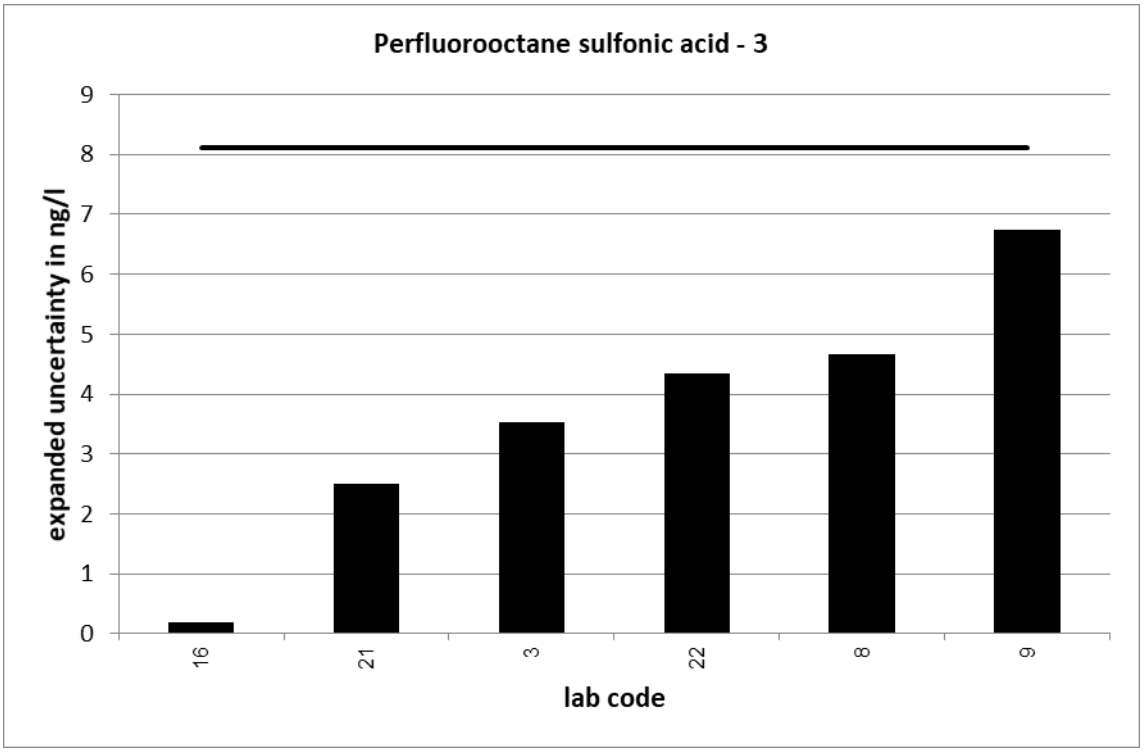
UKWIR PT 2/21		Perfluorooctane sulfonic acid - 3			
assigned value [ng/l]*		19,1	± 5,85		
upper tolerance limit [ng/l]		28,65			
lower tolerance limit [ng/l]		9,551			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	18,2			-0,2	s
3	22,1	3,54	0,9	0,6	s
6	22,83			0,8	s
8	14,548	4,667	-1,2	-1,0	s
9	27	6,75	1,8	1,7	s
11	21,16			0,4	s
12	12			-1,5	s
13	28,3			1,9	s
16	12,75	0,2	-2,2	-1,3	s
19	24,2			1,1	s
21	16,7	2,5	-0,8	-0,5	s
22	9,44	4,34	-2,7	-2,0	s

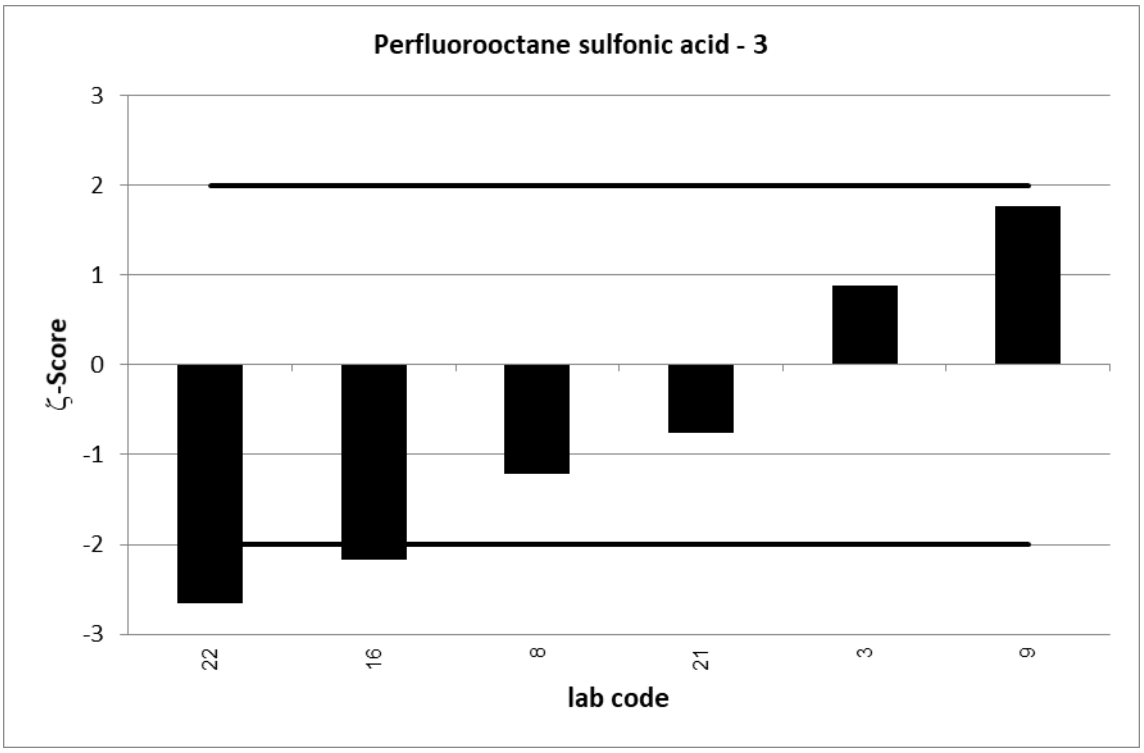
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Perfluorooctane sulfonic acid - 3
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
z-score
22
12
16
8
21
2
11
3
6
19
9
13
lab code

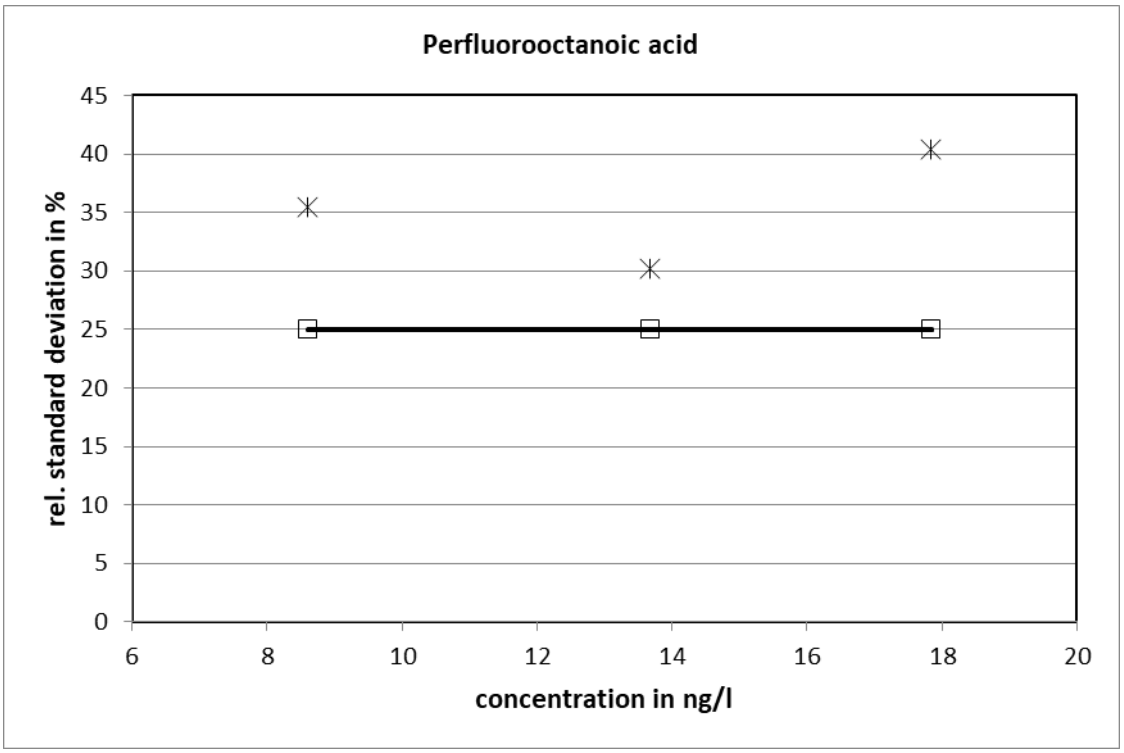

Perfluorooctane sulfonic acid - 3
9
8
7
6
5
4
3
2
1
0
expanded uncertainty in ng/l
16
21
3
22
8
9
lab code


Perfluorooctane sulfonic acid - 3
3
2
1
0
-1
-2
-3
ζ-Score
22
16
8
21
3
9
lab code

Perfluorooctanoic acid

level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [ng/l]	standard deviation for proficiency assessment [ng/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [ng/l]	lower tolerance limit [ng/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]
1	8,604	25,59	3,051	2,151	25	12,91	4,302	50	-50	12	0	1	8,3
2	13,67	21,82	4,133	3,416	25	20,50	6,833	50	-50	12	0	0	0,0
3	17,84	29,17	7,212	4,460	25	26,76	8,921	50	-50	12	1	0	8,3
									sum	36	1	1	5,6

Relative standard deviation

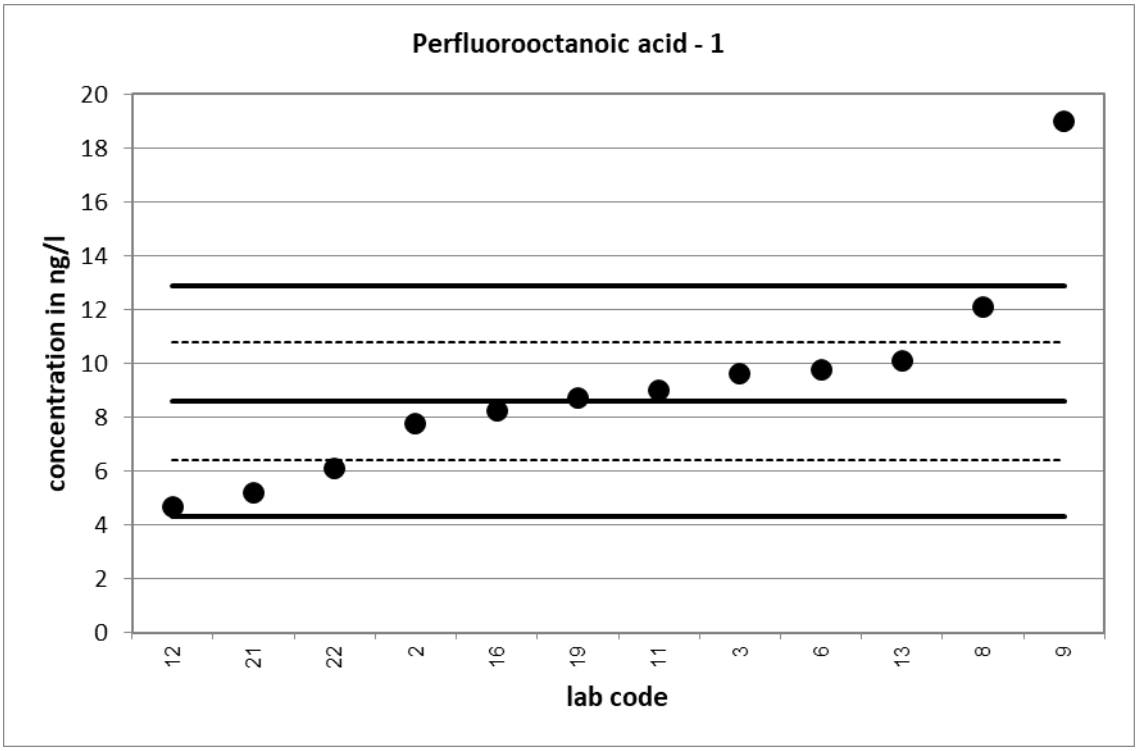


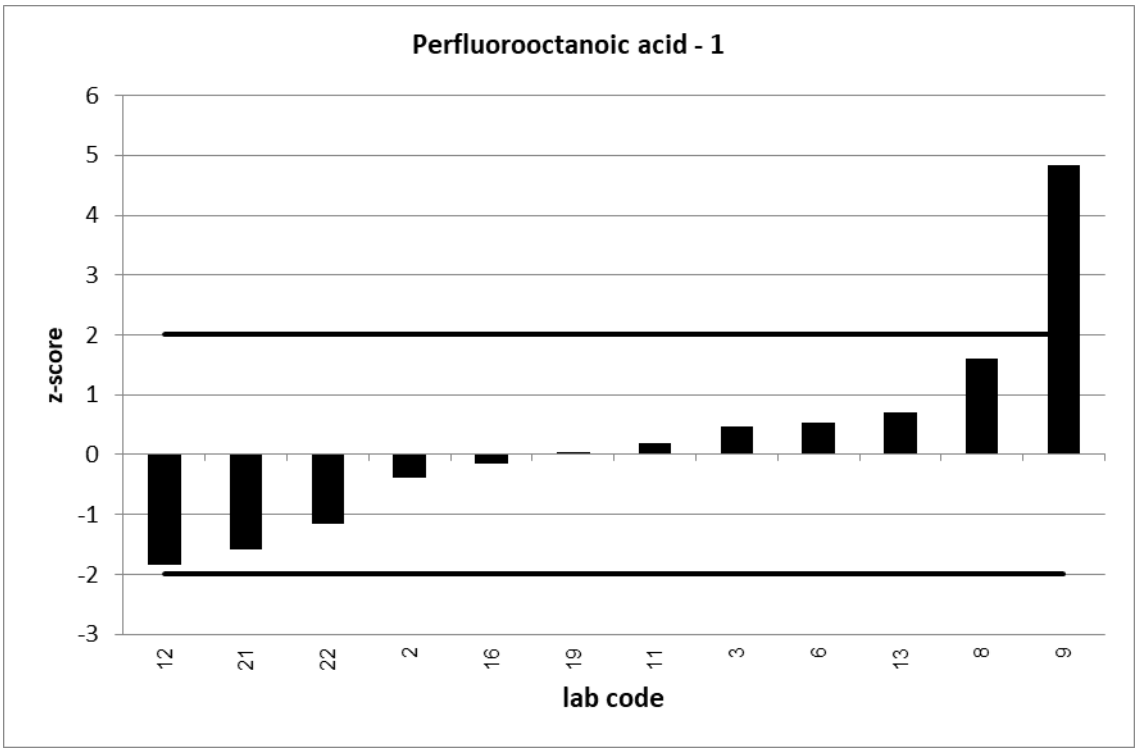
25 % is used as standard deviation for proficiency assessment.

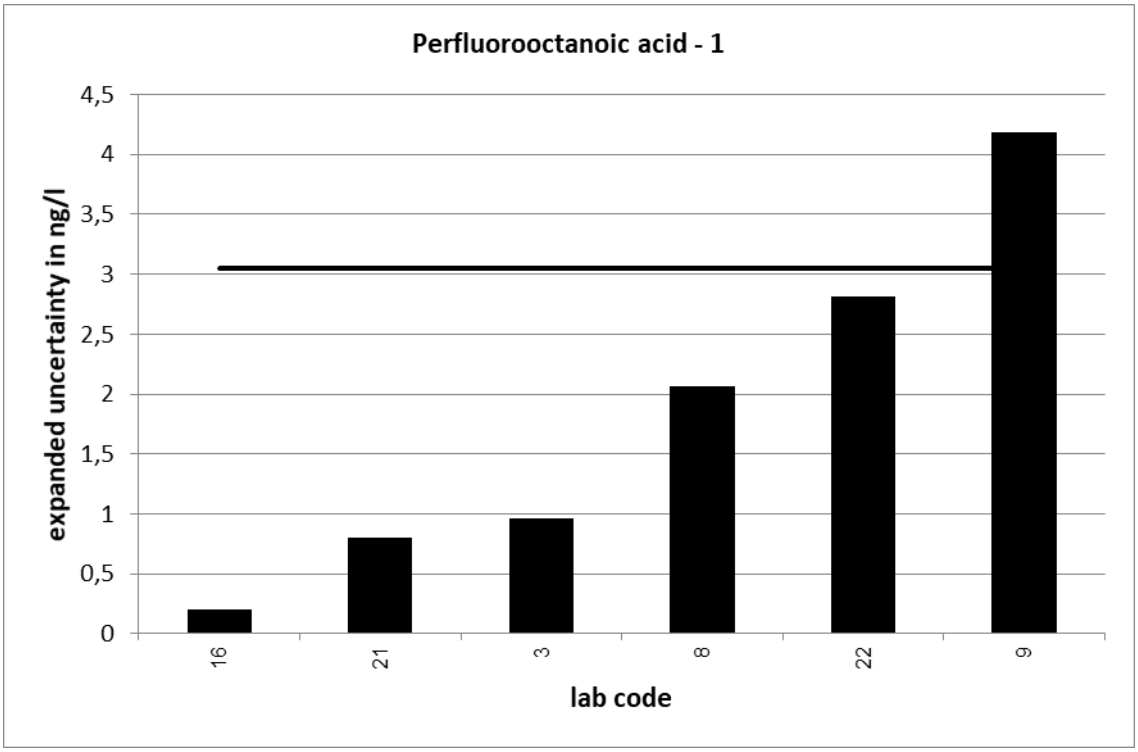
UKWIR PT 2/21		Perfluorooctanoic acid - 1			
assigned value [ng/l]*		8,604	± 2,202		
upper tolerance limit [ng/l]		12,91			
lower tolerance limit [ng/l]		4,302			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	7,79			-0,4	s
3	9,63	0,963	0,9	0,5	s
6	9,76			0,5	s
8	12,076	2,061	2,3	1,6	s
9	19	4,18	4,4	4,8	u
11	9,02			0,2	s
12	4,66			-1,8	s
13	10,1			0,7	s
16	8,255	0,2	-0,3	-0,2	s
19	8,7			0,0	s
21	5,2	0,8	-2,9	-1,6	s
22	6,12	2,81	-1,4	-1,2	s

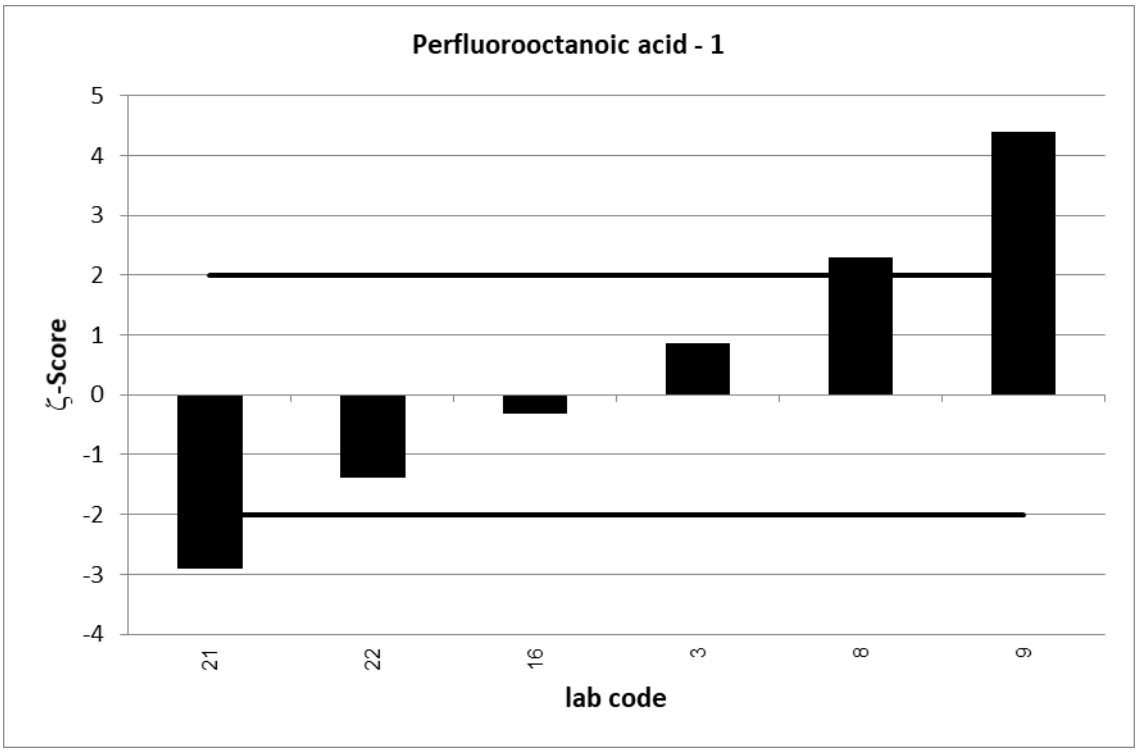
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Perfluorooctanoic acid - 1
z-score
6
5
4
3
2
1
0
-1
-2
-3
12
21
22
2
16
19
11
3
6
13
8
9
lab code

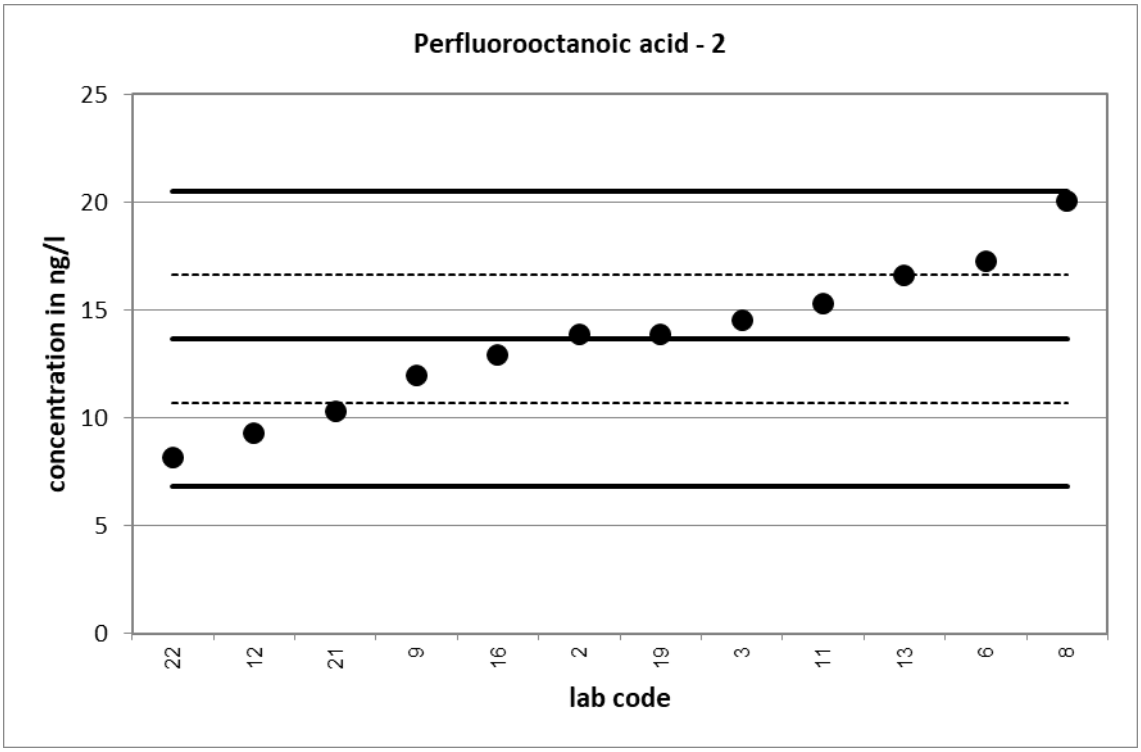

Perfluorooctanoic acid - 1
expanded uncertainty in ng/l
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
16
21
3
8
22
9
lab code

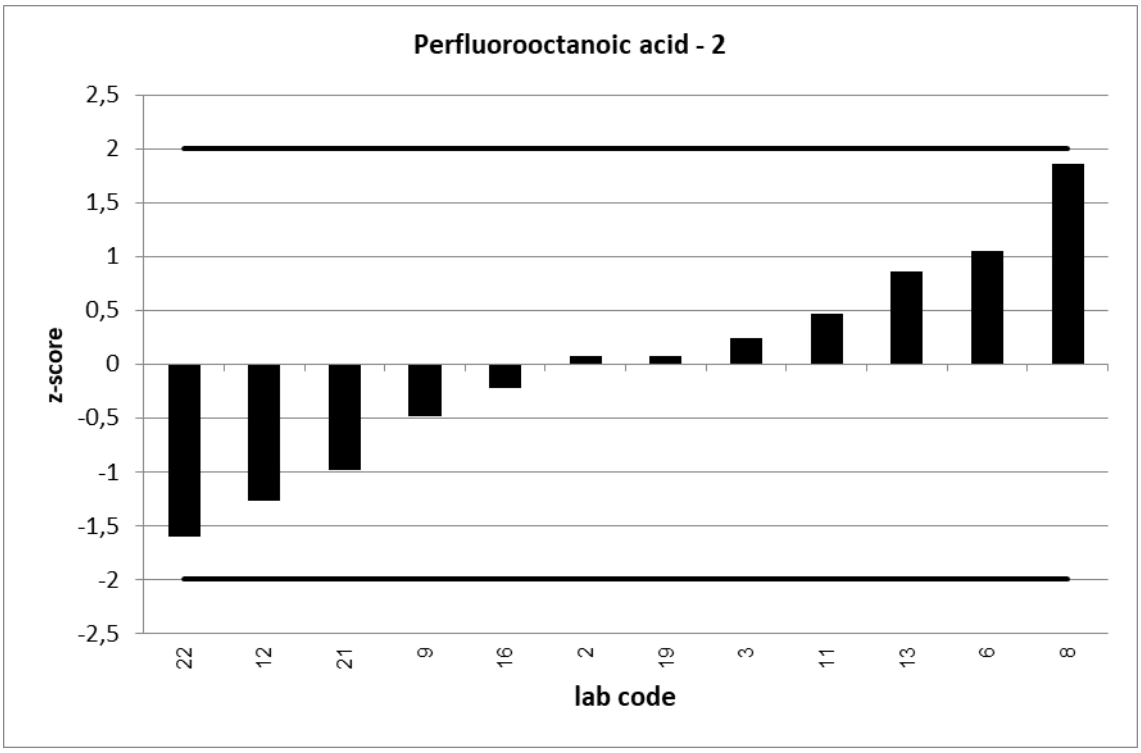

Perfluorooctanoic acid - 1
5
4
3
2
1
0
-1
-2
-3
-4
ζ-Score
21
22
16
3
8
9
lab code

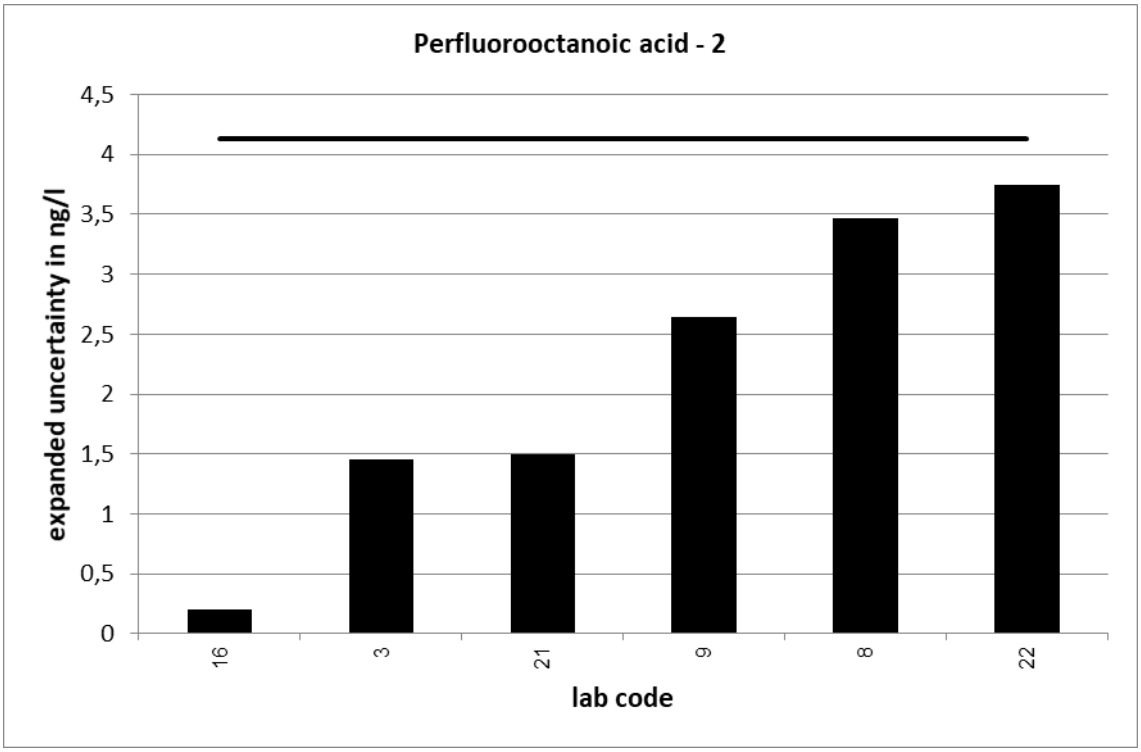
UKWIR PT 2/21		Perfluorooctanoic acid - 2			
assigned value [ng/l]*			13,67	± 2,98	
upper tolerance limit [ng/l]			20,5		
lower tolerance limit [ng/l]			6,833		
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	13,9			0,1	s
3	14,5	1,45	0,5	0,2	s
6	17,24			1,0	s
8	20,032	3,466	2,8	1,9	s
9	12	2,64	-0,8	-0,5	s
11	15,28			0,5	s
12	9,32			-1,3	s
13	16,6			0,9	s
16	12,9	0,2	-0,5	-0,2	s
19	13,9			0,1	s
21	10,3	1,5	-2,0	-1,0	s
22	8,18	3,75	-2,3	-1,6	s

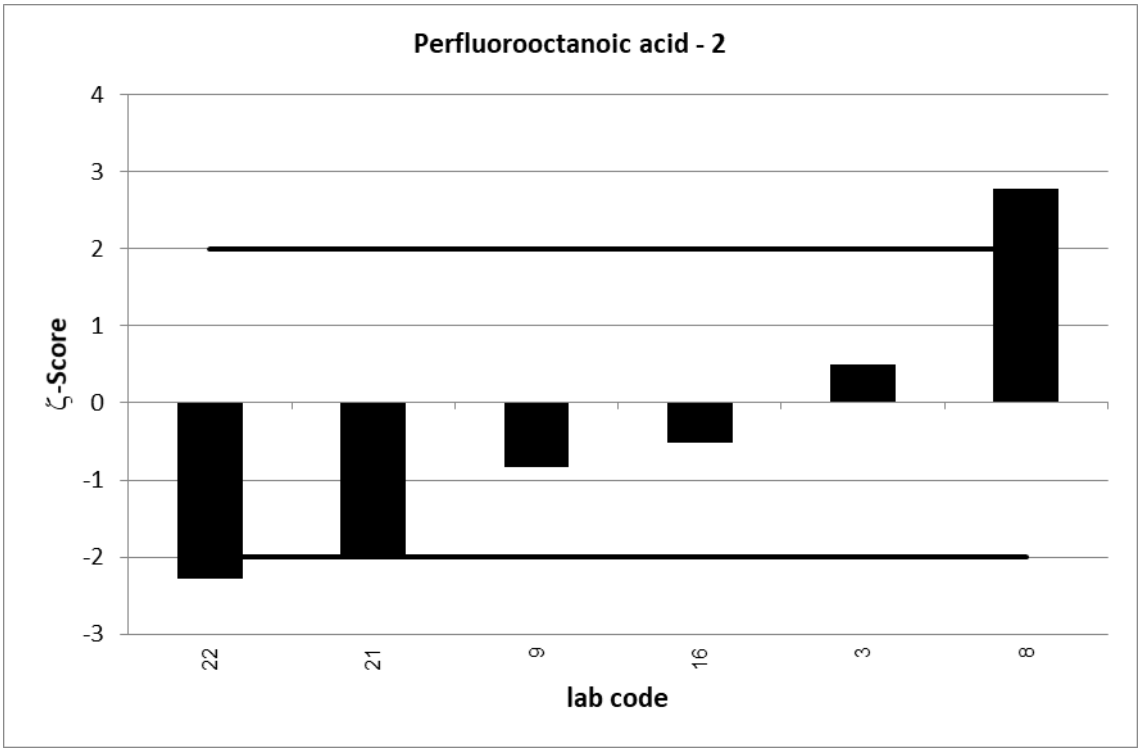
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Perfluorooctanoic acid - 2
z-score
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
22
12
21
9
16
2
19
3
11
13
6
8
lab code

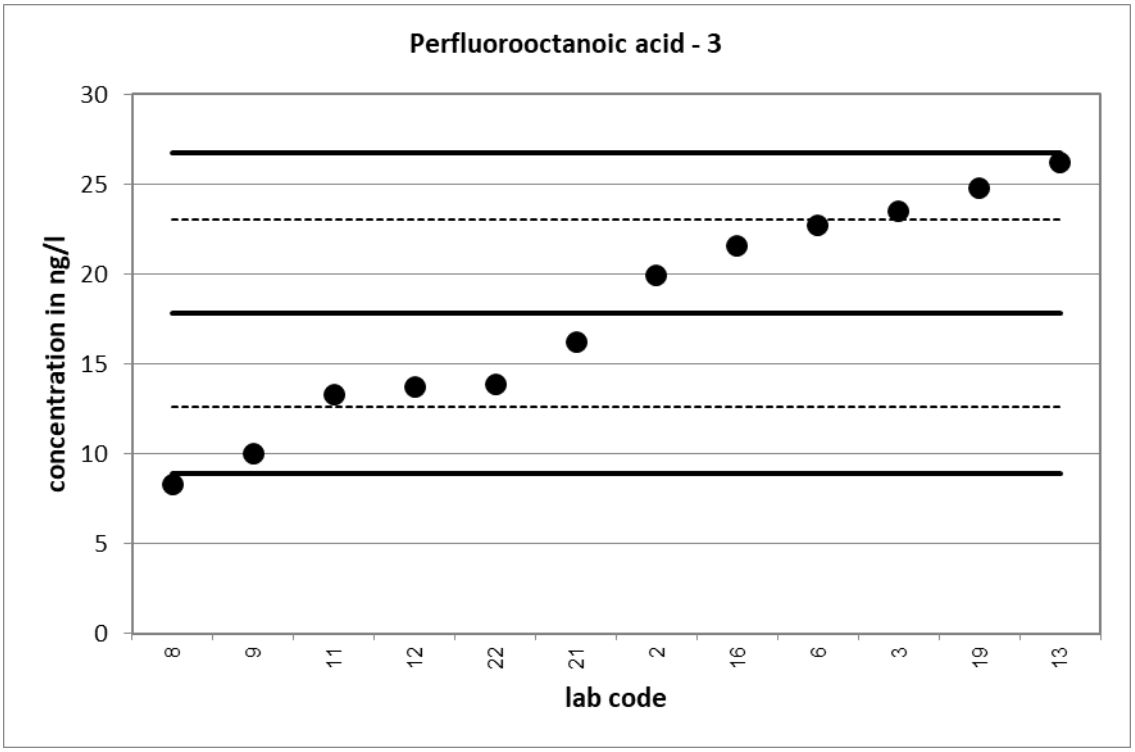

Perfluorooctanoic acid - 2
expanded uncertainty in ng/l
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
16
3
21
9
8
22
lab code

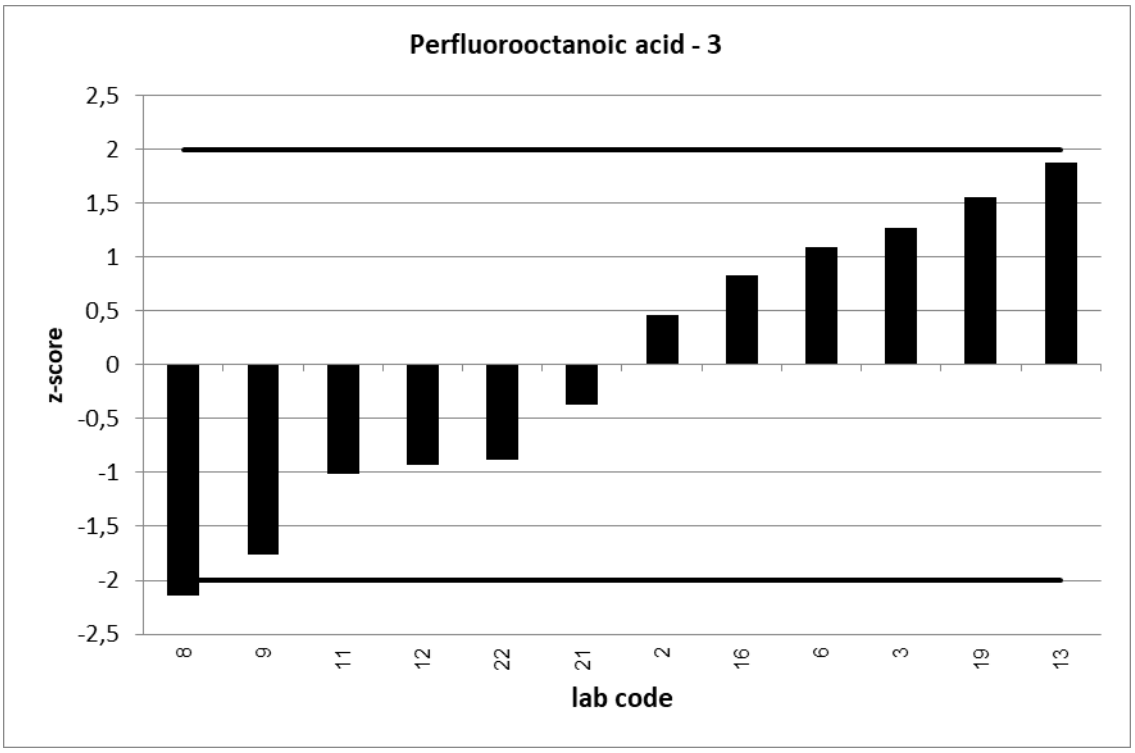

Perfluorooctanoic acid - 2
4
3
2
1
0
-1
-2
-3
ζ-Score
22
21
9
16
3
8
lab code

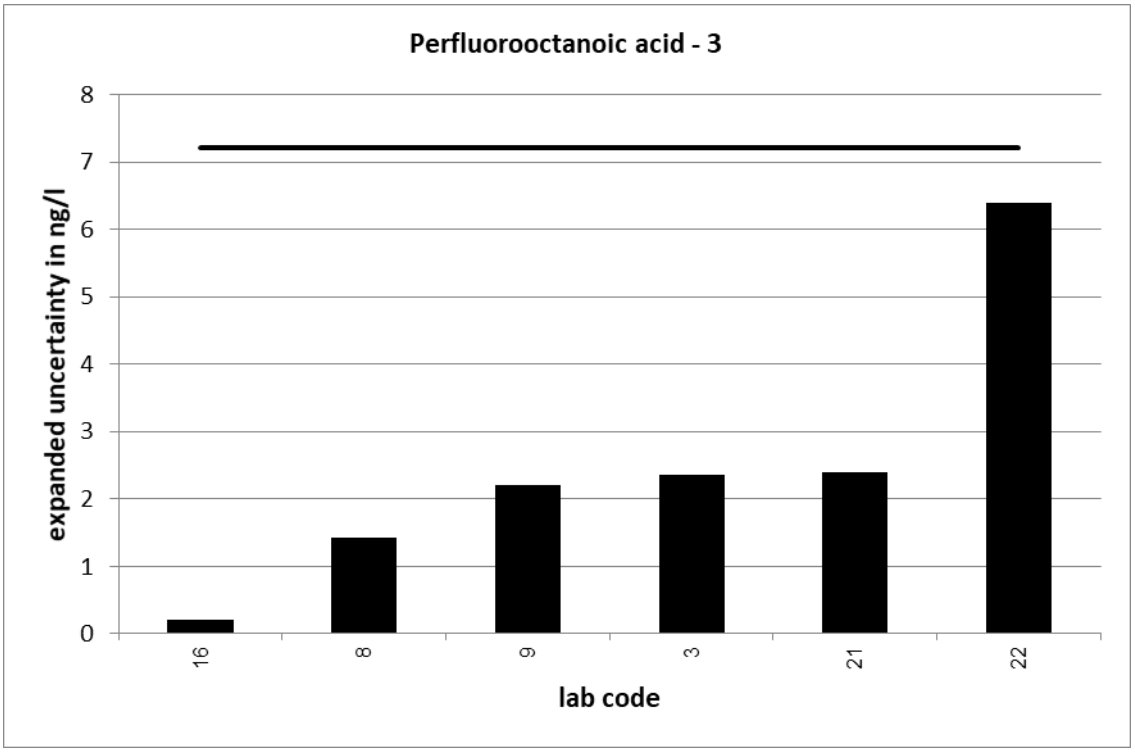
UKWIR PT 2/21		Perfluorooctanoic acid - 3			
assigned value [ng/l]*		17,84	± 5,2		
upper tolerance limit [ng/l]		26,76			
lower tolerance limit [ng/l]		8,921			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	19,9			0,5	s
3	23,5	2,35	2,0	1,3	s
6	22,73			1,1	s
8	8,287	1,42	-3,5	-2,1	q
9	10	2,2	-2,8	-1,8	s
11	13,33			-1,0	s
12	13,7			-0,9	s
13	26,2			1,9	s
16	21,55	0,2	1,4	0,8	s
19	24,8			1,6	s
21	16,2	2,4	-0,6	-0,4	s
22	13,9	6,4	-1,0	-0,9	s

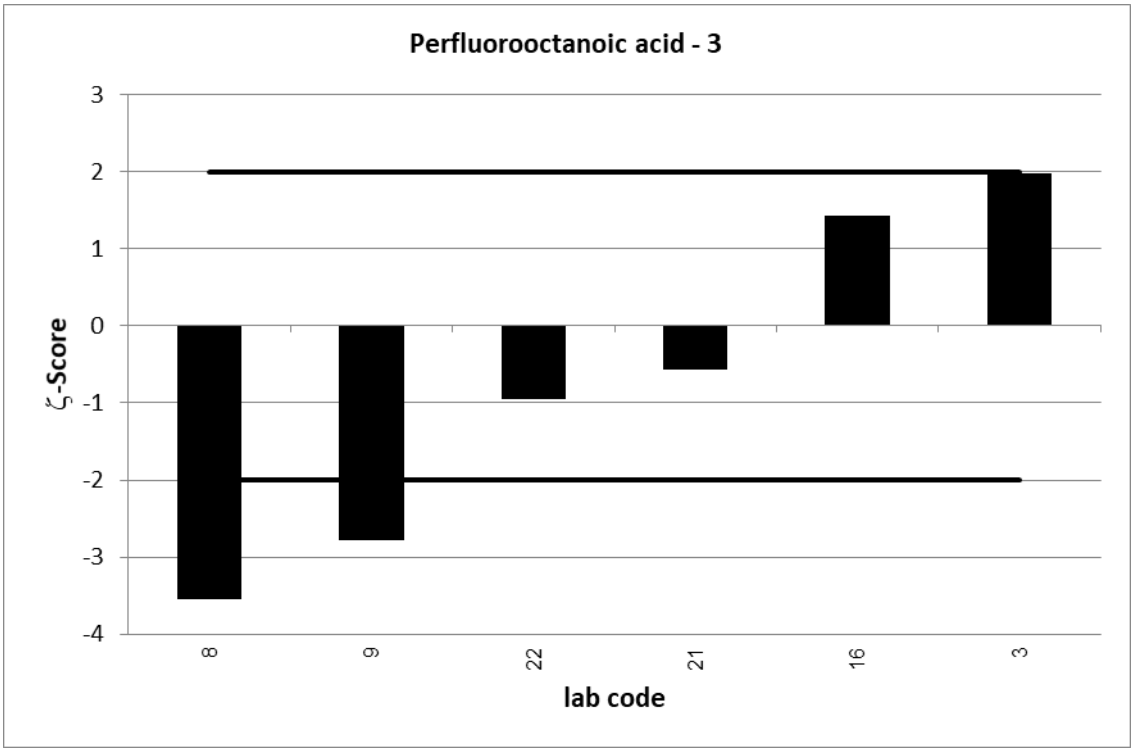
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Perfluorooctanoic acid - 3
z-score
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
8
9
11
12
22
21
2
16
6
3
19
13
lab code

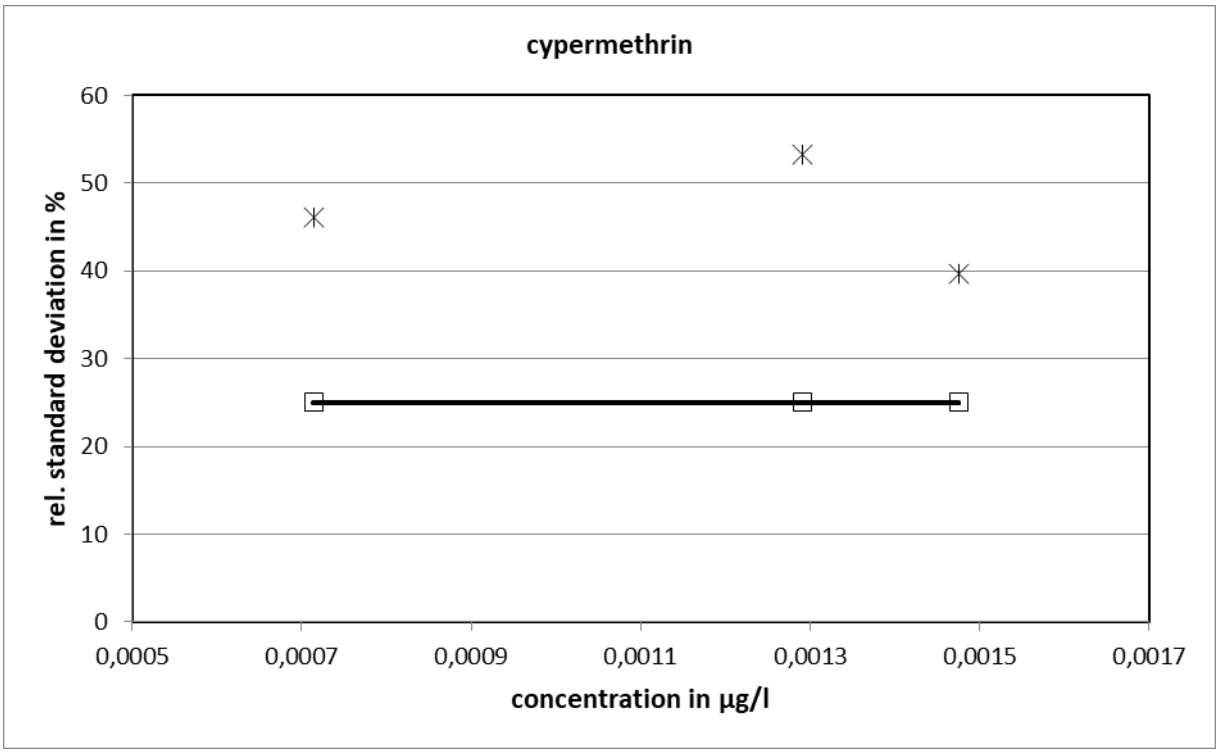

Perfluorooctanoic acid - 3
expanded uncertainty in ng/l
8
7
6
5
4
3
2
1
0
16
8
9
3
21
22
lab code


Perfluorooctanoic acid - 3
3
2
1
0
-1
-2
-3
-4
ζ-Score
8
9
22
21
16
3
lab code

UKWIR 3/21:

cypermethrin													
level	assigned value [µg/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [µg/l]	standard deviation for proficiency assessment [µg/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [µg/l]	lower tolerance limit [µg/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]
1	0,000714	38,38	0,000329	0,000179	25	0,001071	0,000357	50	-50	9	0	0	0,0
2	0,001291	44,33	0,000687	0,000323	25	0,001937	0,000646	50	-50	9	1	1	22,2
3	0,001475	33,04	0,000585	0,000369	25	0,002213	0,000738	50	-50	9	0	1	11,1
									sum	27	1	2	11,1

Relative standard deviation

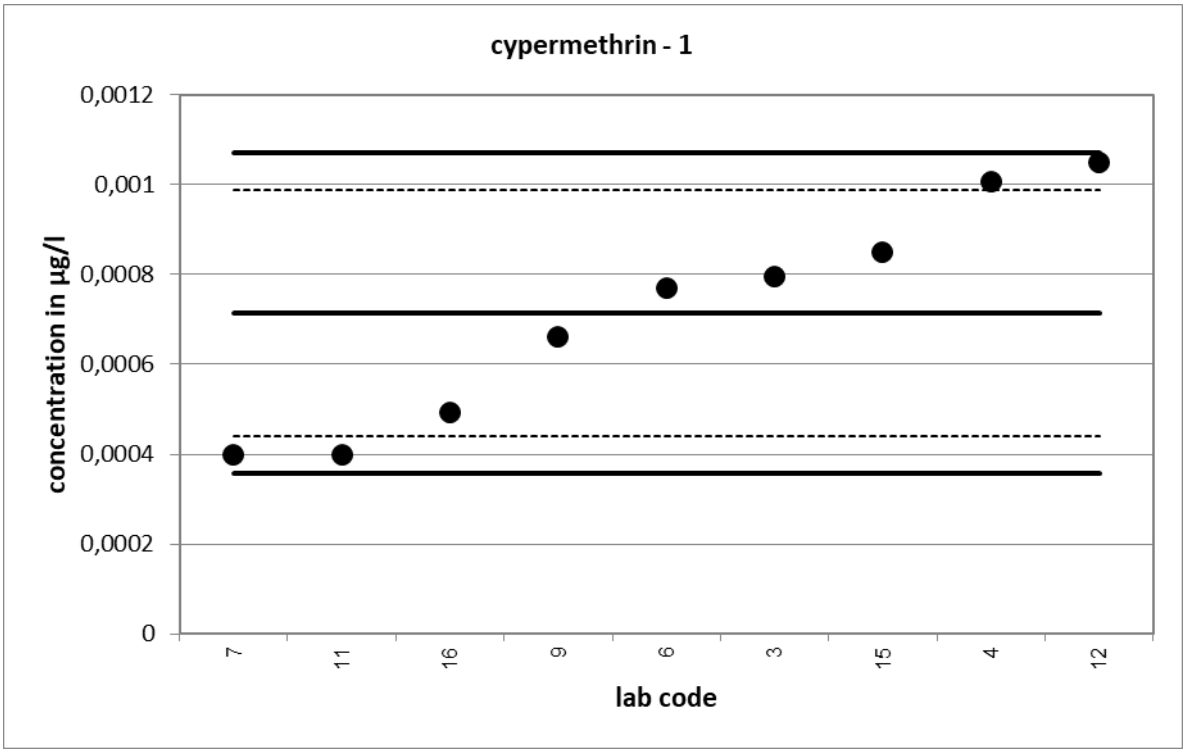


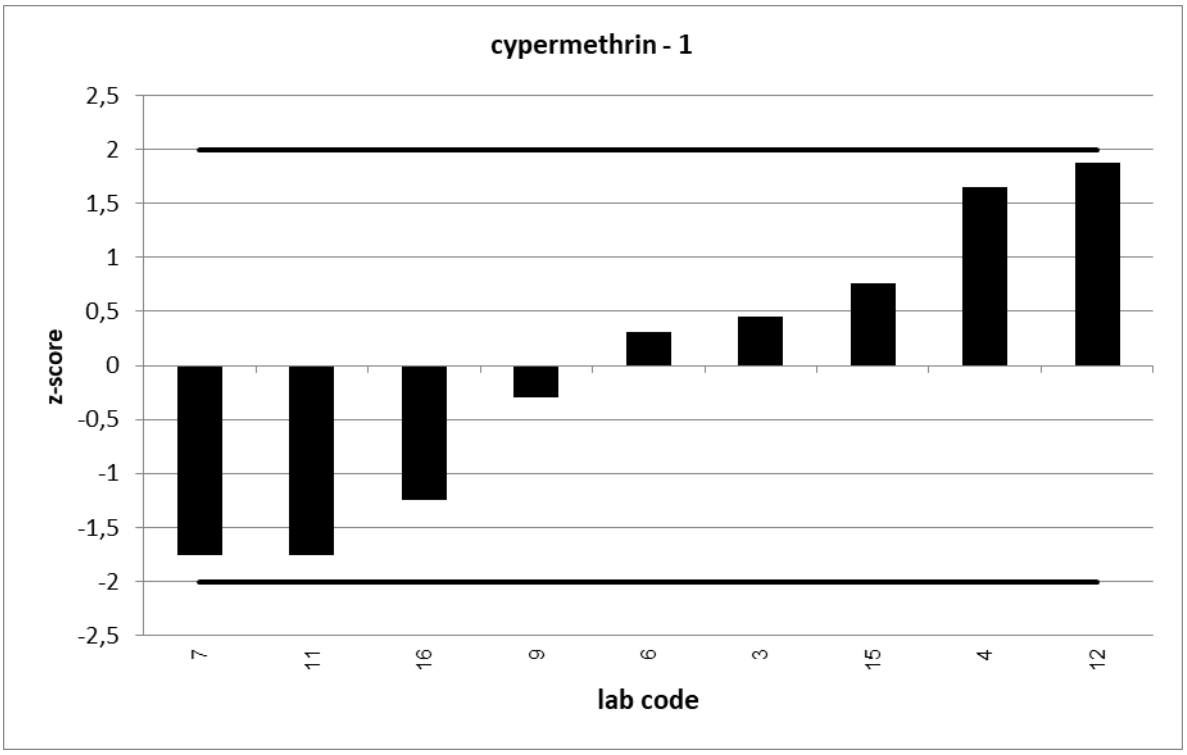
25 % is used as standard deviation for proficiency assessment.

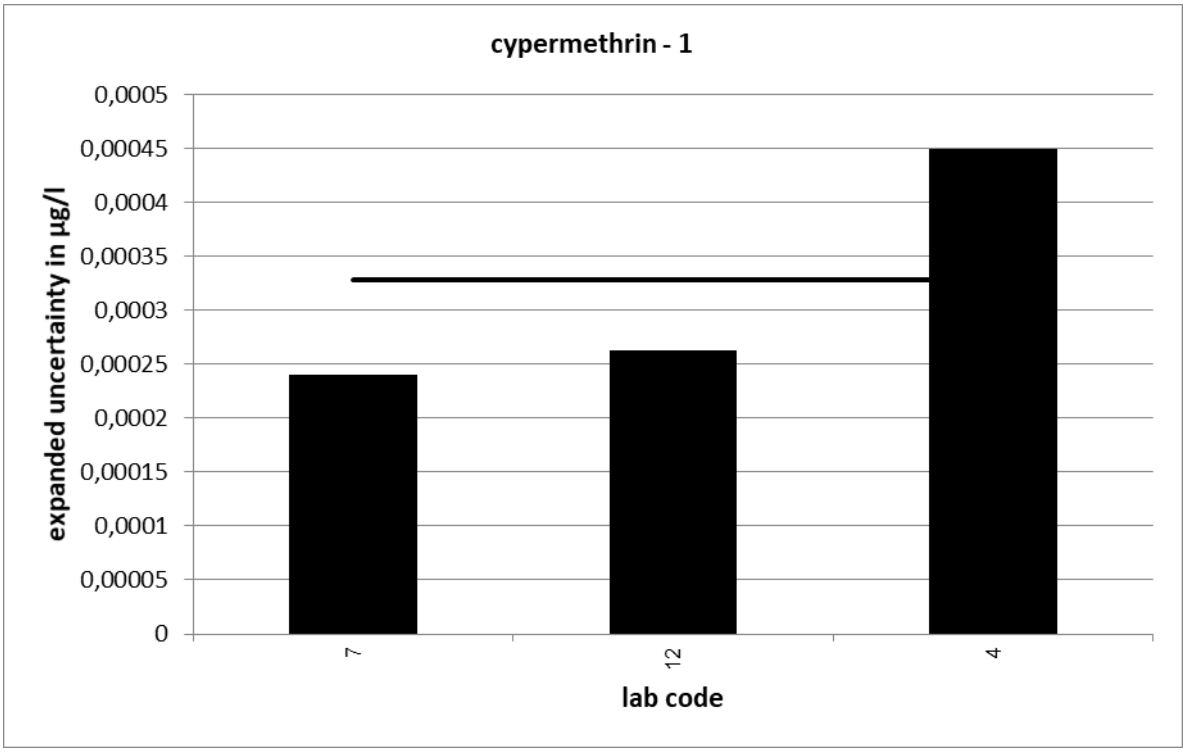
UKWIR PT 3/21		cypermethrin - 1			
assigned value [µg/l]*		0,000714		± 0,000274	
upper tolerance limit [µg/l]		0,001071			
lower tolerance limit [µg/l]		0,000357			
lab code	result [µg/l]	±	ζ-score	z-score	assessm.**
3	0,000794			0,4	s
4	0,001008	0,00045	1,1	1,6	s
6	0,000769			0,3	s
7	0,0004	0,00024	-1,7	-1,8	s
9	0,000662			-0,3	s
11	0,0004			-1,8	s
12	0,00105	0,000263	1,8	1,9	s
15	0,00085			0,8	s
16	0,000492			-1,2	s

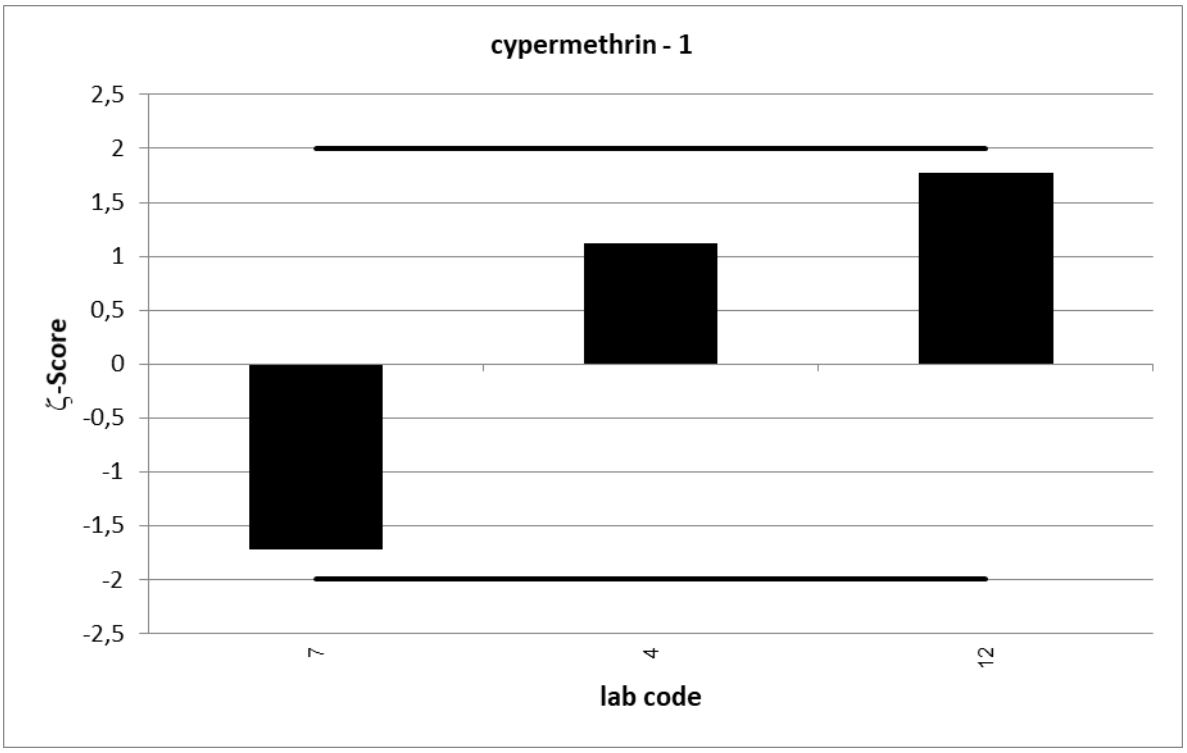
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




cypermethrin - 1
z-score
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
7
11
16
9
6
3
15
4
12
lab code

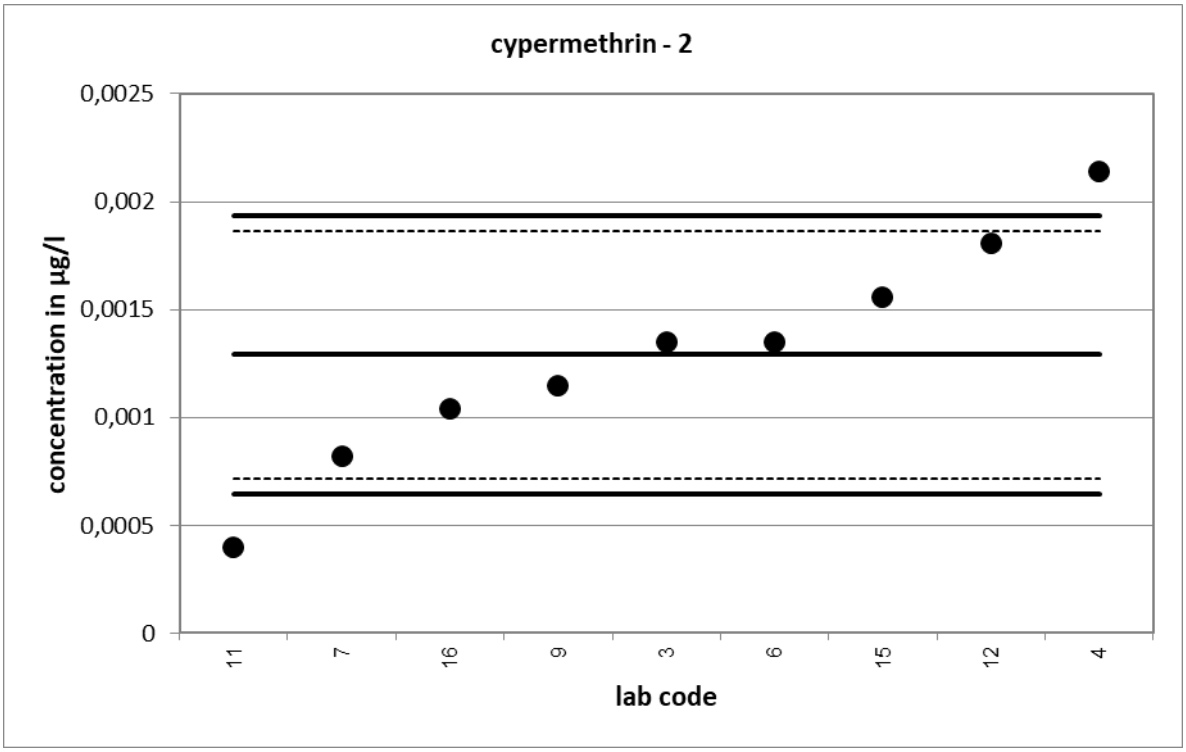

cypermethrin - 1
expanded uncertainty in µg/l
0,0005
0,00045
0,0004
0,00035
0,0003
0,00025
0,0002
0,00015
0,0001
0,00005
0
7
12
4
lab code

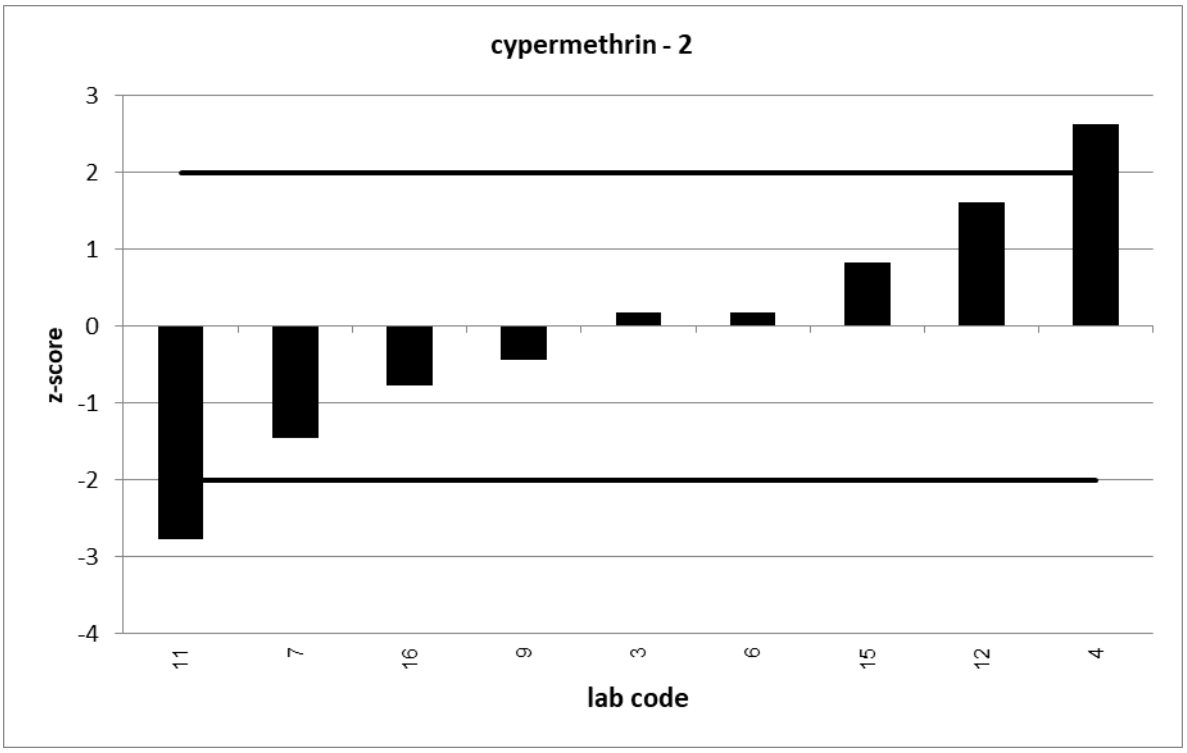

cypermethrin - 1
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
ζ-Score
7
4
12
lab code

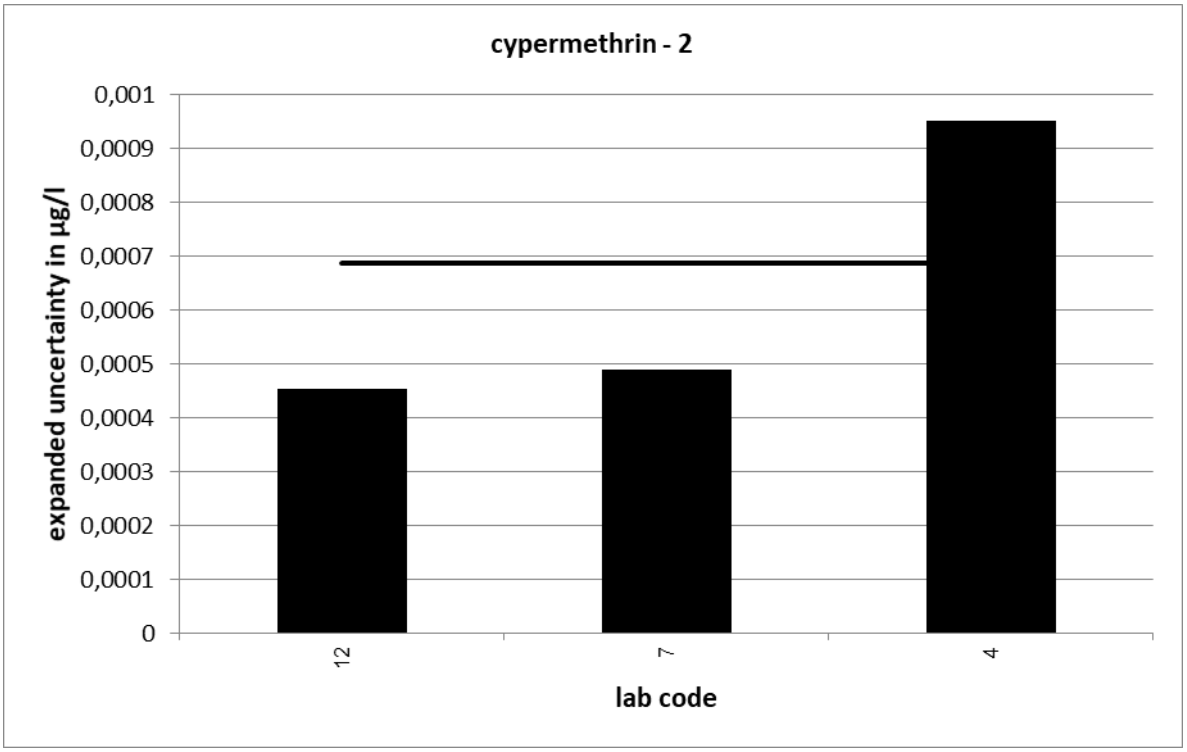
UKWIR PT 3/21		cypermethrin - 2			
assigned value [µg/l]*			0,001291	± 0,000572	
upper tolerance limit [µg/l]			0,001937		
lower tolerance limit [µg/l]			0,0006455		
lab code	result [µg/l]	±	ζ-score	z-score	assessm.**
3	0,001349			0,2	s
4	0,002141	0,00095	1,5	2,6	q
6	0,00135			0,2	s
7	0,00082	0,00049	-1,3	-1,5	s
9	0,00115			-0,4	s
11	0,0004			-2,8	q
12	0,00181	0,000454	1,4	1,6	s
15	0,00156			0,8	s
16	0,00104			-0,8	s

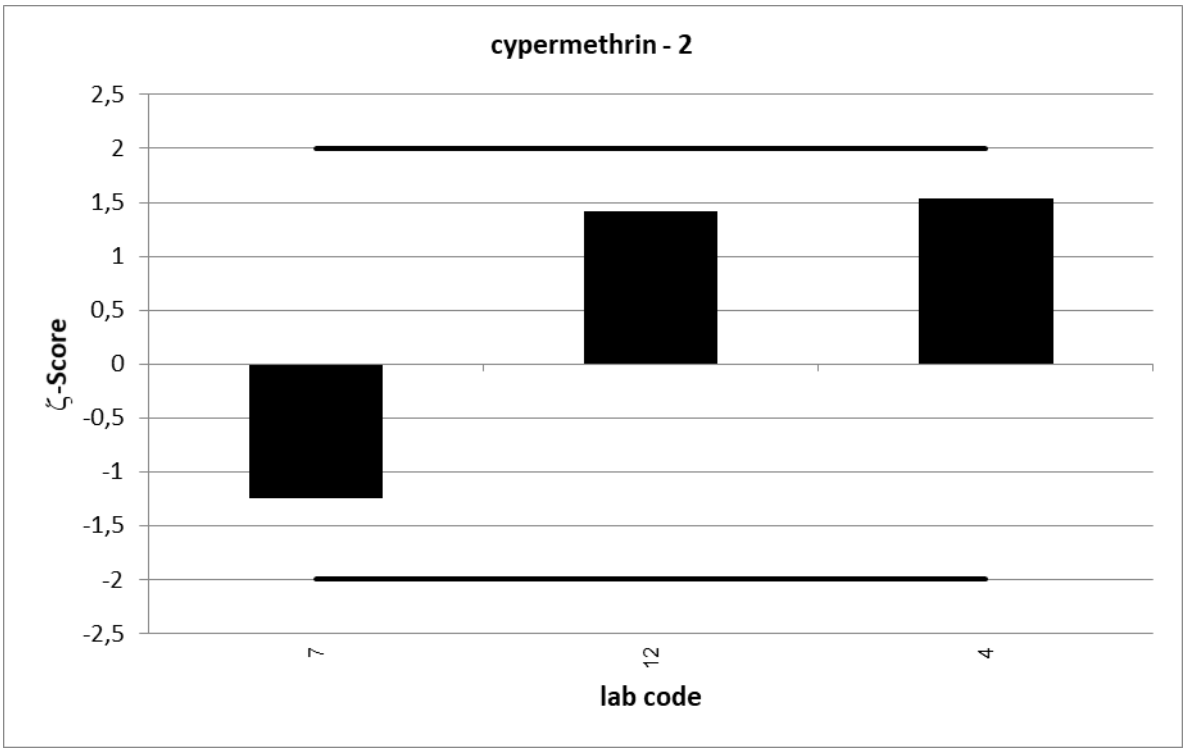
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




cypermethrin - 2
z-score
3
2
1
0
-1
-2
-3
-4
11
7
16
9
3
6
15
12
4
lab code

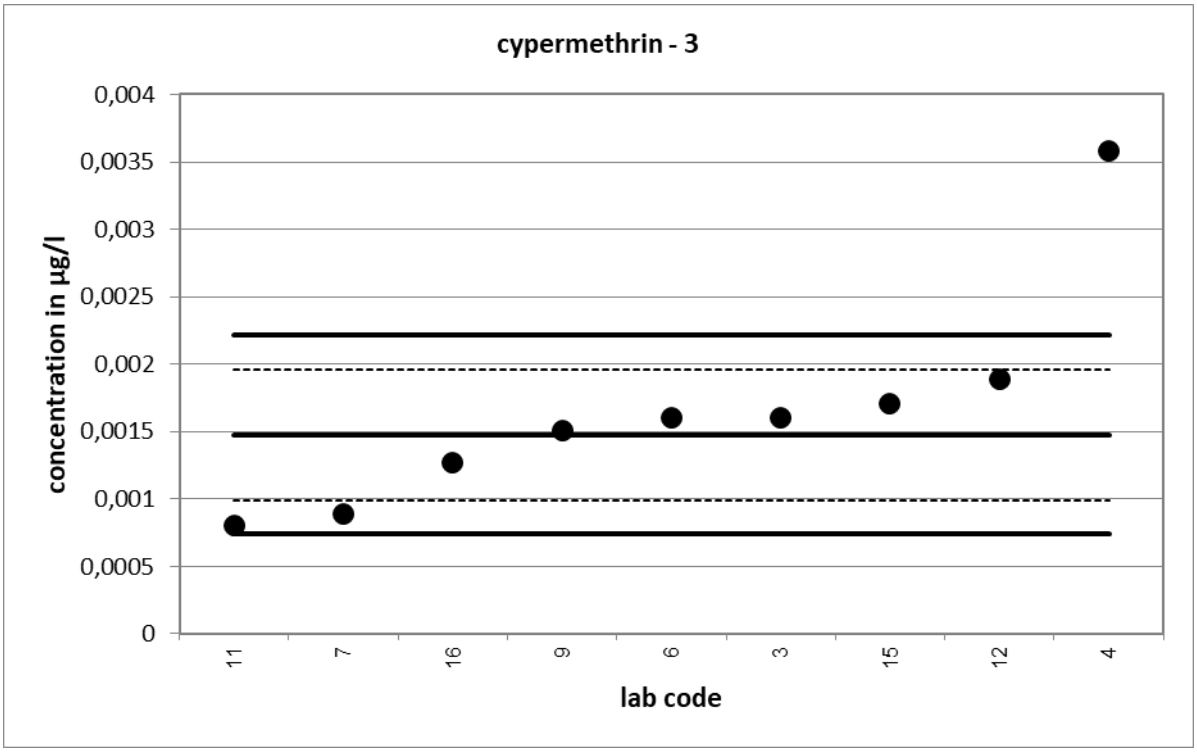

cypermethrin - 2
expanded uncertainty in µg/l
0,001
0,0009
0,0008
0,0007
0,0006
0,0005
0,0004
0,0003
0,0002
0,0001
0
12
7
4
lab code

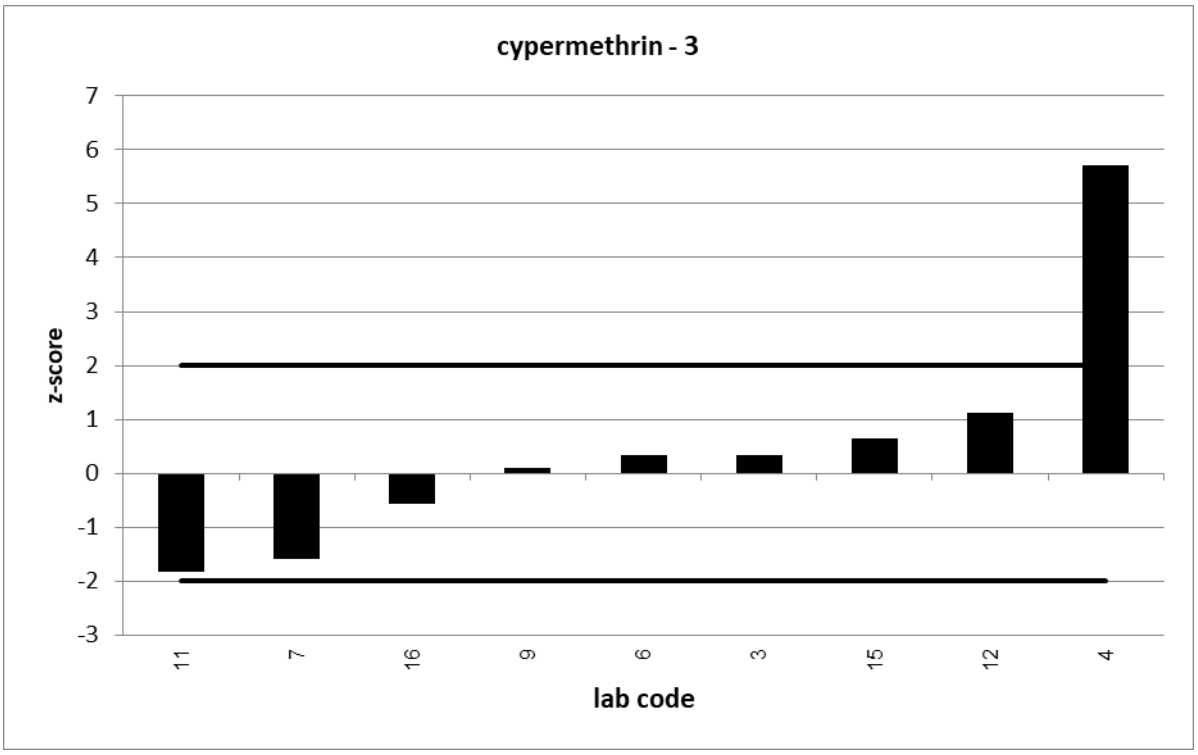

cypermethrin - 2
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
ζ-Score
7
12
4
lab code

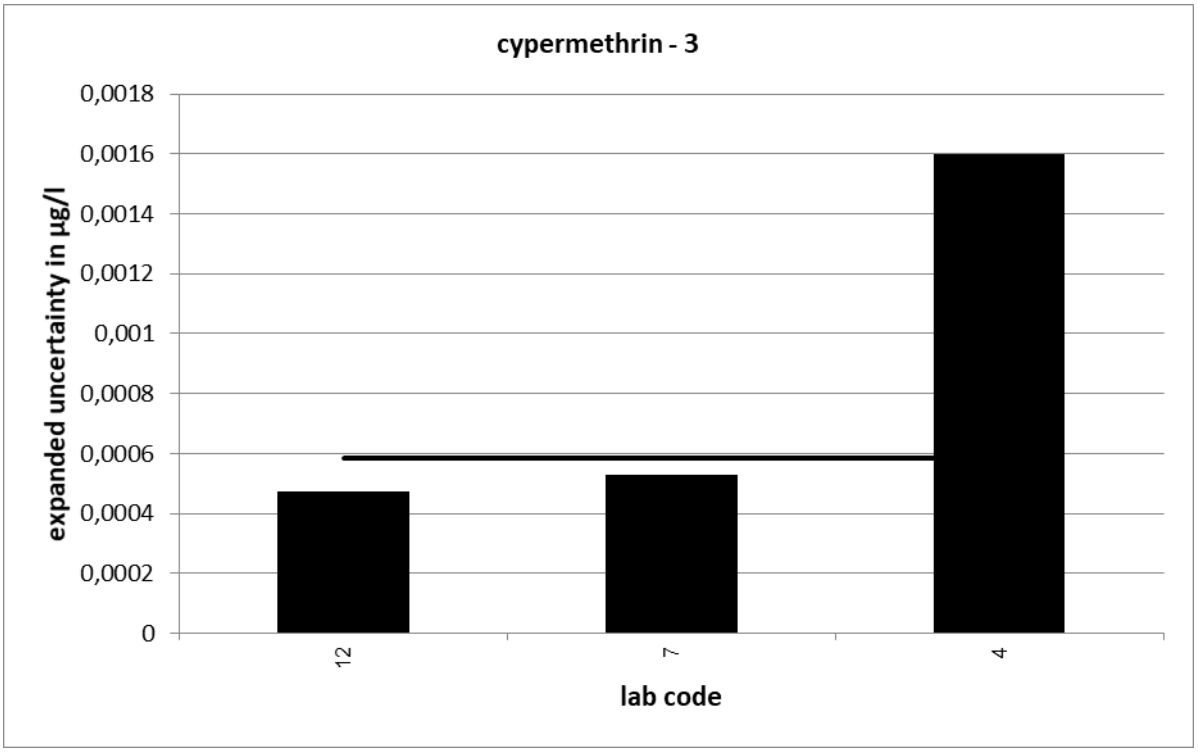
UKWIR PT 3/21		cypermethrin - 3			
assigned value [µg/l]*			0,001475	± 0,000487	
upper tolerance limit [µg/l]			0,002213		
lower tolerance limit [µg/l]			0,0007375		
lab code	result [µg/l]	±	ζ-score	z-score	assessm.**
3	0,001602			0,3	s
4	0,003577	0,0016	2,5	5,7	u
6	0,0016			0,3	s
7	0,00089	0,00053	-1,6	-1,6	s
9	0,001509			0,1	s
11	0,0008			-1,8	s
12	0,00189	0,000473	1,2	1,1	s
15	0,00171			0,6	s
16	0,00127			-0,6	s

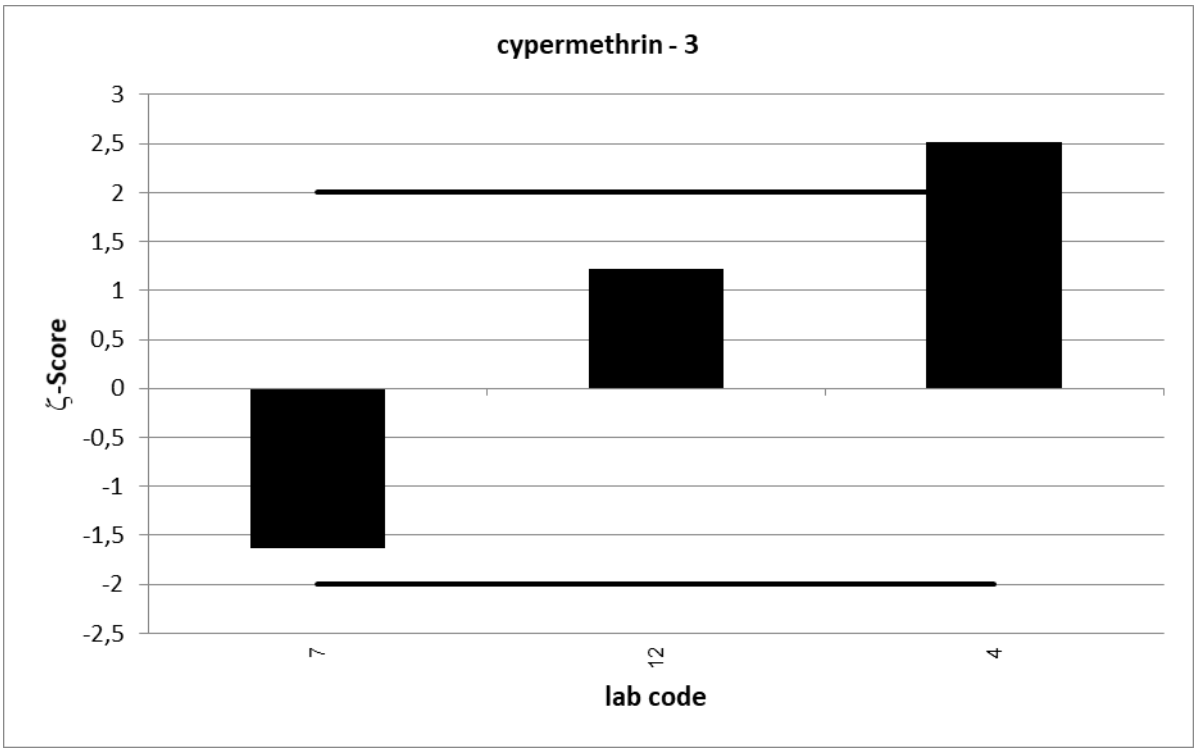
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




cypermethrin - 3
z-score
7
6
5
4
3
2
1
0
-1
-2
-3
11
7
16
9
6
3
15
12
4
lab code

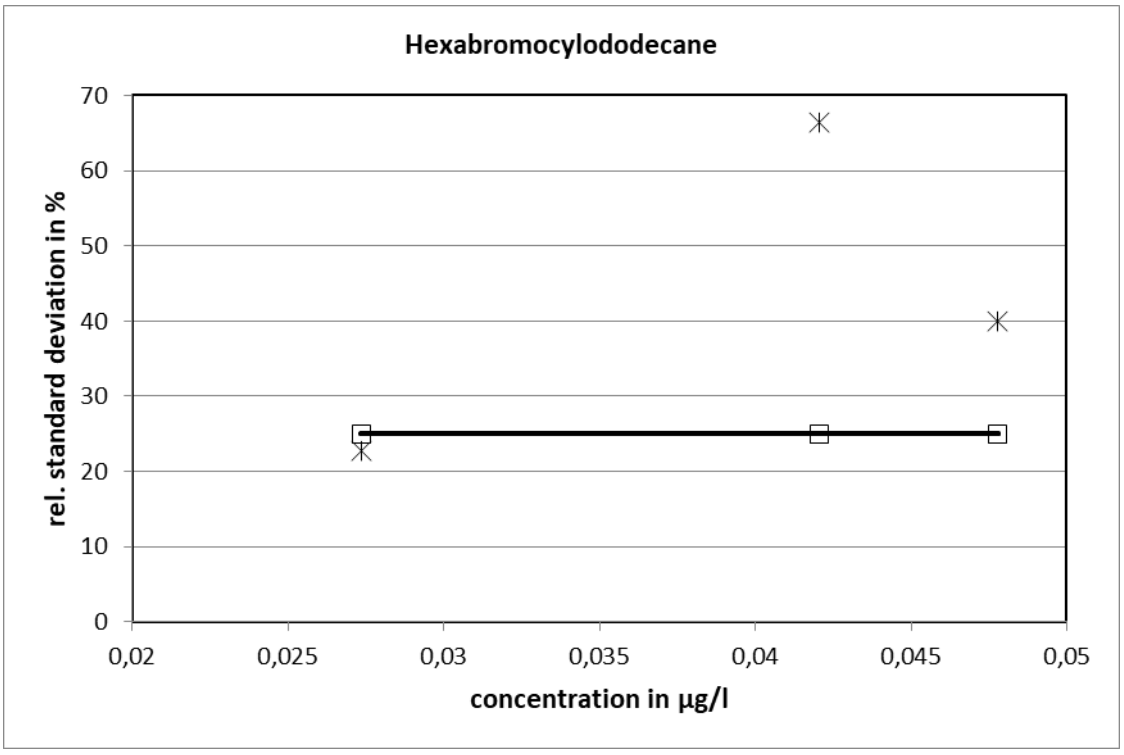

cypermethrin - 3
expanded uncertainty in µg/l
0,0018
0,0016
0,0014
0,0012
0,001
0,0008
0,0006
0,0004
0,0002
0
12
7
4
lab code


cypermethrin - 3
3
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
ζ-Score
7
12
4
lab code

UKWIR 4/21:

Hexabromocylododecane													
level	assigned value [µg/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [µg/l]	standard deviation for proficiency assessment [µg/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [µg/l]	lower tolerance limit [µg/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]
1	0,0274	23,19	0,0062	0,0068	25	0,0410	0,0137	50	-50	6	0	1	16,7
2	0,0420	67,85	0,0279	0,0105	25	0,0631	0,0210	50	-50	6	1	1	33,3
3	0,0478	40,87	0,0191	0,0119	25	0,0717	0,0239	50	-50	6	0	1	16,7
									sum	18	1	3	22,2

Relative standard deviation

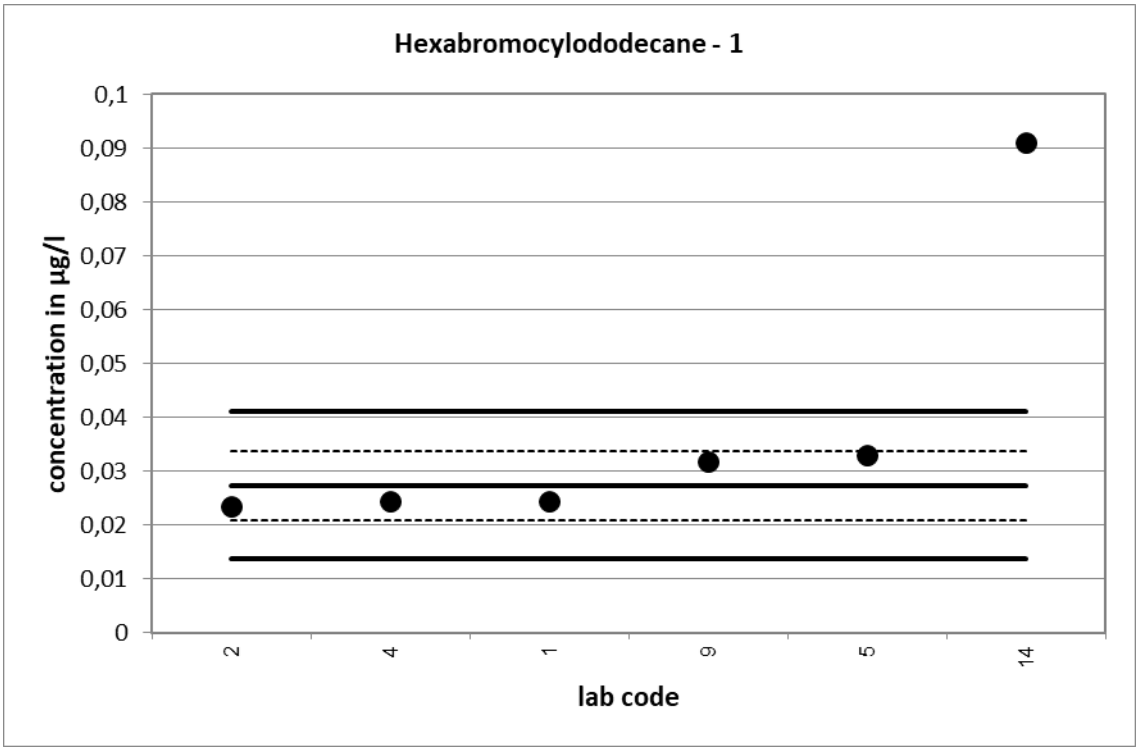


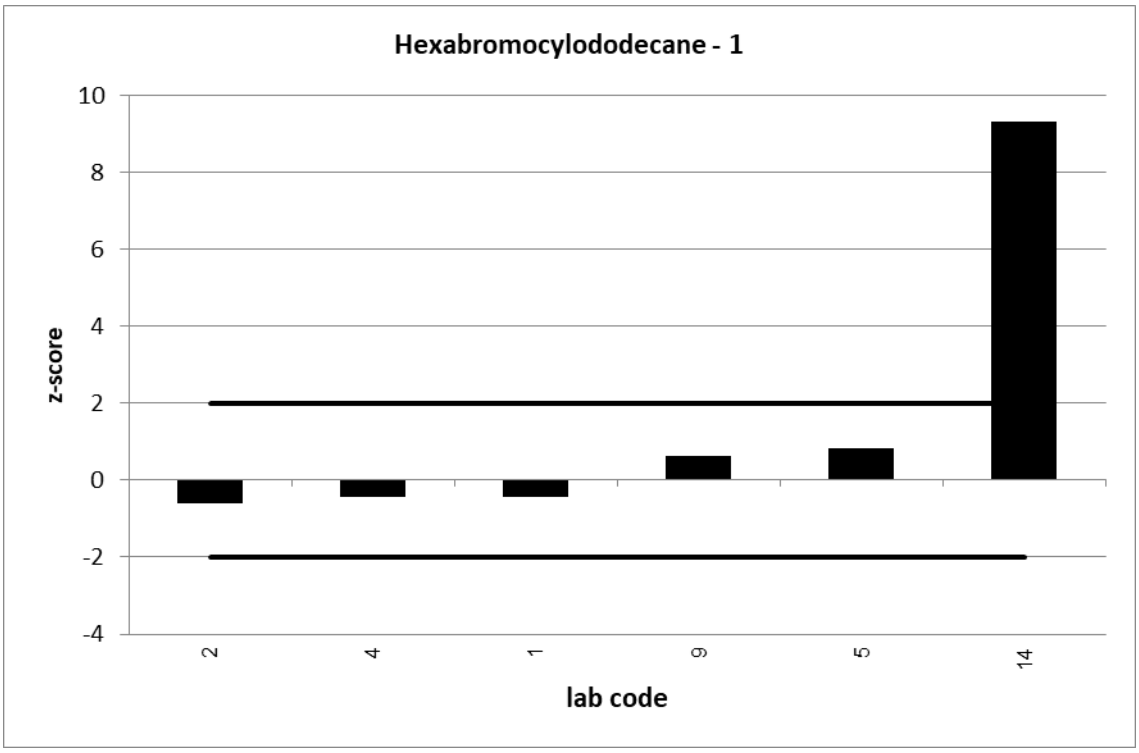
25 % is used as standard deviation for proficiency assessment.

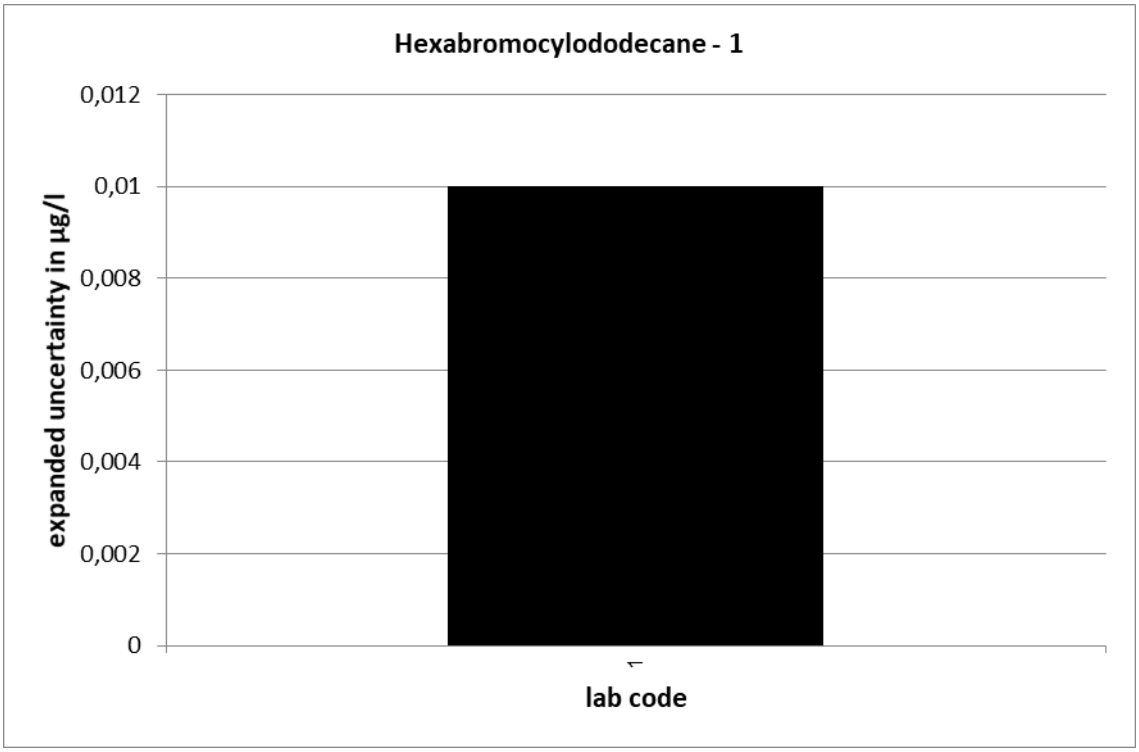
UKWIR PT 4/21		Hexabromocylododecane - 1			
assigned value [µg/l]*		0,02735	± 0,00634		
upper tolerance limit [µg/l]		0,04103			
lower tolerance limit [µg/l]		0,01368			
lab code	result [µg/l]	±	ζ-score	z-score	assessm.**
1	0,0244	0,01	-0,5	-0,4	s
2	0,0233			-0,6	s
4	0,02435			-0,4	s
5	0,033			0,8	s
9	0,0317			0,6	s
14	0,091			9,3	u

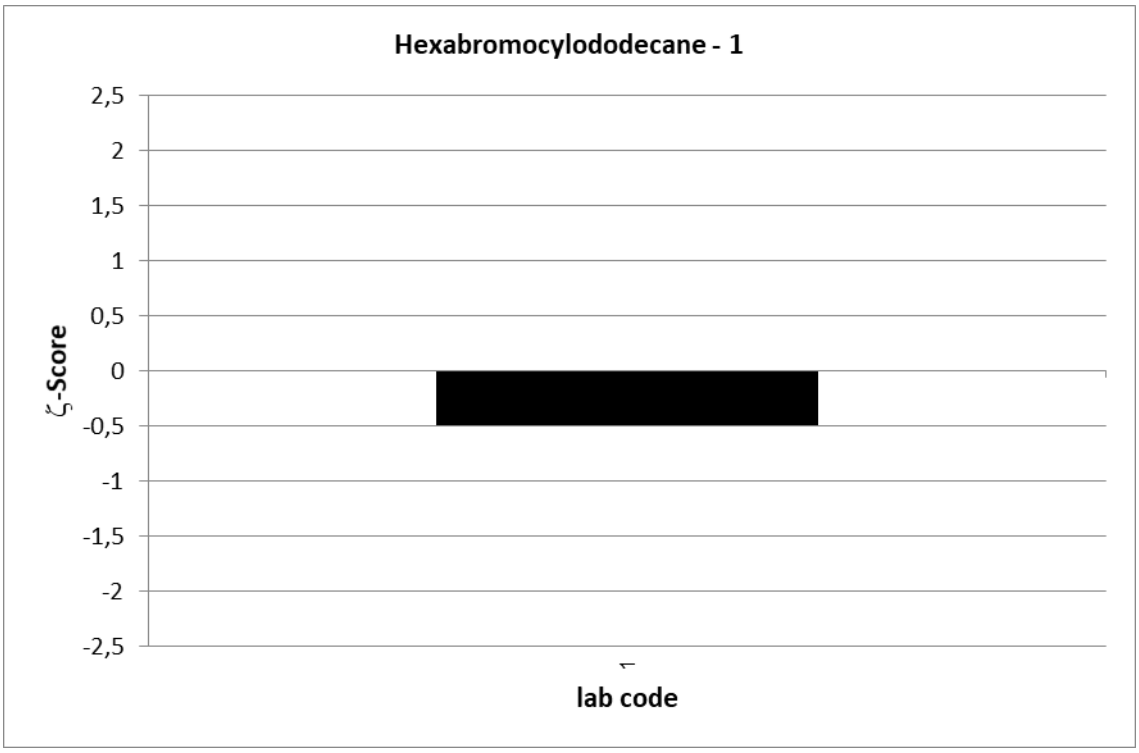
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Hexabromocylododecane - 1
10
8
6
4
2
0
-2
-4
z-score
2
4
1
9
5
14
lab code

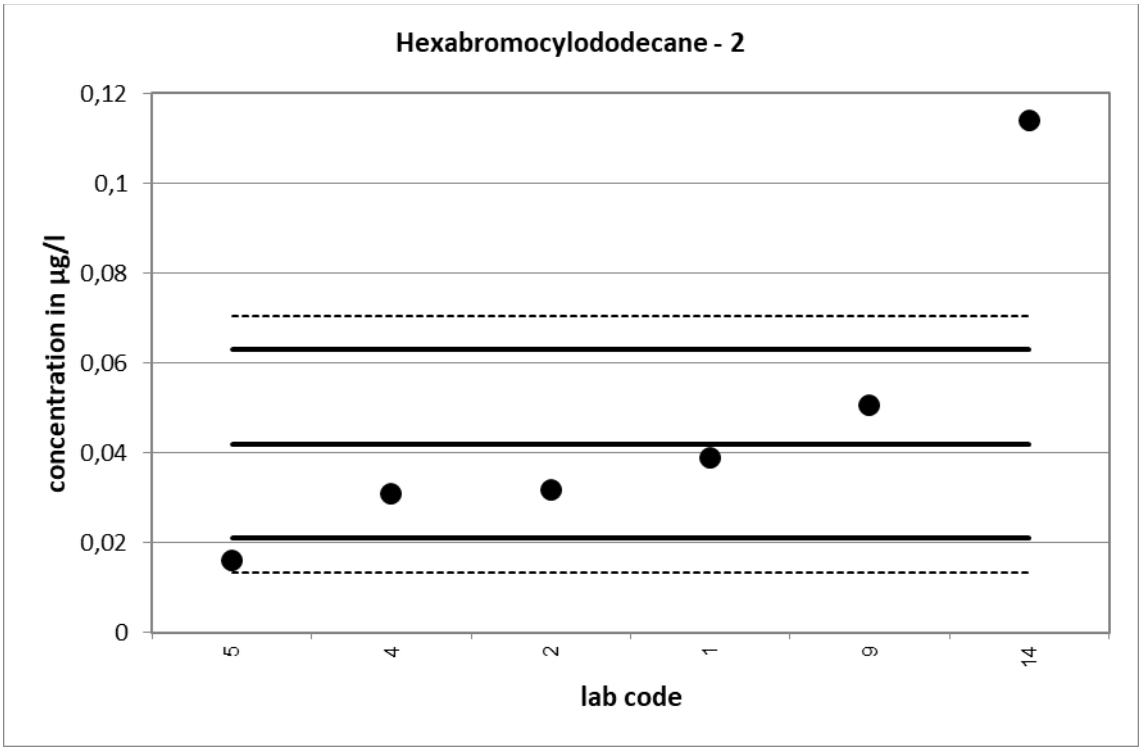

Hexabromocylododecane - 1
0,012
0,01
0,008
0,006
0,004
0,002
0
expanded uncertainty in µg/l
1
lab code

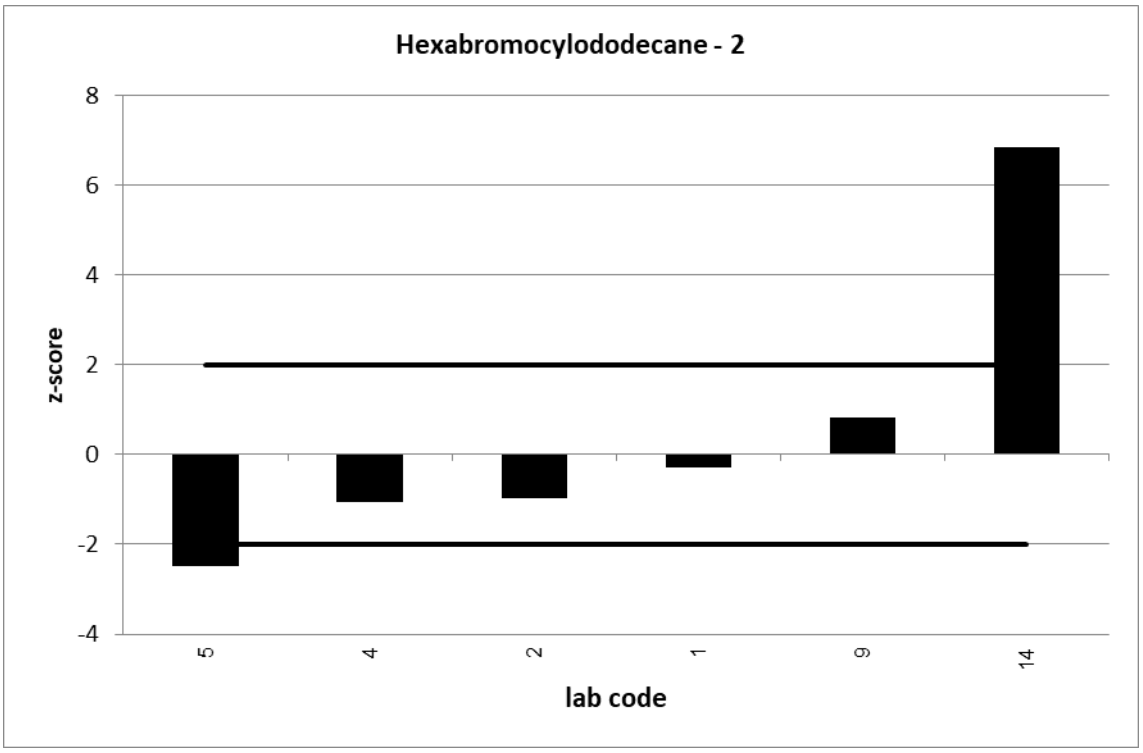

Hexabromocylododecane - 1
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
ζ-Score
1
lab code

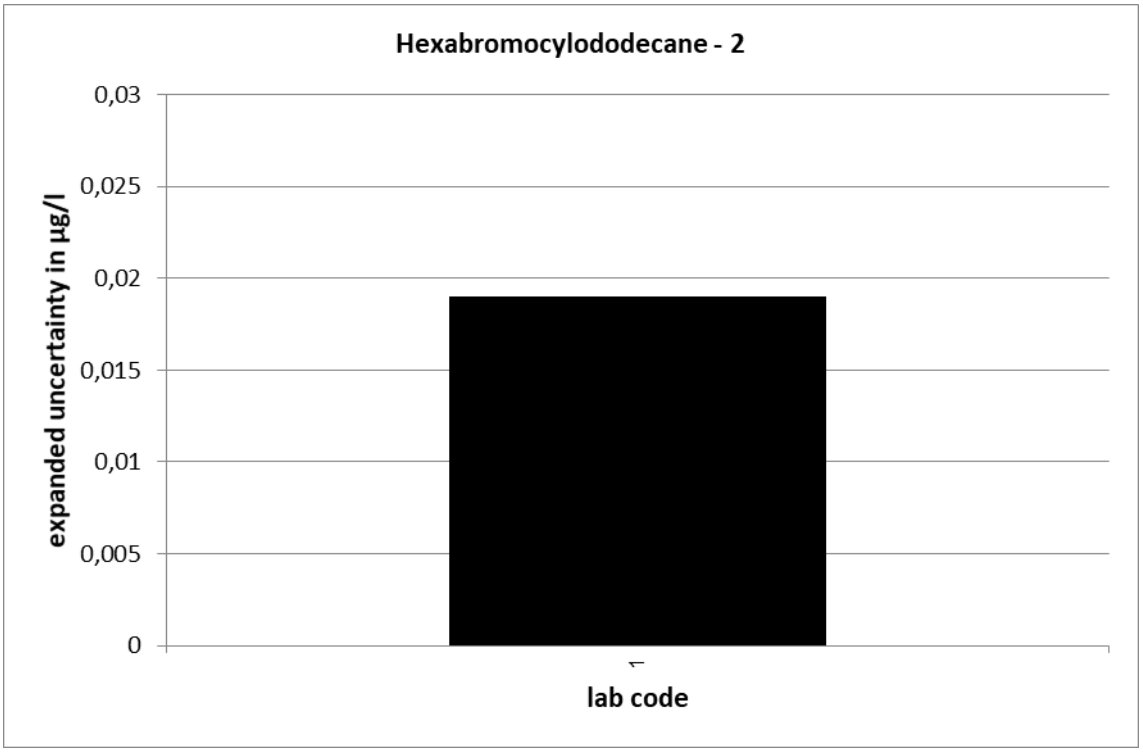
UKWIR PT 4/21		Hexabromocylododecane - 2			
assigned value [µg/l]*		0,04204	± 0,02853		
upper tolerance limit [µg/l]		0,06306			
lower tolerance limit [µg/l]		0,02102			
lab code	result [µg/l]	±	ζ-score	z-score	assessm.**
1	0,0389	0,019	-0,2	-0,3	s
2	0,0317			-1,0	s
4	0,030979			-1,1	s
5	0,016			-2,5	q
9	0,0507			0,8	s
14	0,114			6,8	u

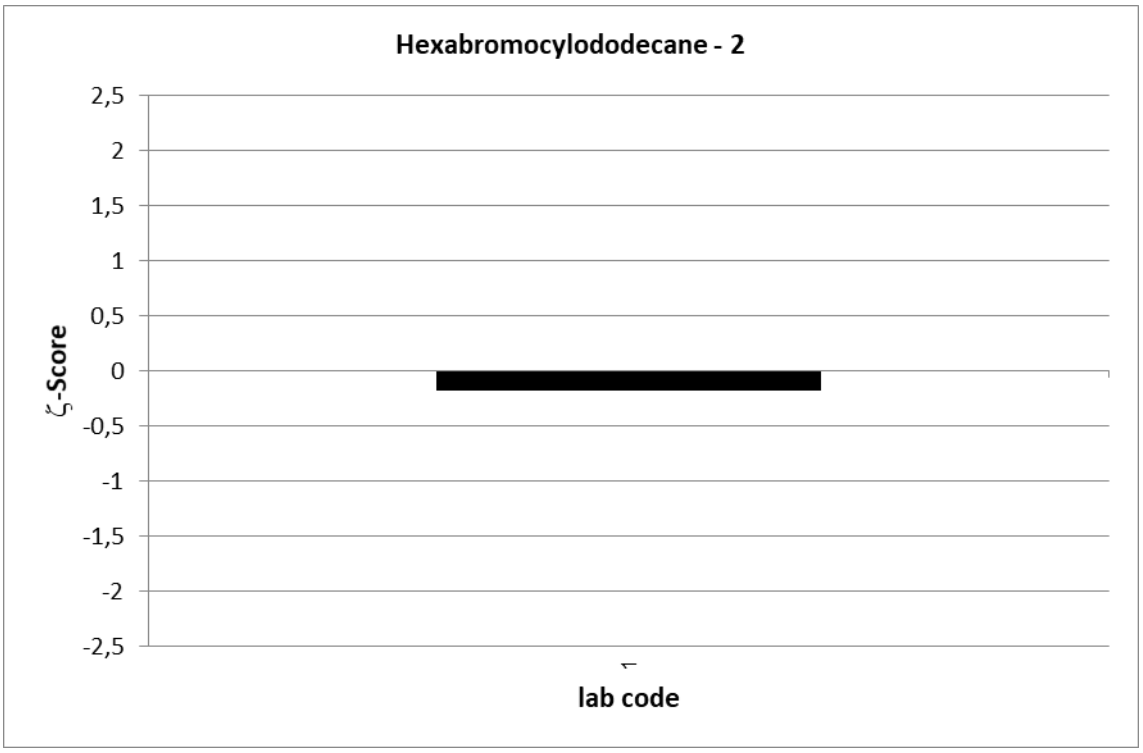
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Hexabromocylododecane - 2
8
6
4
2
0
-2
-4
z-score
5
4
2
1
9
14
lab code

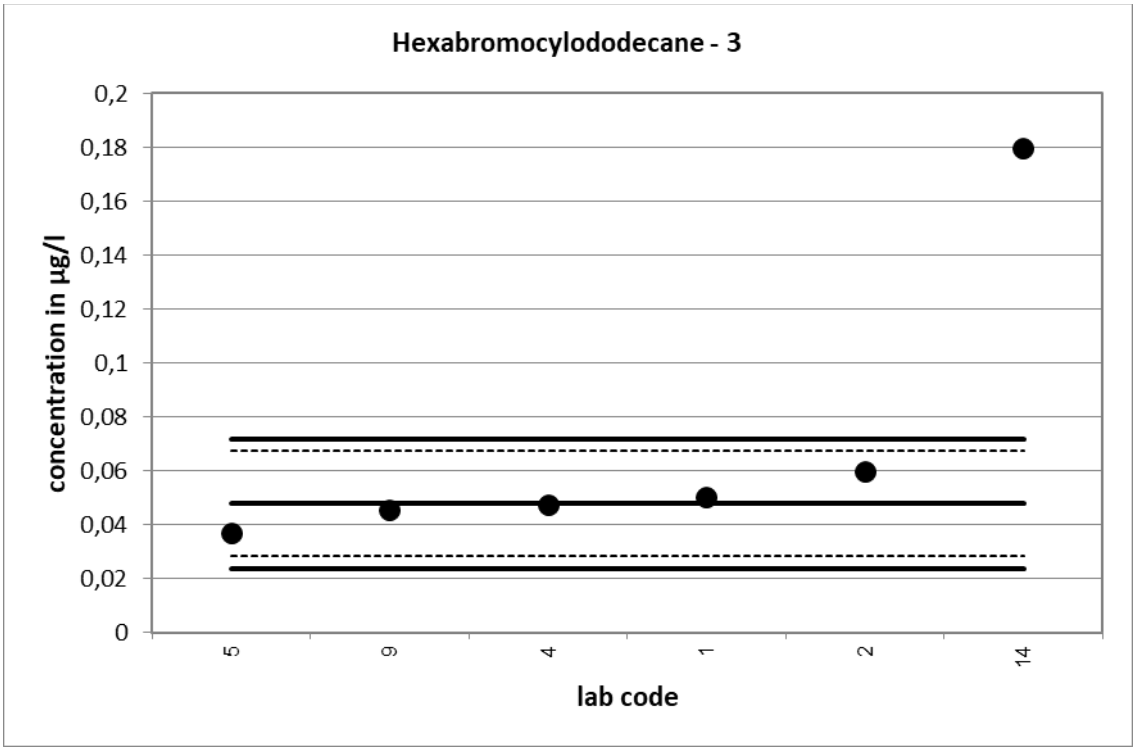

Hexabromocylododecane - 2
0,03
0,025
0,02
0,015
0,01
0,005
0
expanded uncertainty in µg/l
1
lab code

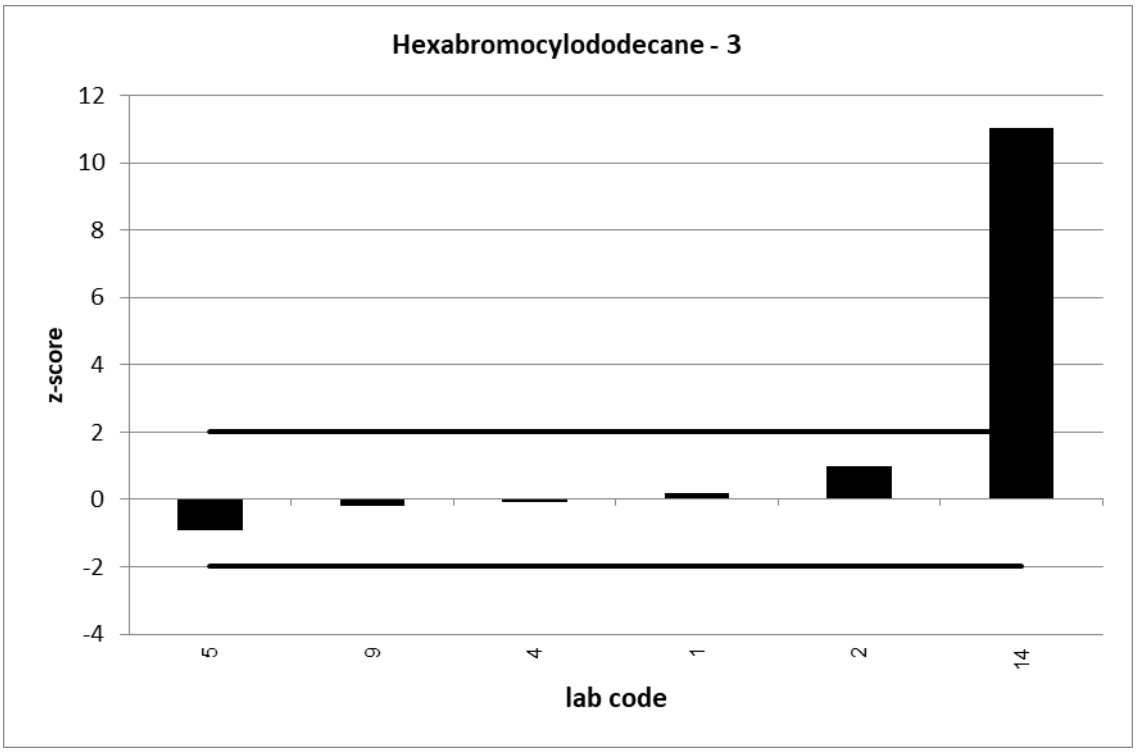

Hexabromocylododecane - 2
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
ζ-Score
1
lab code

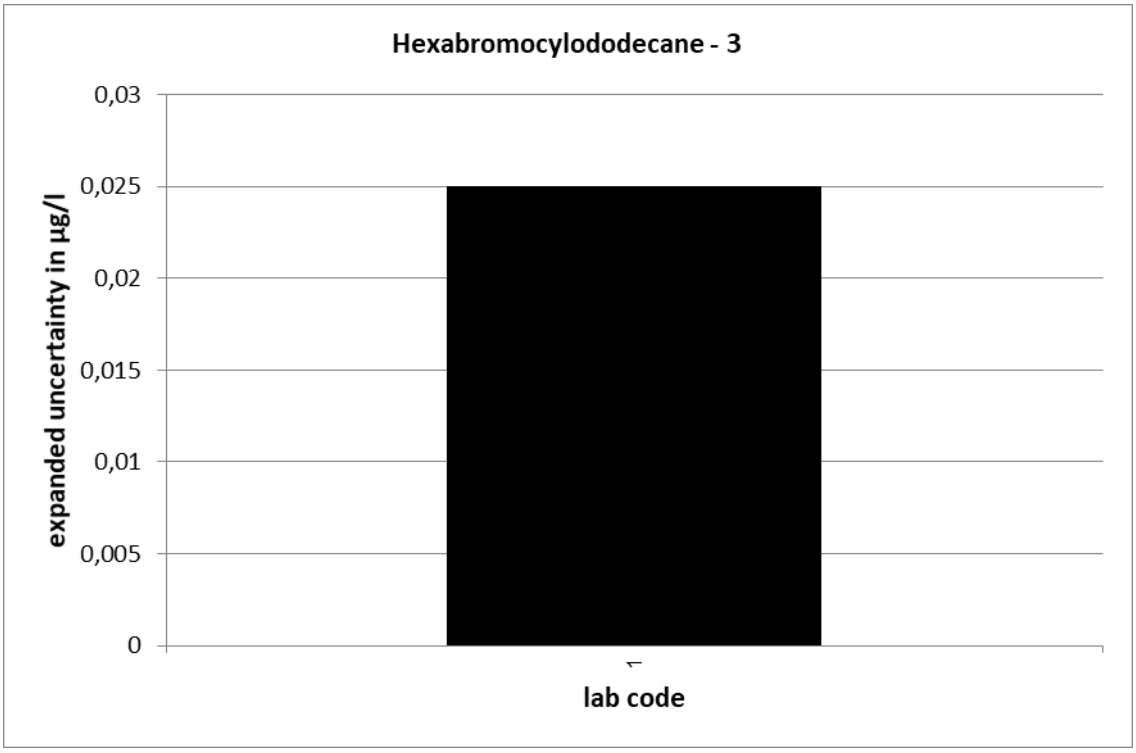
UKWIR PT 4/21		Hexabromocylododecane - 3			
assigned value [µg/l]*		0,04779	± 0,01953		
upper tolerance limit [µg/l]		0,07169			
lower tolerance limit [µg/l]		0,0239			
lab code	result [µg/l]	±	ζ-score	z-score	assessm.**
1	0,0501	0,025	0,1	0,2	s
2	0,0594			1,0	s
4	0,04707			-0,1	s
5	0,037			-0,9	s
9	0,0454			-0,2	s
14	0,1796			11,0	u

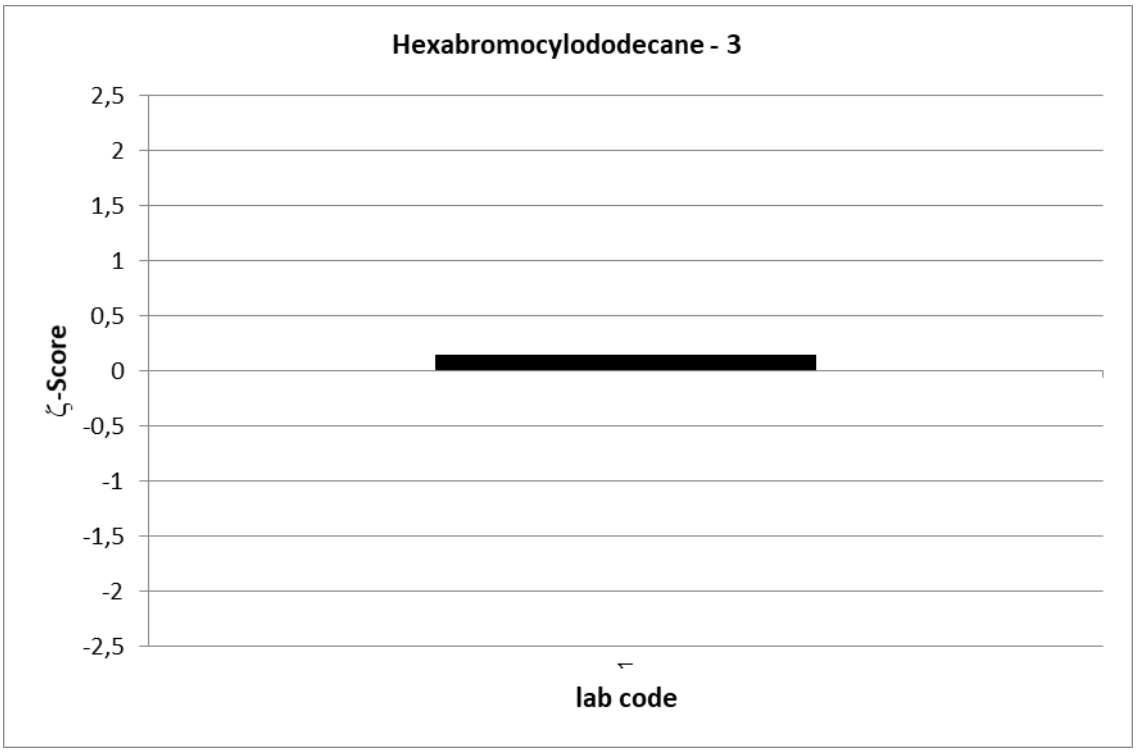
* The stated uncertainty of the assigned value is the expanded uncertainty with a coverage factor k=2 corresponding to a confidence level of about 95%

** s = satisfactory, q = questionable, u = unsatisfactory




Hexabromocylododecane - 3
12
10
8
6
4
2
0
-2
-4
z-score
5
9
4
1
2
14
lab code


Hexabromocylododecane - 3
0,03
0,025
0,02
0,015
0,01
0,005
0
expanded uncertainty in µg/l
1
lab code


Hexabromocylododecane - 3
2,5
2
1,5
1
0,5
0
-0,5
-1
-1,5
-2
-2,5
ζ-Score
1
lab code