

Analytische Qualitätssicherung Baden-Württemberg

Proficiency Tests UKWIR 5/21 to 9/21
priority substances in surface water -

nonylphenol, octylphenol, triclosan, tributyltin, benzo[a]pyrene,
fluoranthene, perfluorooctane sulfonic acid, perfluorooctanoic acid

Stuttgart, July 2021

provided by
AQS Baden-Württemberg
c/o Institute for Sanitary Engineering, Water Quality and Solid Waste Management,
University of Stuttgart
Bandtäle 2, 70569 Stuttgart-Büsnau, Germany

Responsibilities:

Scientific director AQS:	Dr.-Ing. Dipl.-Chem. Michael Koch
PT manager:	Dr.-Ing. Frank Baumeister
Sample preparation:	Gertrud Joas, Cornelia Orth

Release of the report: 23 July 2021
by Scientific director AQS: Dr.-Ing. Michael Koch

AQS Baden-Württemberg at
Institute of Sanitary Engineering,
Water Quality and Solid Waste Management
at University of Stuttgart
Bandtäle 2
70569 Stuttgart-Büsnau
Germany
<http://www.aqsbw.de>
Tel.: +49 (0)711 / 685-65446
Fax: +49 (0)711 / 685-53769
E-Mail: info@aqsbw.de

Table of contents

General	1
PT design	1
Analytical methods.....	2
Evaluation procedure	2
Results of evaluation	3
Explanation of tables and graphs in the appendix.....	4
Appendix A	
nonylphenol.....	A-1
octylphenol.....	A-5
triclosan	A-15
tributyltin.....	A-22
benzo[a]pyrene	A-32
fluoranthene.....	A-42
perfluorooctane sulfonic acid	A-52
perfluorooctanoic acid	A-62

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 5/21
 - nonylphenol
 - octylphenol
- UKWIR 6/21
 - triclosan
- UKWIR 7/21
 - tributyltin
- UKWIR 8/21
 - benzo[a]pyrene
 - fluoranthene
- UKWIR 9/21
 - perfluorooctane sulfonic acid (PFOS)
 - perfluorooctanoic acid (PFOA)

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 (for UKWIR 5/21 waste water treatment plant effluent) sample in 1000 ml glass bottles with ground glass plug
- 1 blank sample of the filtered surface water or waste water treatment plant effluent water resp.

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
nonylphenol	50 ng/l
octylphenol	10 ng/l
triclosan	10 ng/l
tributyltin	0.12 ng/l
benzo[a]pyrene	0.5 ng/l
fluoranthene	1.8 ng/l
PFOS	2 ng/l
PFOA	2 ng/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.

Consensus means were calculated with arithmetic mean after exclusion of Grubbs outliers for the UKWIR 5/21 to UKWIR 7/21 PTs (because of the very low number of results) and with the combined estimator Hampel/Q-method, a method of robust statistics for the UKWIR 8/21 and UKWIR 9/21 PTs.

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

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

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

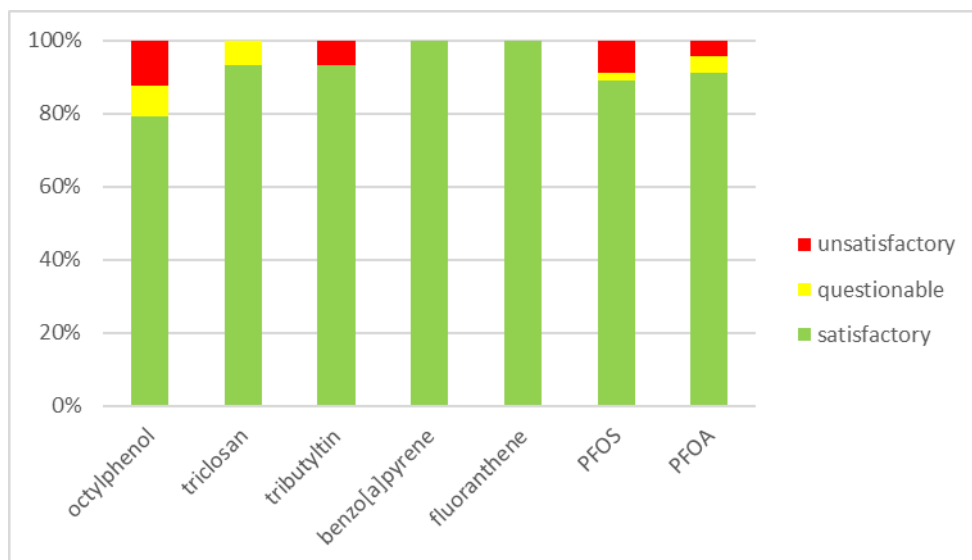
Results of evaluation

Number of participants:

PT round	determinands	number of participants	number of participants reporting results
UKWIR 5/21	nonylphenol octylphenol	9	8
UKWIR 6/21	triclosan	5	5
UKWIR 7/21	tributyltin	6	5
UKWIR 8/21	benzo[a]pyrene fluoranthene	10	9
UKWIR 9/21	perfluorooctane sulfonic acid (PFOS) perfluorooctanoic acid (PFOA)	15	15

Unfortunately, **it was not possible to evaluate the parameter nonylphenol**. As can be seen from the diagrams in the appendix A there were for all three samples two groups of participants, one reporting very low results and the other group reporting comparably high results. It was not possible for us to decide which of the groups is right and which is wrong. It was also not possible for us to calculate a reliable estimate of the matrix content in the unspiked samples. Therefore we decided not to evaluate the parameter in this PT round.

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 $\leq 2,0$ 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 ($z = \pm 2,0$).

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.

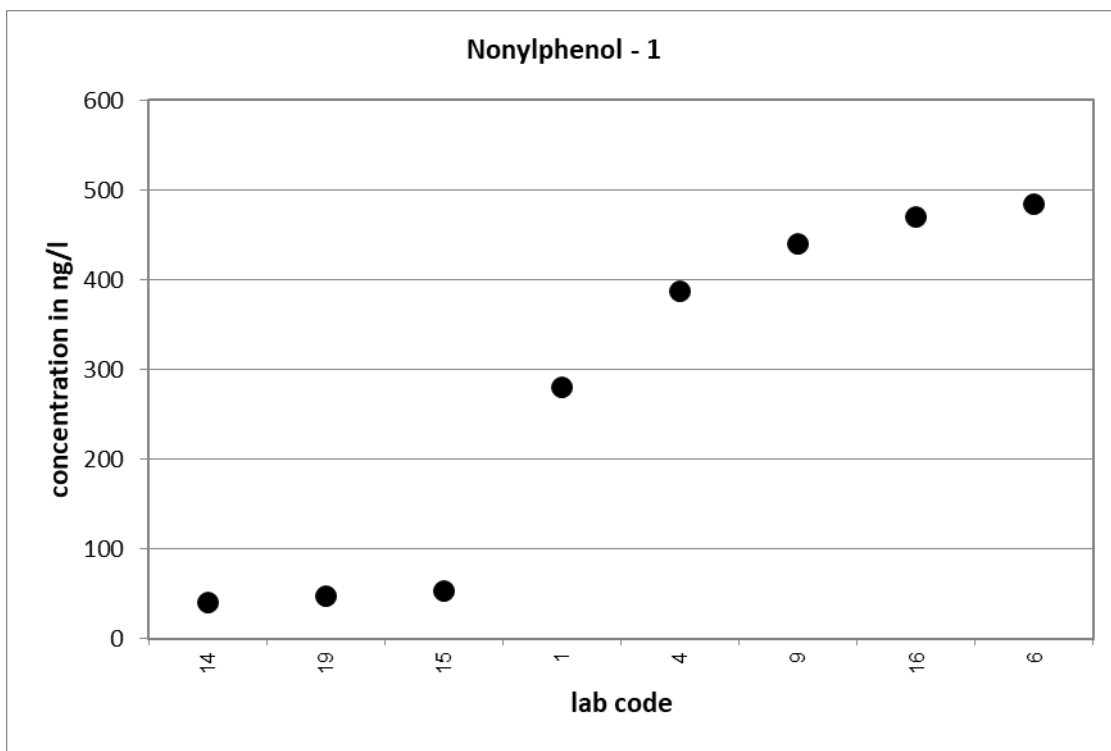
 ζ -score graphs

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

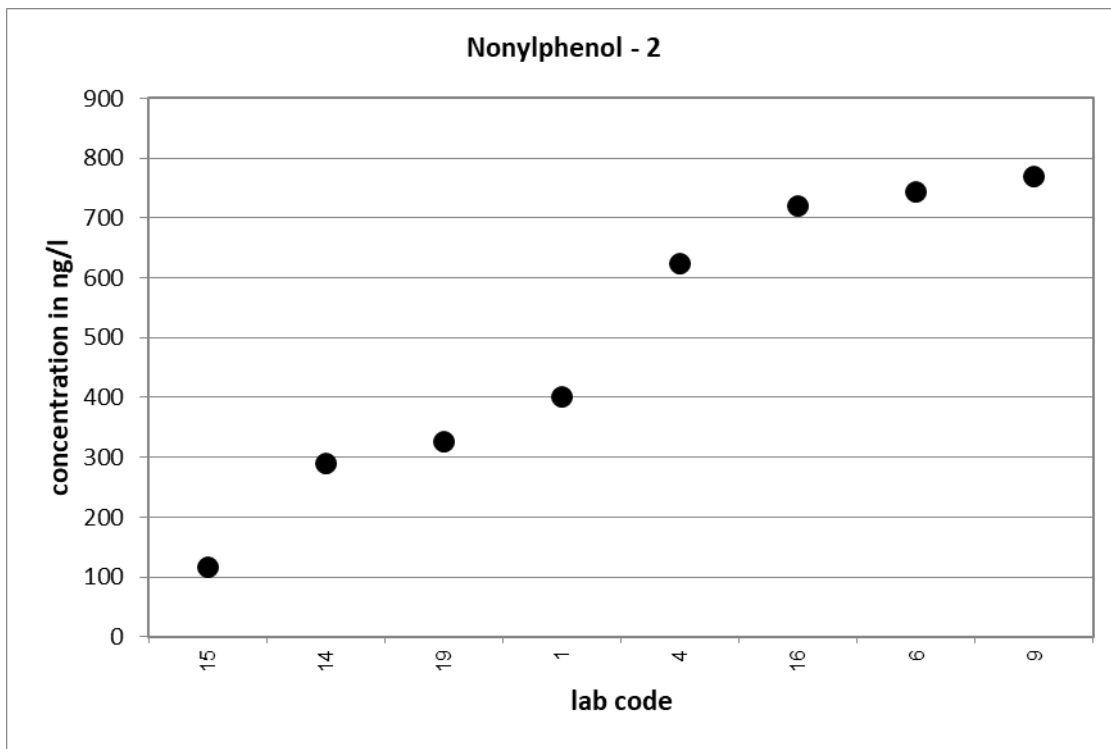
UKWIR 5/21

Nonylphenol	
level	
1	no evaluation possible
2	
3	
	sum

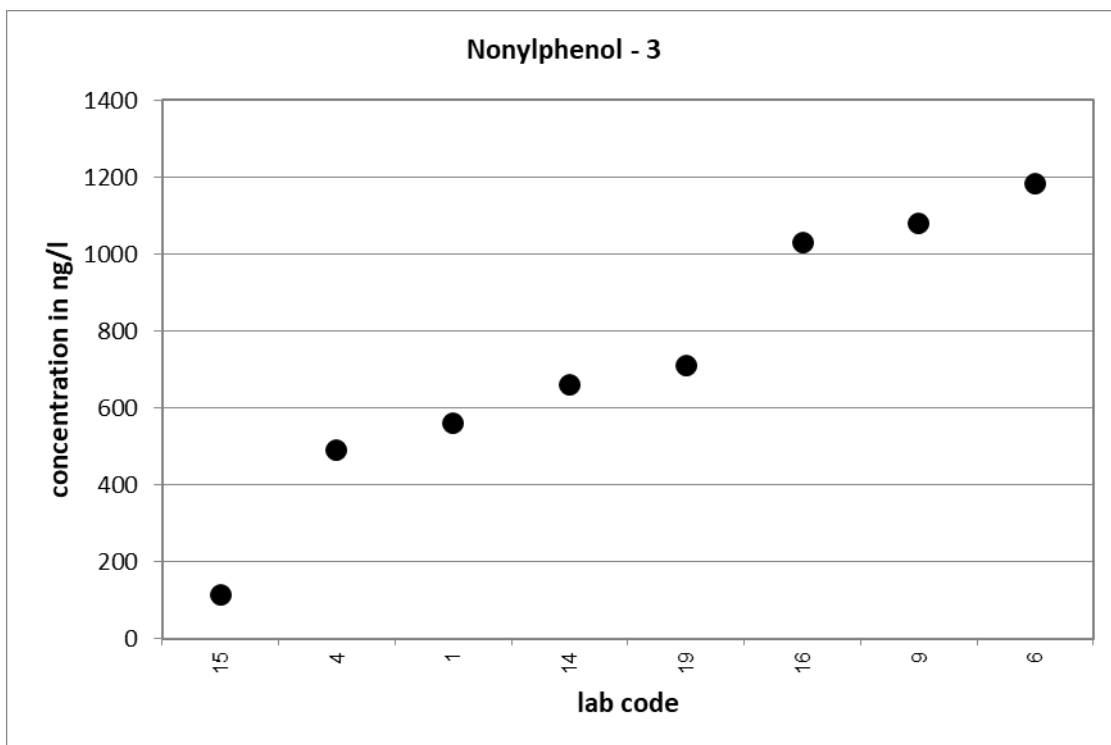
UKWIR PT 5/21		Nonylphenol - 1			
assigned value [ng/l]		-	-		
upper tolerance limit [ng/l]		-			
lower tolerance limit [ng/l]		-			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.
1	280			-	-
4	387			-	-
6	484			-	-
9	440			-	-
14	40			-	-
15	53			-	-
16	470			-	-
19	47	16,22		-	-



UKWIR PT 5/21		Nonylphenol - 2			
assigned value [ng/l]		-	-		
upper tolerance limit [ng/l]		-			
lower tolerance limit [ng/l]		-			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.
1	400			-	-
4	624			-	-
6	743			-	-
9	770			-	-
14	290			-	-
15	116			-	-
16	720			-	-
19	326,1	16,22		-	-

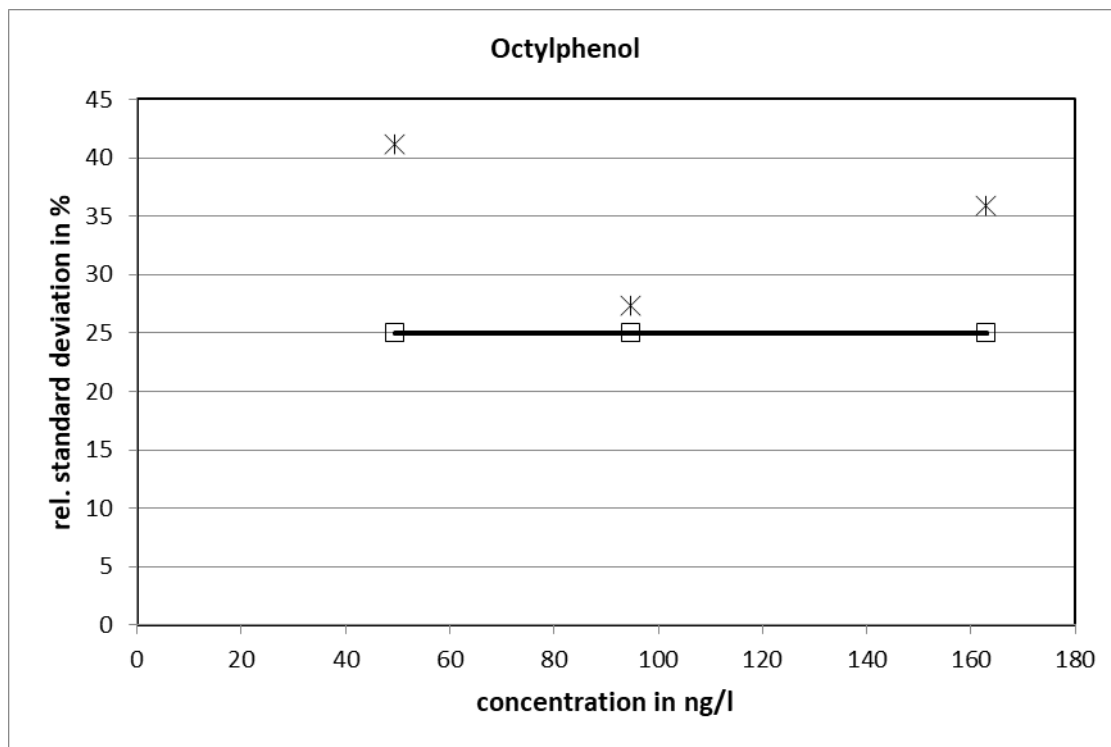


UKWIR PT 5/21		Nonylphenol - 3			
assigned value [ng/l]		-	-		
upper tolerance limit [ng/l]		-			
lower tolerance limit [ng/l]		-			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.
1	560			-	-
4	489			-	-
6	1184			-	-
9	1080			-	-
14	660			-	-
15	116			-	-
16	1030			-	-
19	709,2	16,22		-	-



Octylphenol													
level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	calculated standard deviation [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	49,43	34,28	20,33	12,36	25,00	74,14	24,71	50,00	-50,00	8	0	1	12,5
2	94,70	24,20	25,93	23,68	25,00	142,1	47,35	50,00	-50,00	8	0	1	12,5
3	162,9	31,77	58,57	40,74	25,00	244,4	81,47	50,00	-50,00	8	1	2	37,5
									sum	24	1	4	20,8

Relative standard deviation

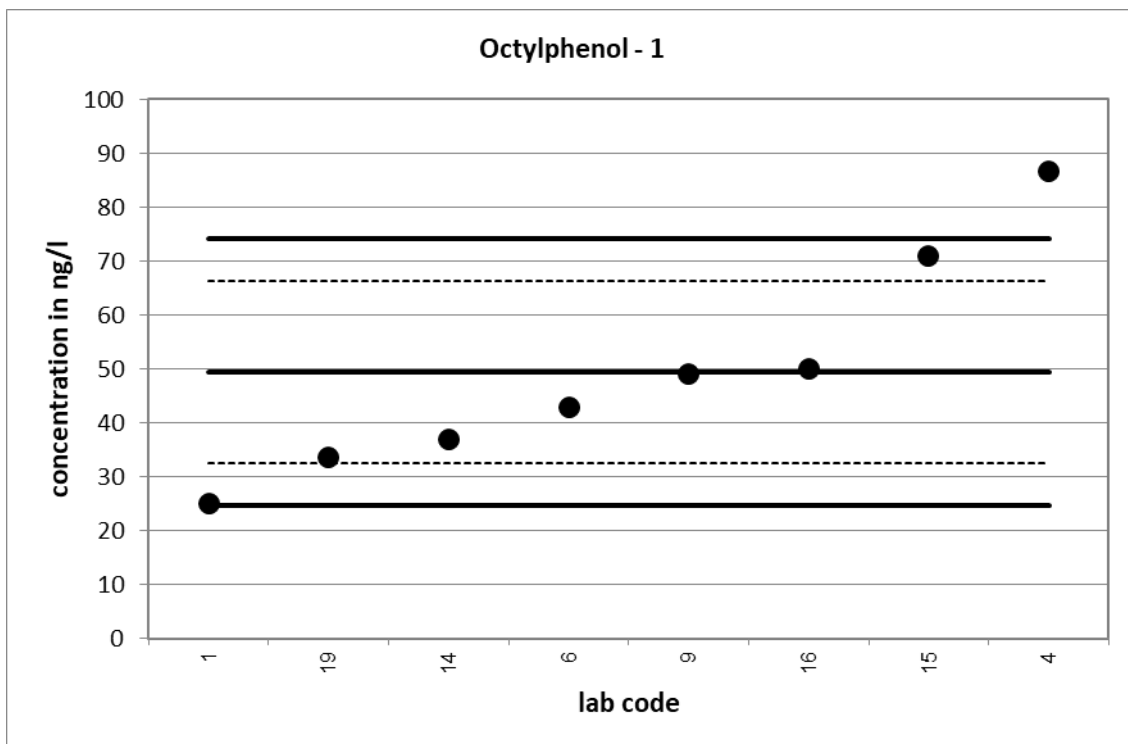


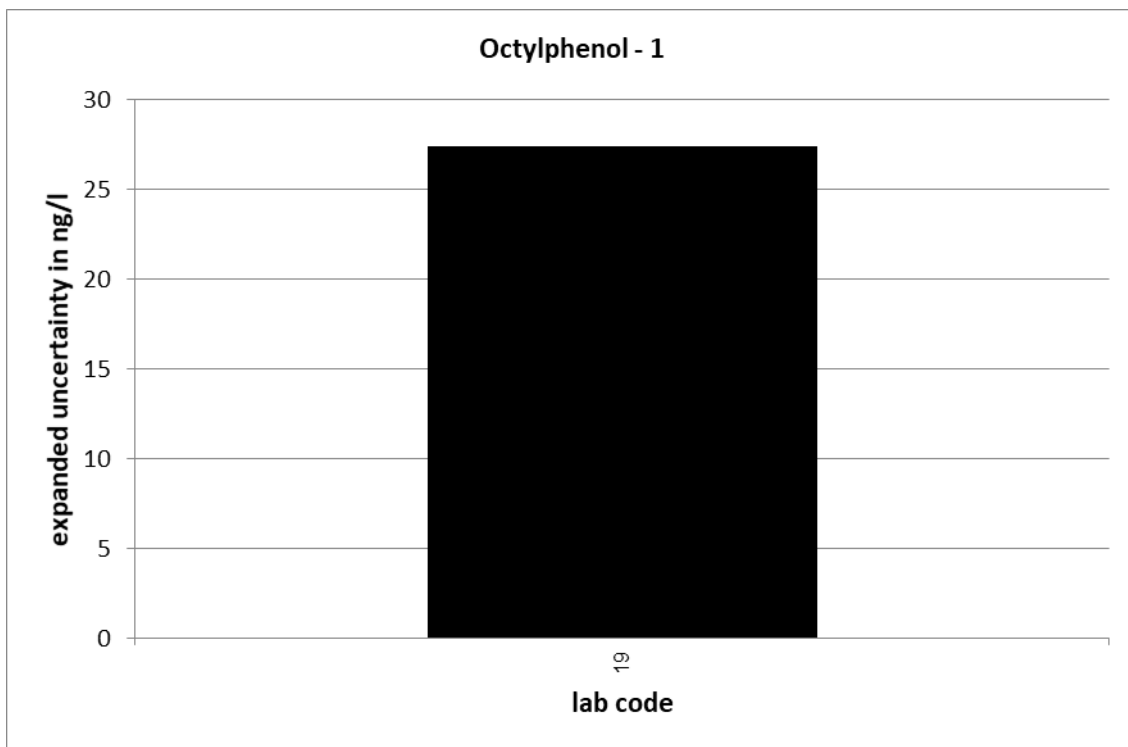
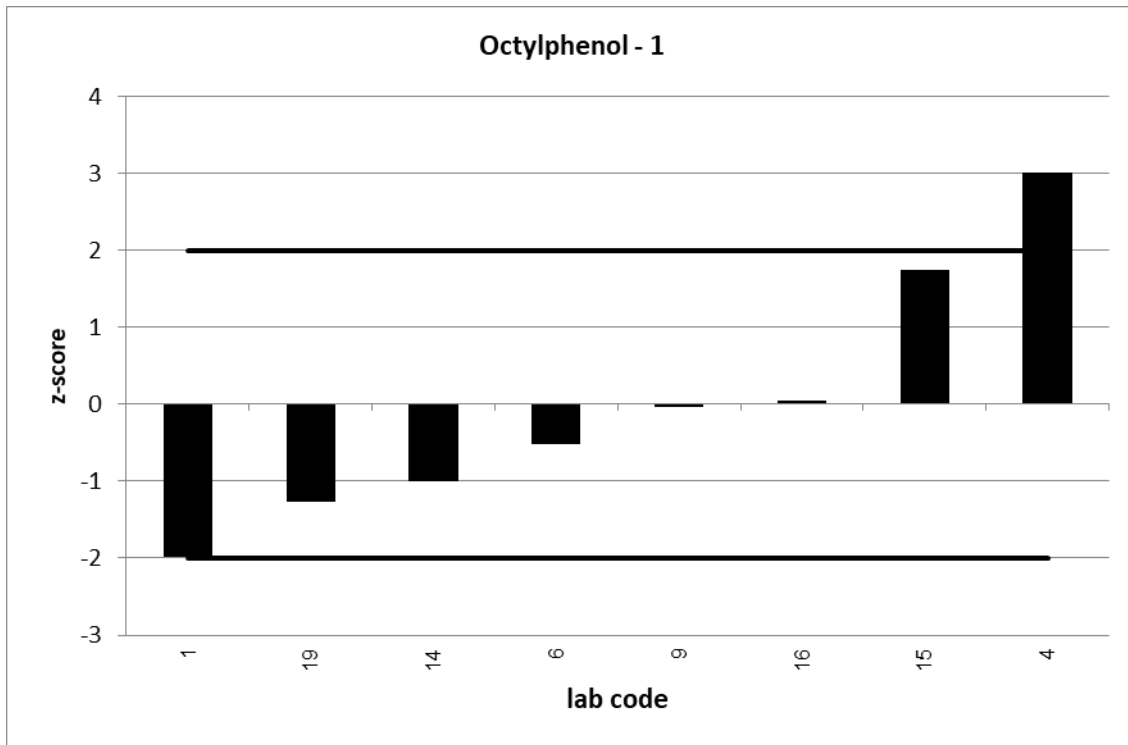
25 % is the value used as standard deviation for proficiency assessment.

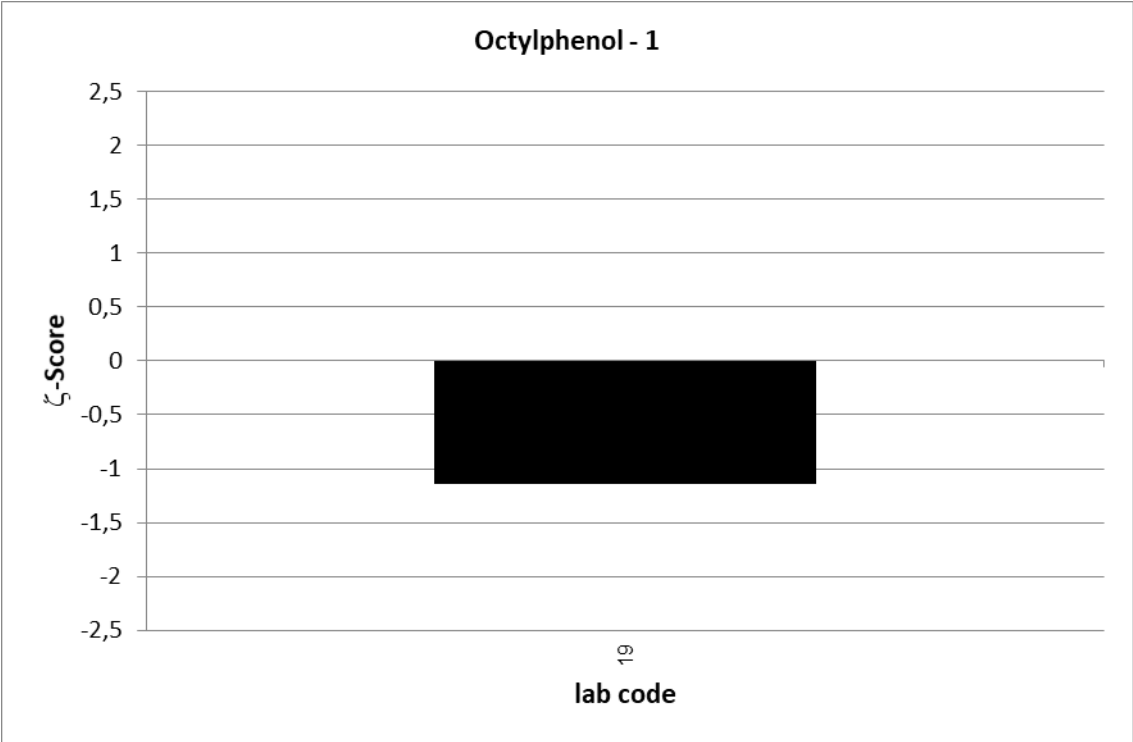
UKWIR PT 5/21		Octylphenol - 1			
assigned value [ng/l]*		49,43 ± 16,94			
upper tolerance limit [ng/l]		74,14			
lower tolerance limit [ng/l]		24,71			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	25			-2,0	s
4	86,7			3,0	u
6	43			-0,5	s
9	49			0,0	s
14	37			-1,0	s
15	71			1,7	s
16	50			0,0	s
19	33,72	27,43	-1,1	-1,3	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



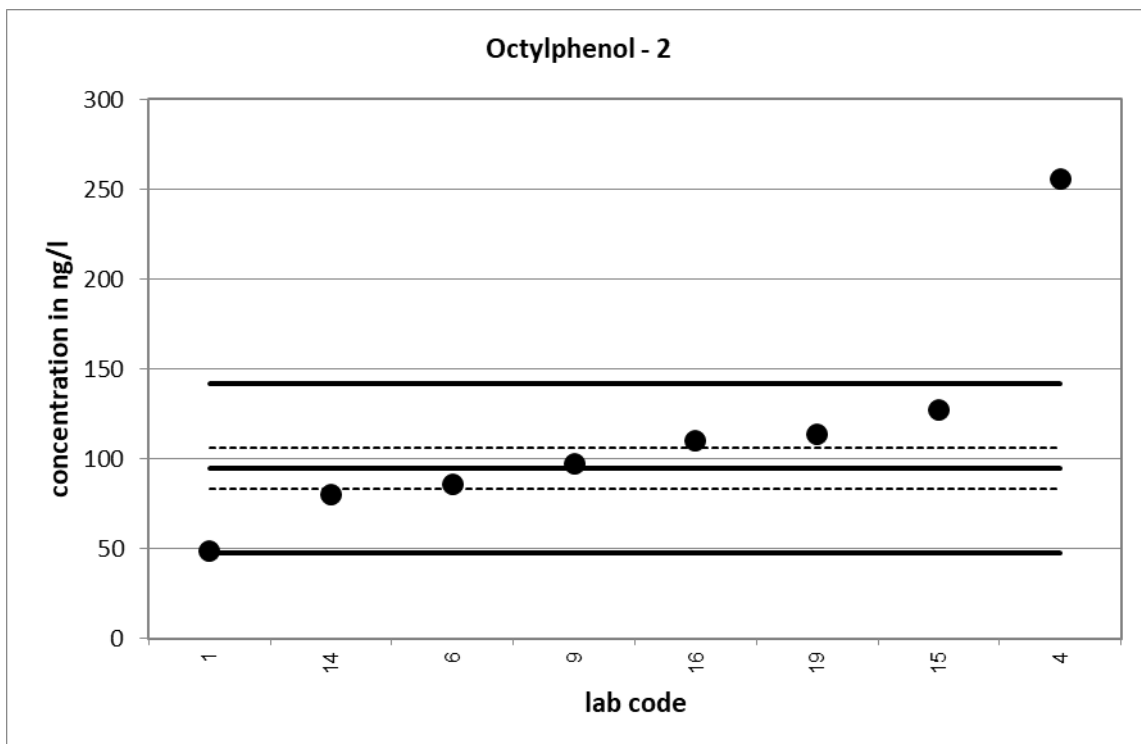


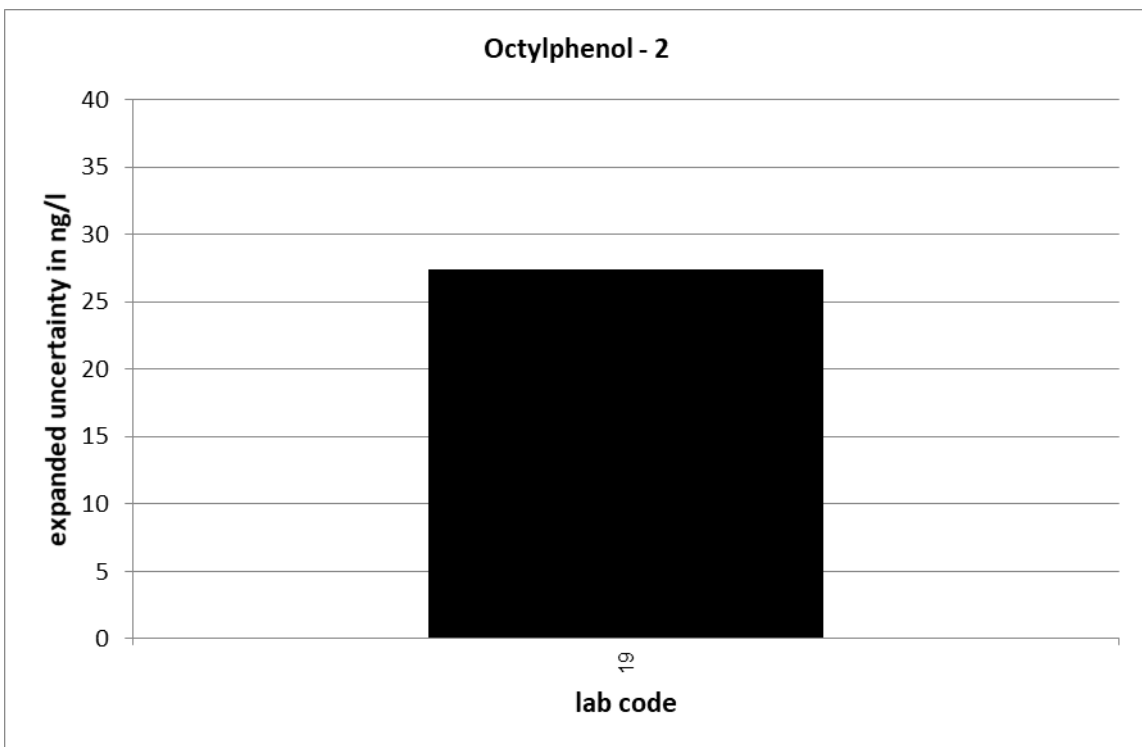
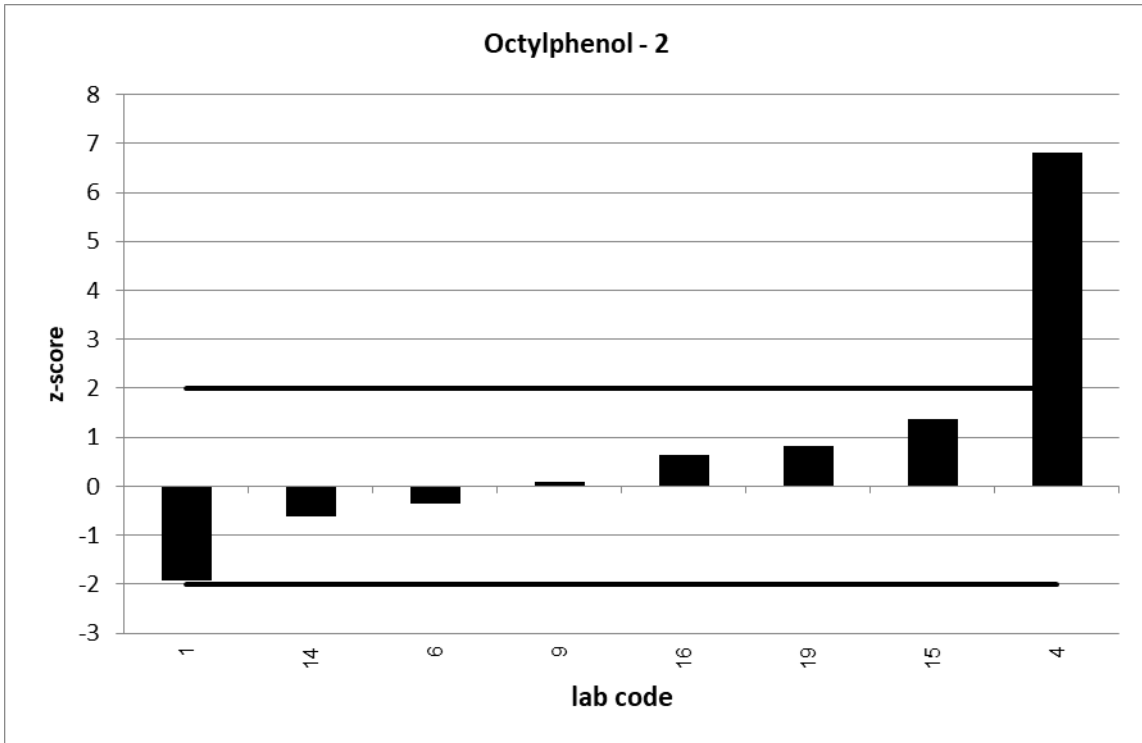


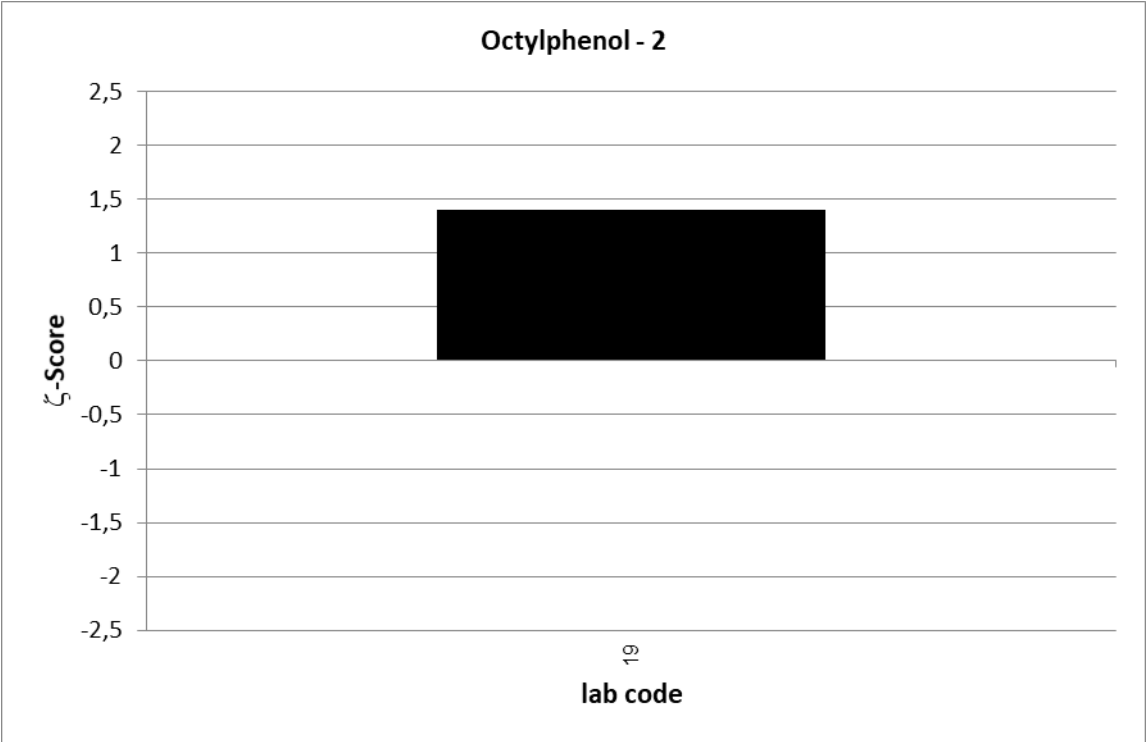
UKWIR PT 5/21		Octylphenol - 2			
assigned value [ng/l]*		94,7 ± 11,46			
upper tolerance limit [ng/l]		142,1			
lower tolerance limit [ng/l]		47,35			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	49			-1,9	s
4	256			6,8	u
6	86			-0,4	s
9	97			0,1	s
14	80			-0,6	s
15	127			1,4	s
16	110			0,6	s
19	113,93	27,43	1,4	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



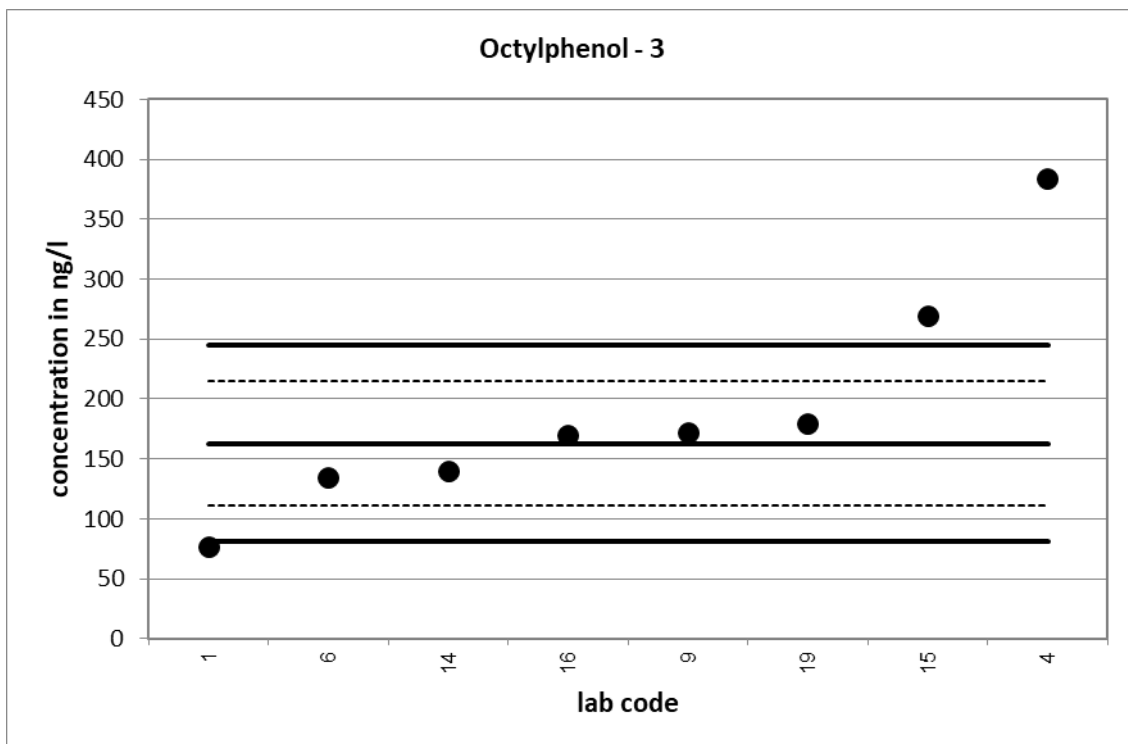


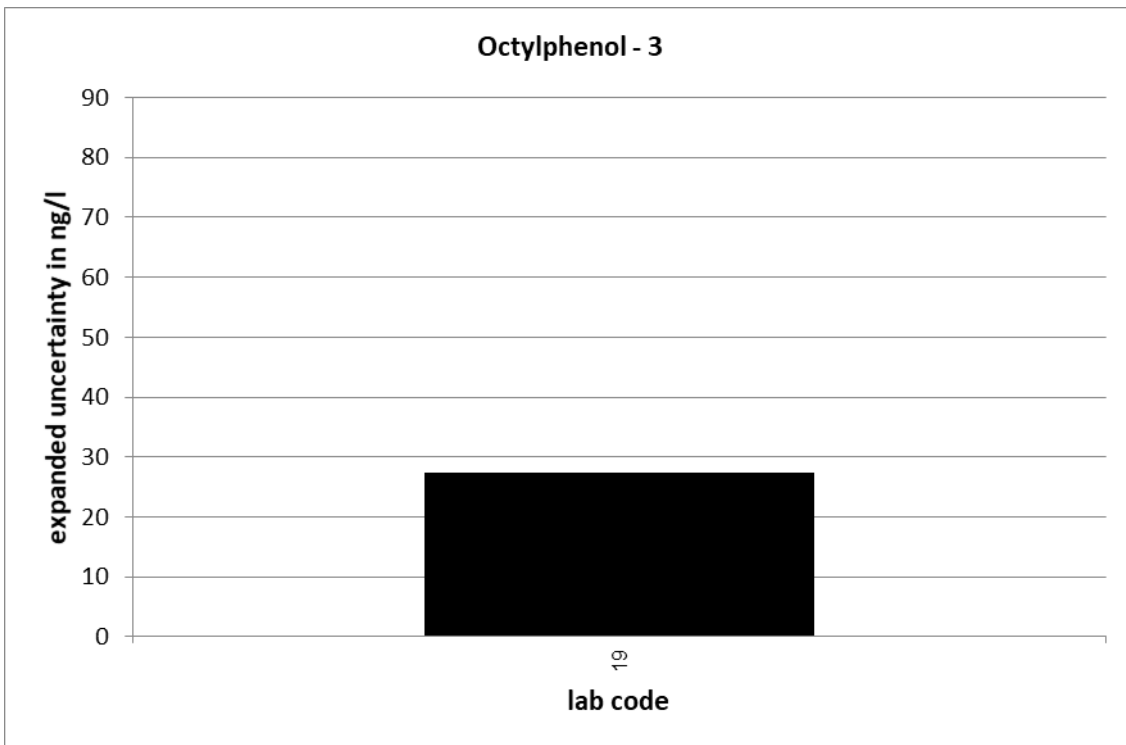
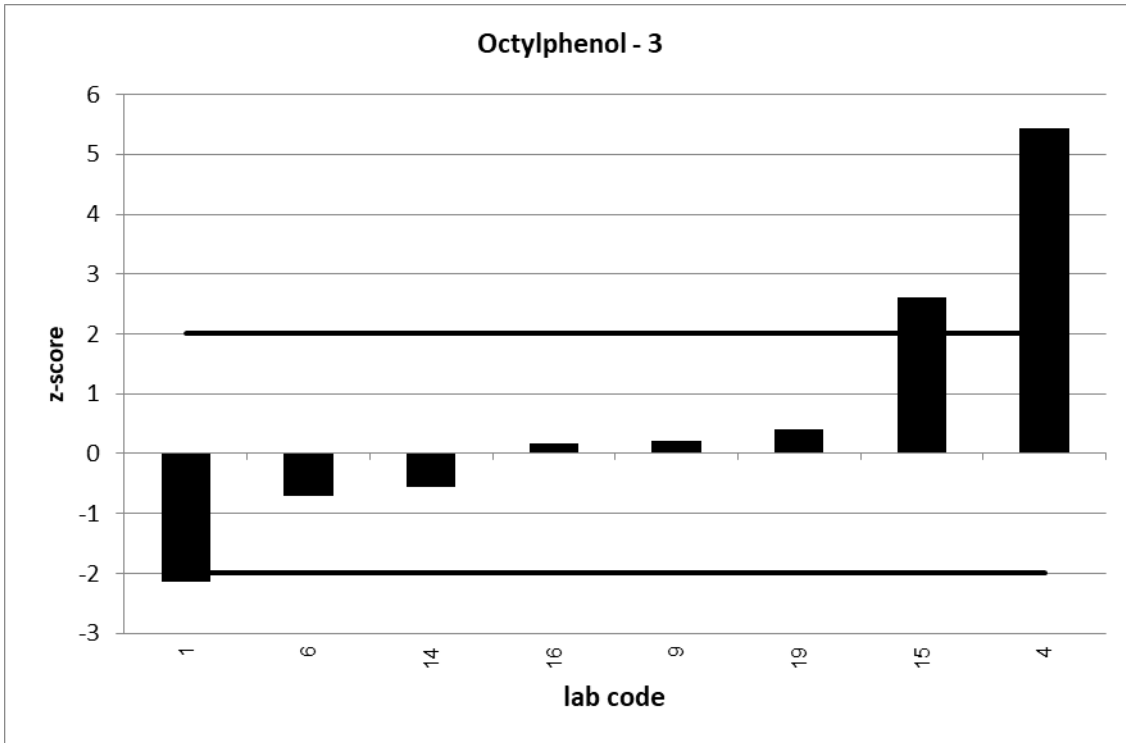


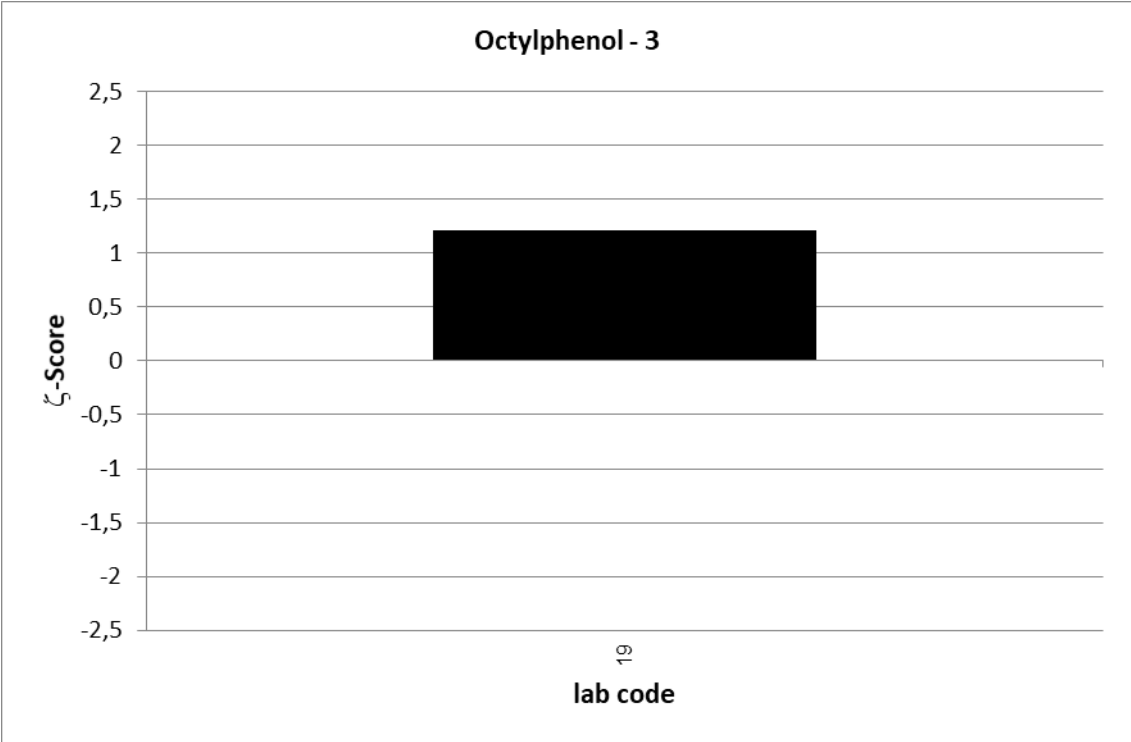
UKWIR PT 5/21		Octylphenol - 3			
assigned value [ng/l]*		162,9 ± 51,77			
upper tolerance limit [ng/l]		244,4			
lower tolerance limit [ng/l]		81,47			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	76			-2,1	q
4	384			5,4	u
6	134			-0,7	s
9	172			0,2	s
14	140			-0,6	s
15	269			2,6	q
16	170			0,2	s
19	179,63	27,43	1,2	0,4	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



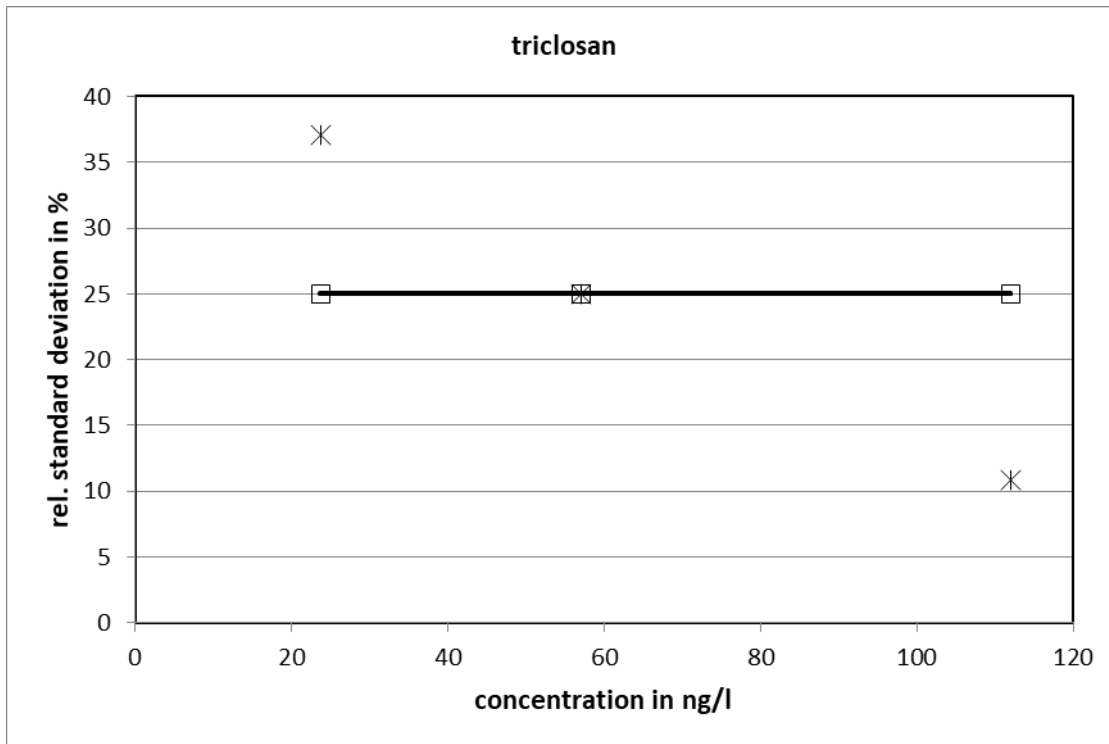




UKWIR 6/21:

triclosan														
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	23,70	33,16	7,767	5,925	25,00	35,55	11,85	50,00	-50,00	5	1	0	20,0	
2	57,01	22,33	6,879	14,25	25,00	85,51	28,50	50,00	-50,00	5	0	0	0,0	
3	112,0	9,71	17,75	28,00	25,00	168,0	55,99	50,00	-50,00	5	0	0	0,0	
										sum	15	1	0	6,7

Relative standard deviation

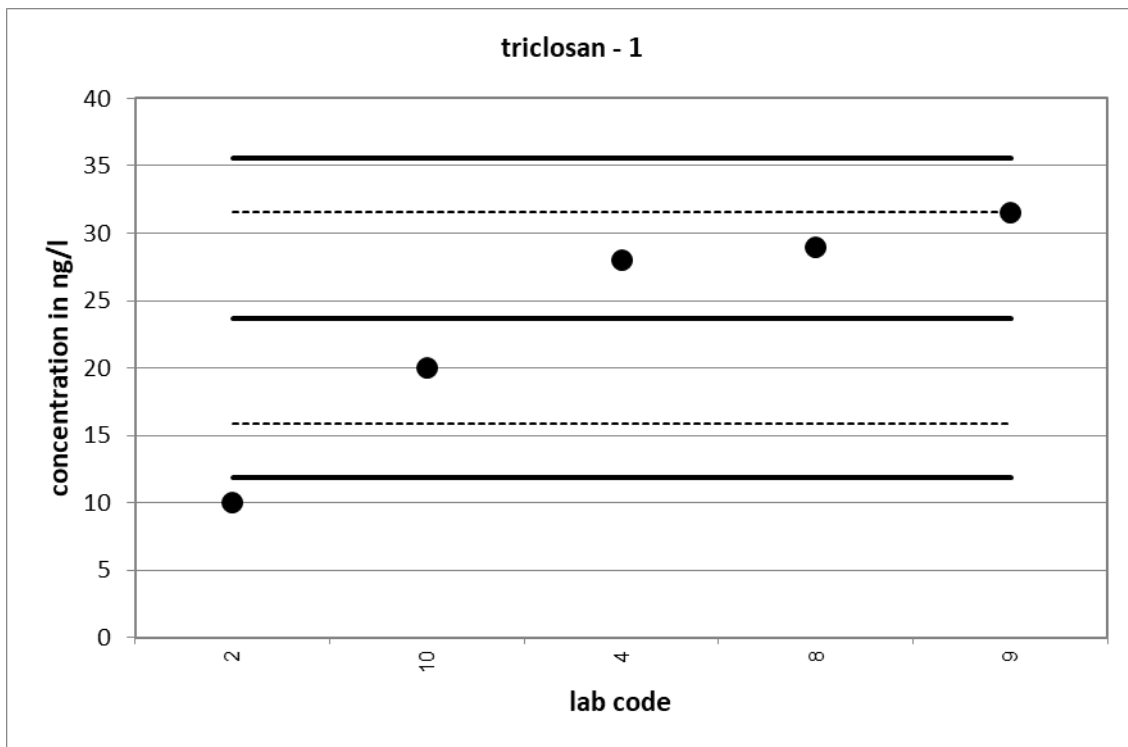


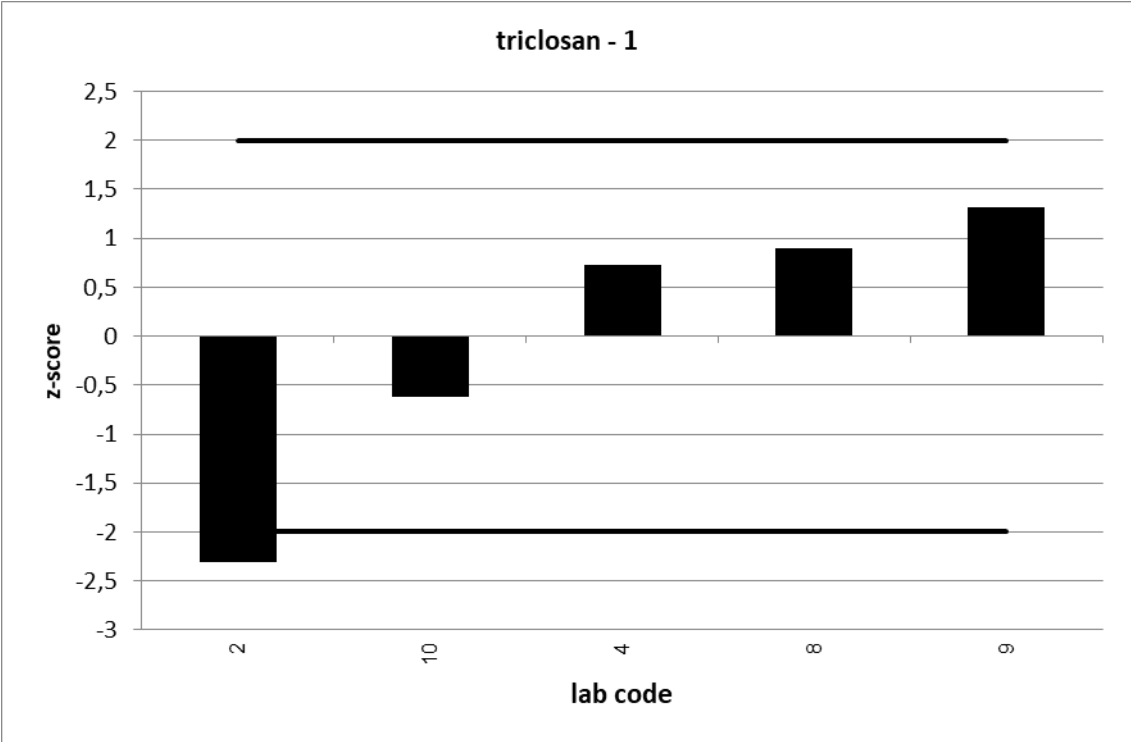
25 % is used as standard deviation for proficiency assessment.

UKWIR 6/21		triclosan - 1			
assigned value [ng/l]*		23,7 ± 7,859			
upper tolerance limit [ng/l]		35,55			
lower tolerance limit [ng/l]		11,85			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	10			-2,3	q
4	28			0,7	s
8	29			0,9	s
9	31,5			1,3	s
10	20			-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

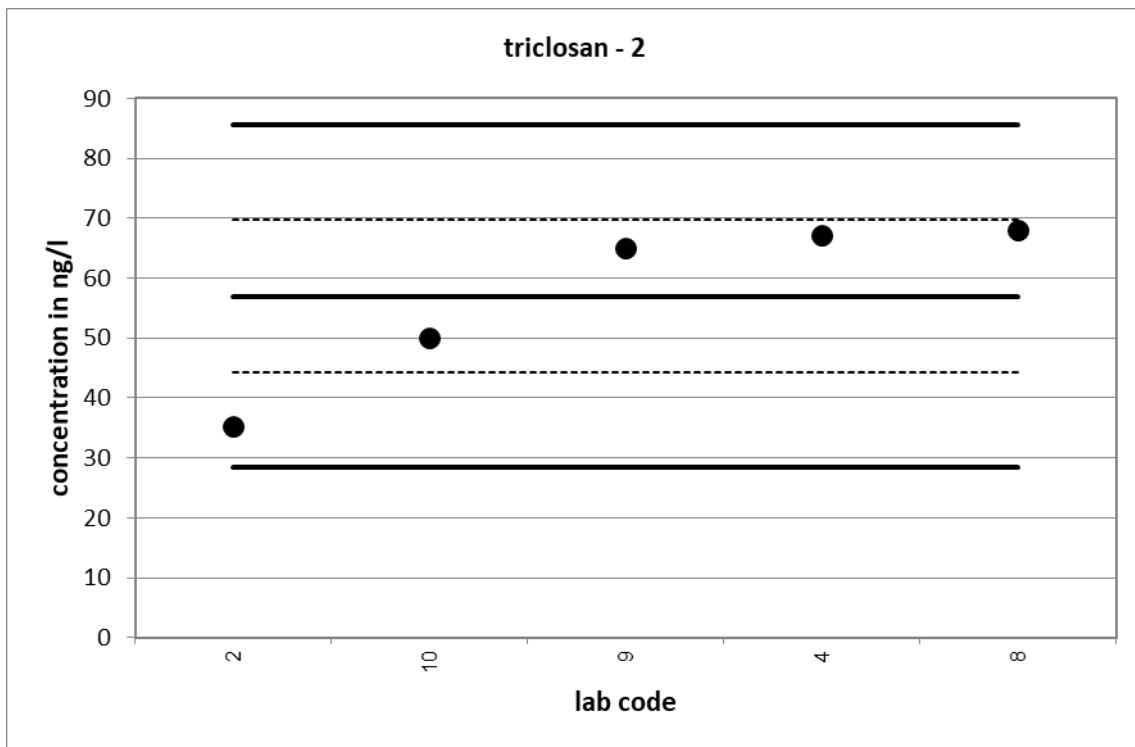


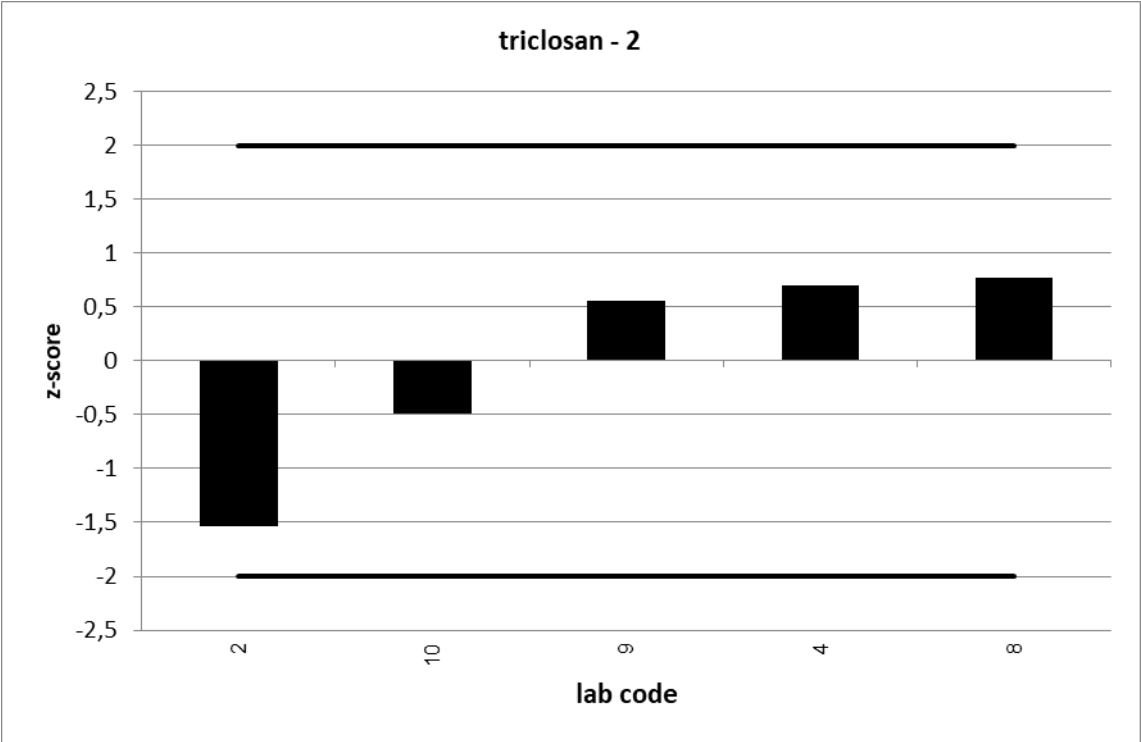


UKWIR 6/21		triclosan - 2			
assigned value [ng/l]*		57,01 ± 12,73			
upper tolerance limit [ng/l]		85,51			
lower tolerance limit [ng/l]		28,5			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	35,14			-1,5	s
4	67			0,7	s
8	68			0,8	s
9	64,9			0,6	s
10	50			-0,5	s

* 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

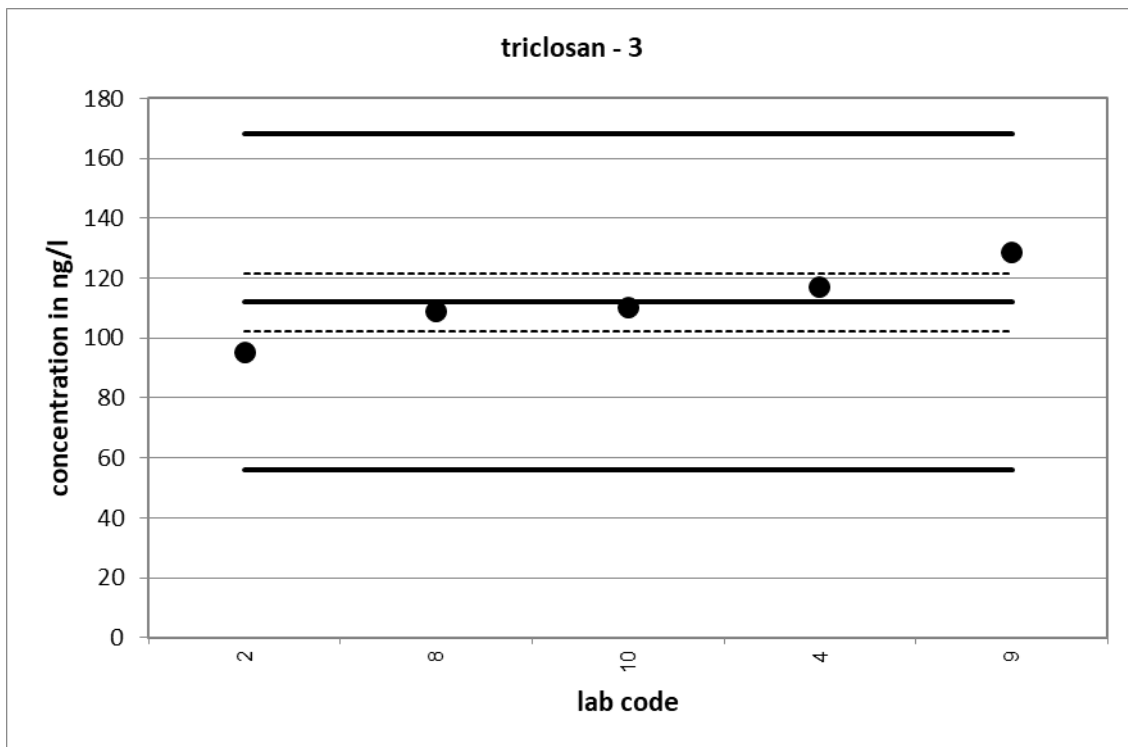


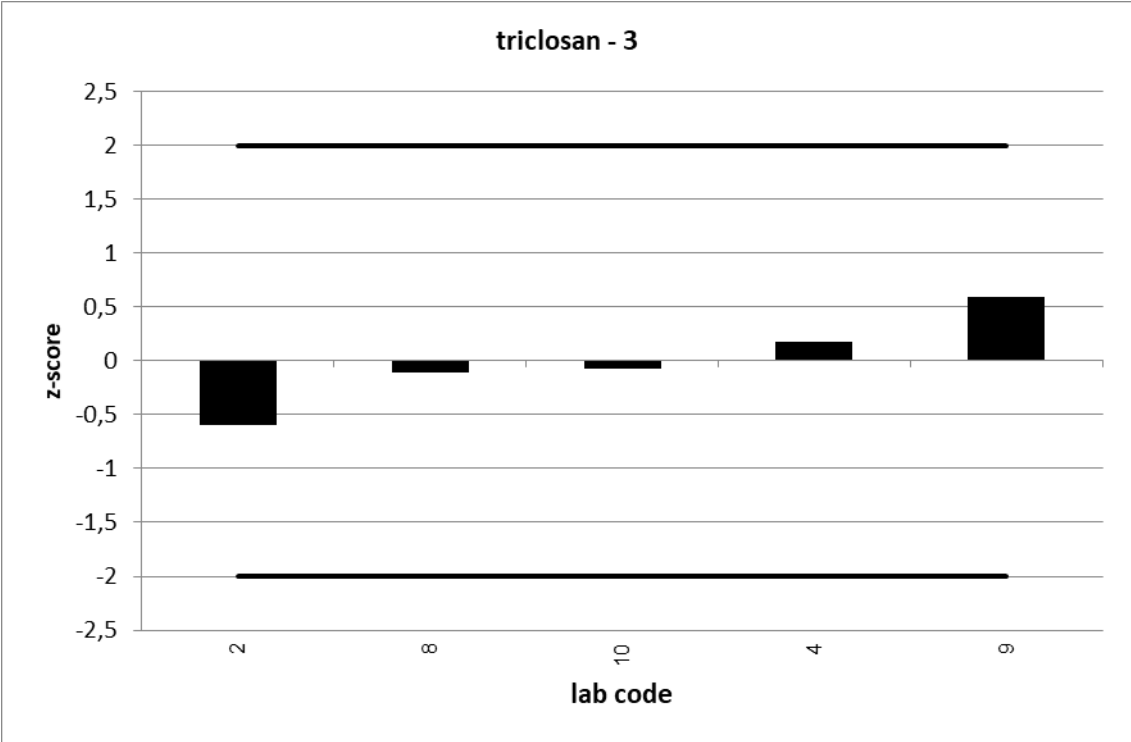


UKWIR 6/21		triclosan - 3			
assigned value [ng/l]*		112 ± 9,71			
upper tolerance limit [ng/l]		168			
lower tolerance limit [ng/l]		55,99			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
2	95,33			-0,6	s
4	117			0,2	s
8	109			-0,1	s
9	128,6			0,6	s
10	110			-0,1	s

* 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

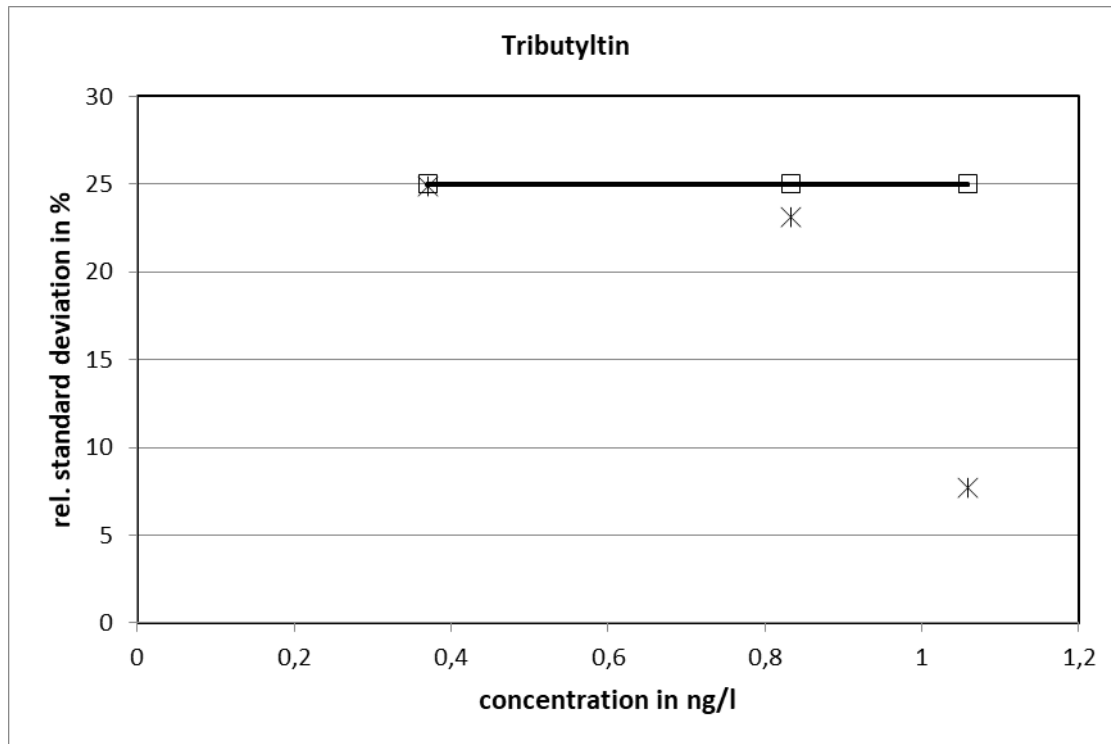




UKWIR 7/21:

Tributyltin														
level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	calculated standard deviation [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	0,3700	22,20	0,0920	0,0925	25,00	0,5550	0,1850	50,00	-50,00	5	0	0	0,0	
2	0,8342	20,70	0,1927	0,2085	25,00	1,251	0,4171	50,00	-50,00	5	0	0	0,0	
3	1,058	6,90	0,0819	0,2646	25,00	1,588	0,5292	50,00	-50,00	5	0	1	20,0	
										sum	15	0	1	6,7

Relative standard deviation

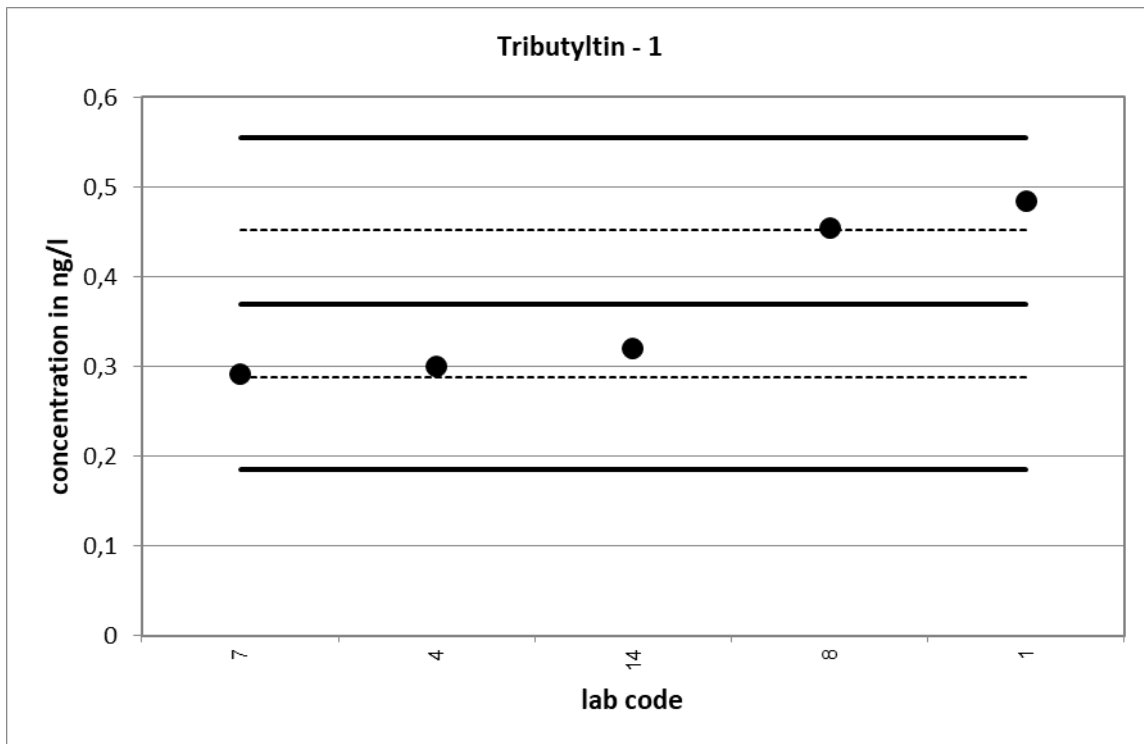


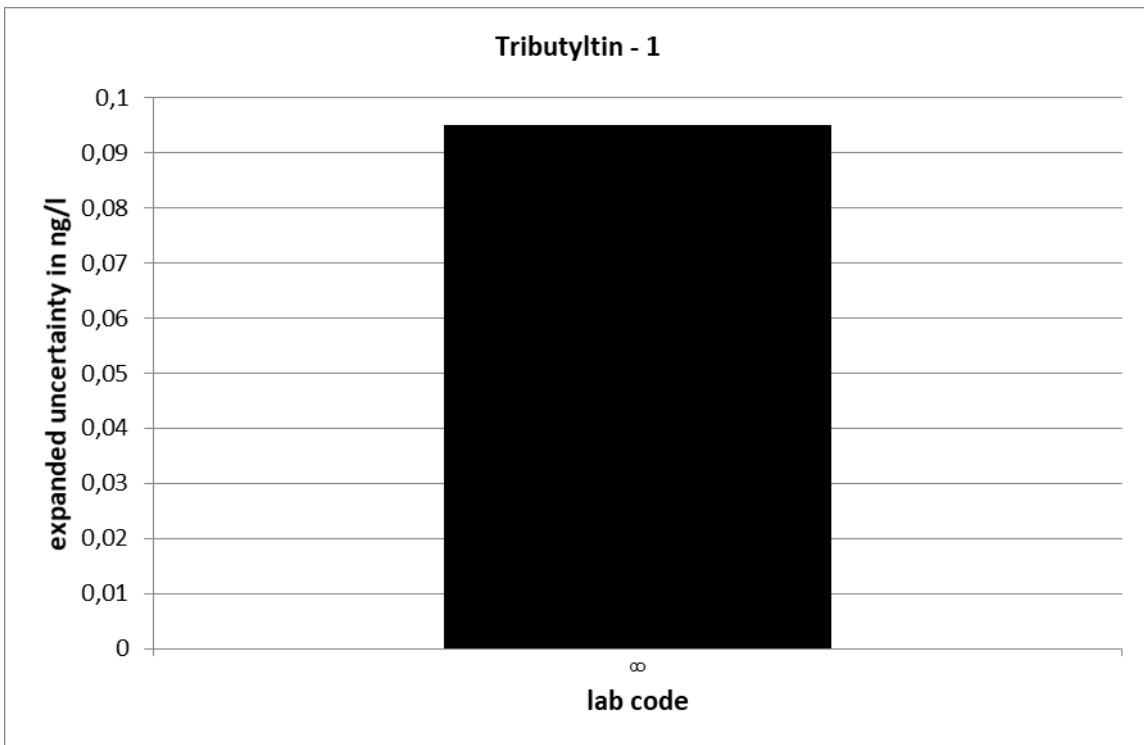
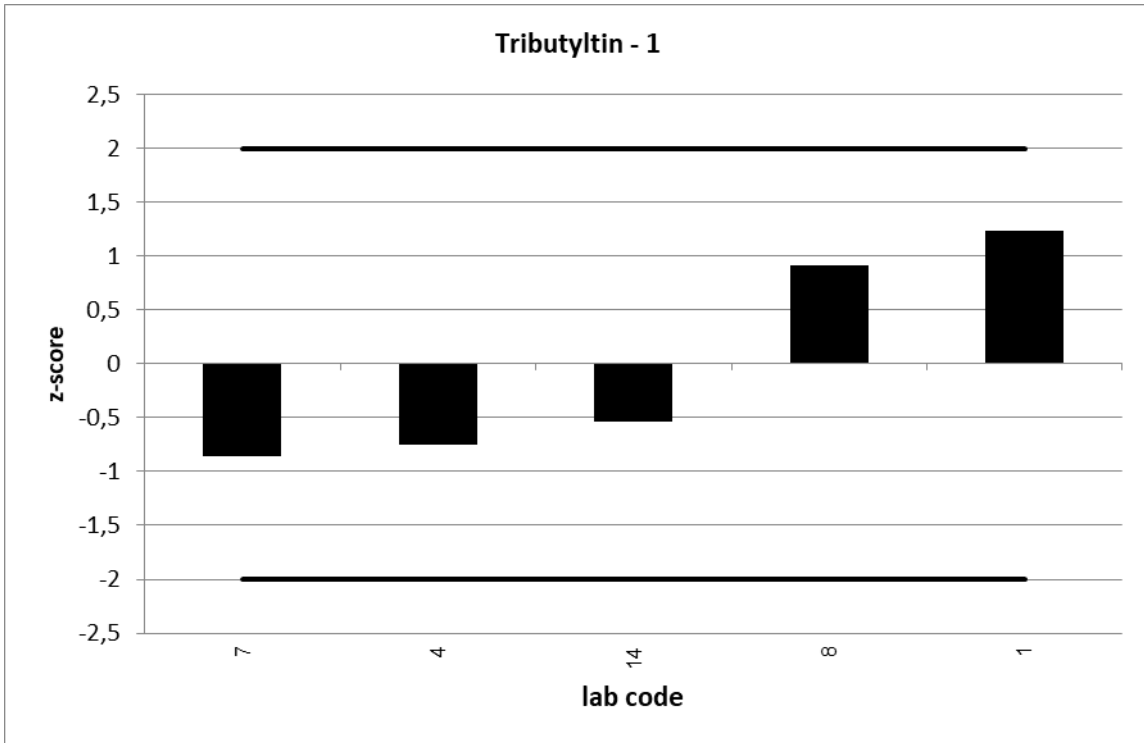
25 % is used as standard deviation for proficiency assessment.

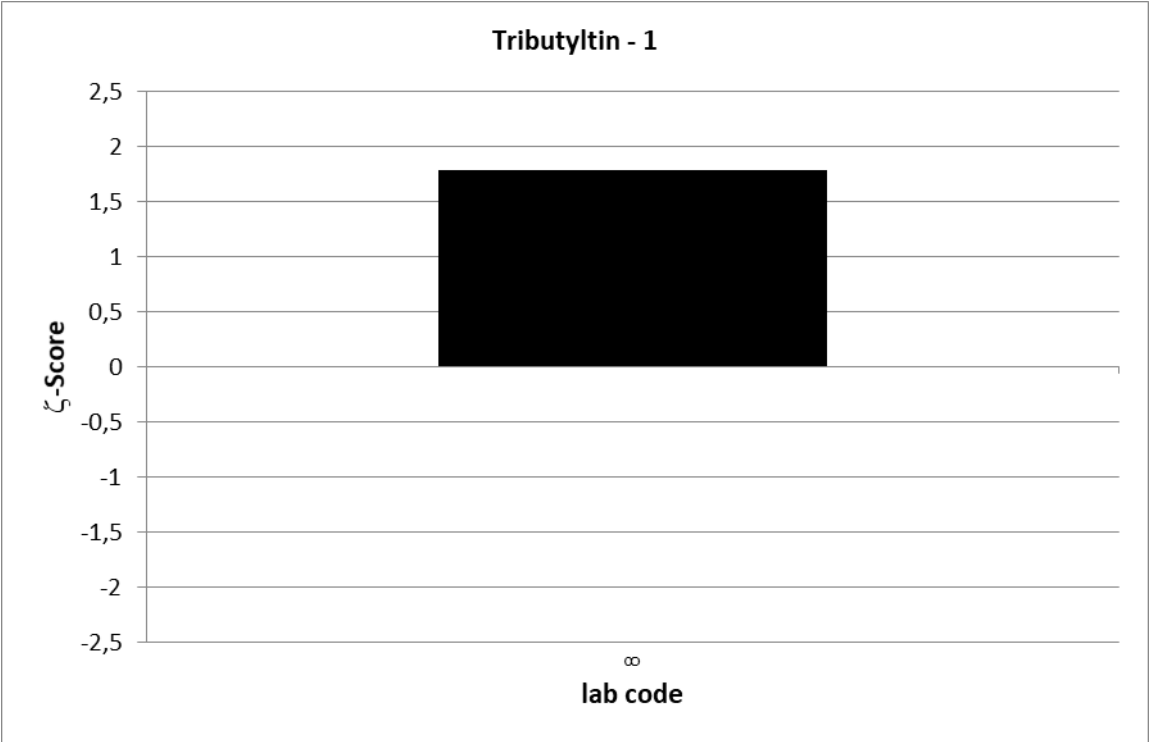
UKWIR PT 7/21		Tributyltin - 1			
assigned value [ng/l]*		0,37 ± 0,082			
upper tolerance limit [ng/l]		0,555			
lower tolerance limit [ng/l]		0,185			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	0,484			1,2	s
4	0,3			-0,8	s
7	0,291			-0,9	s
8	0,455	0,095	1,8	0,9	s
14	0,32			-0,5	s

* 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



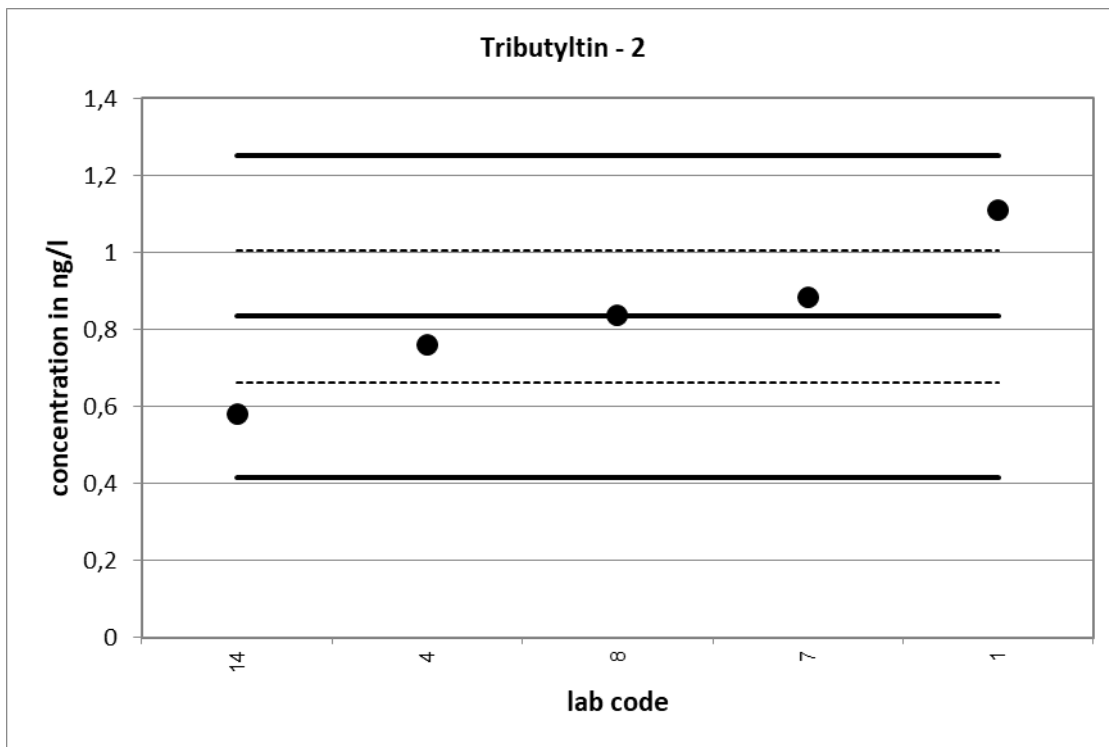


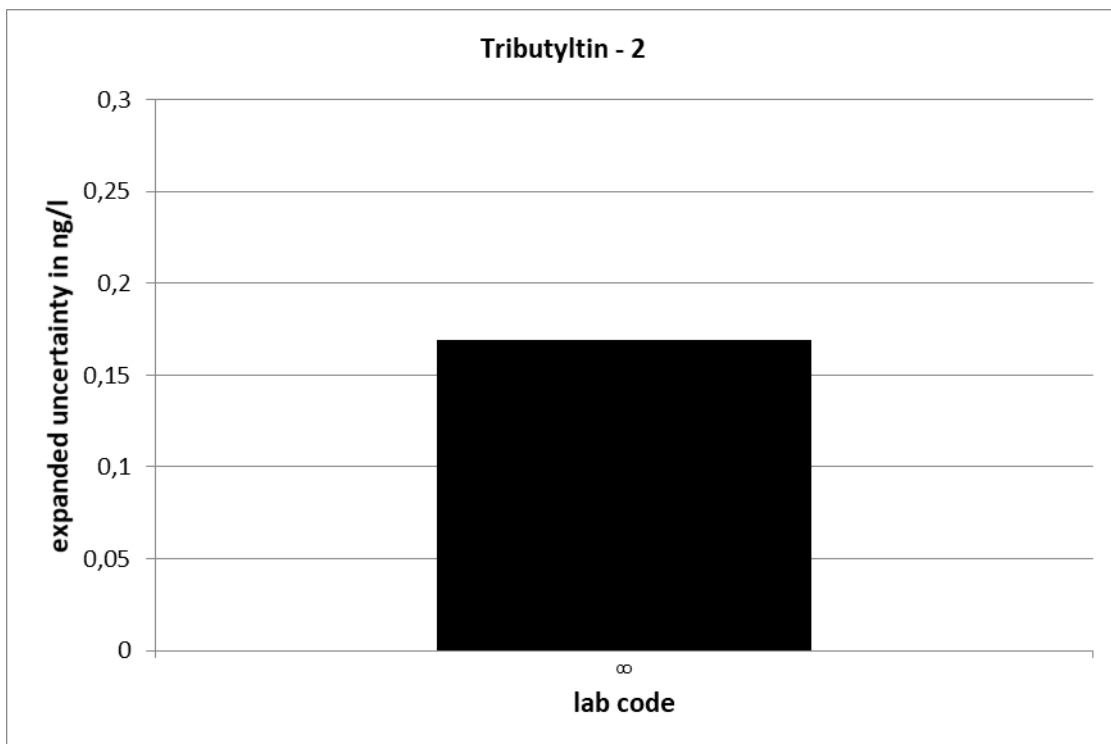
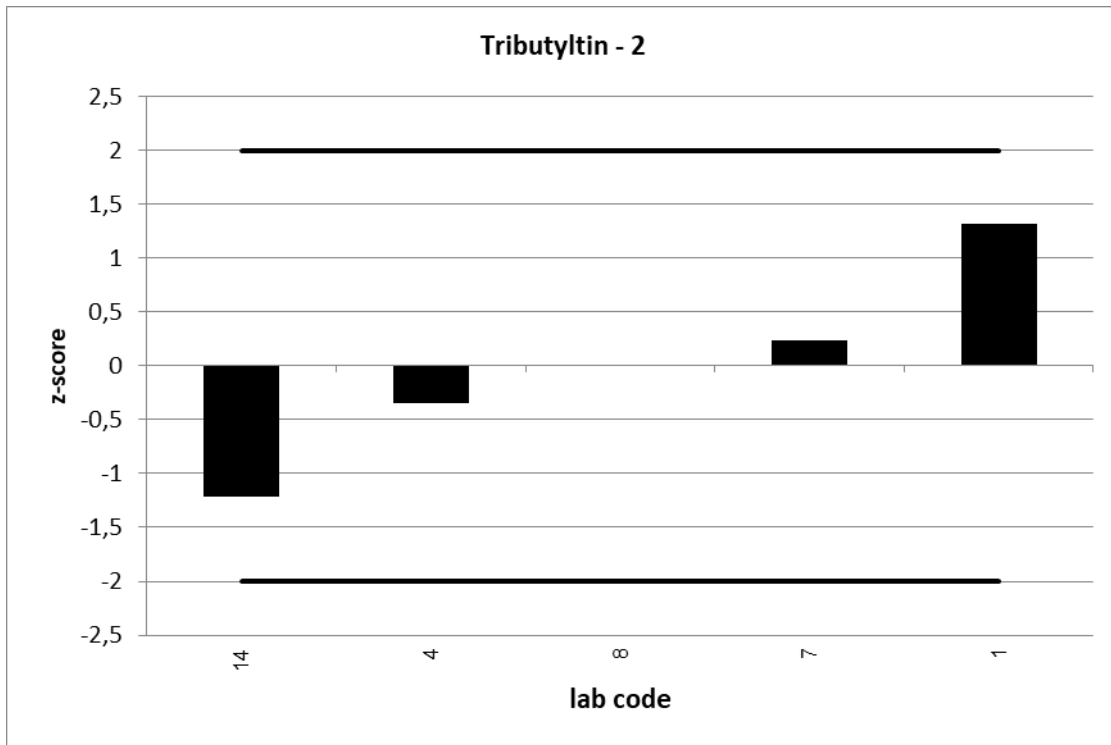


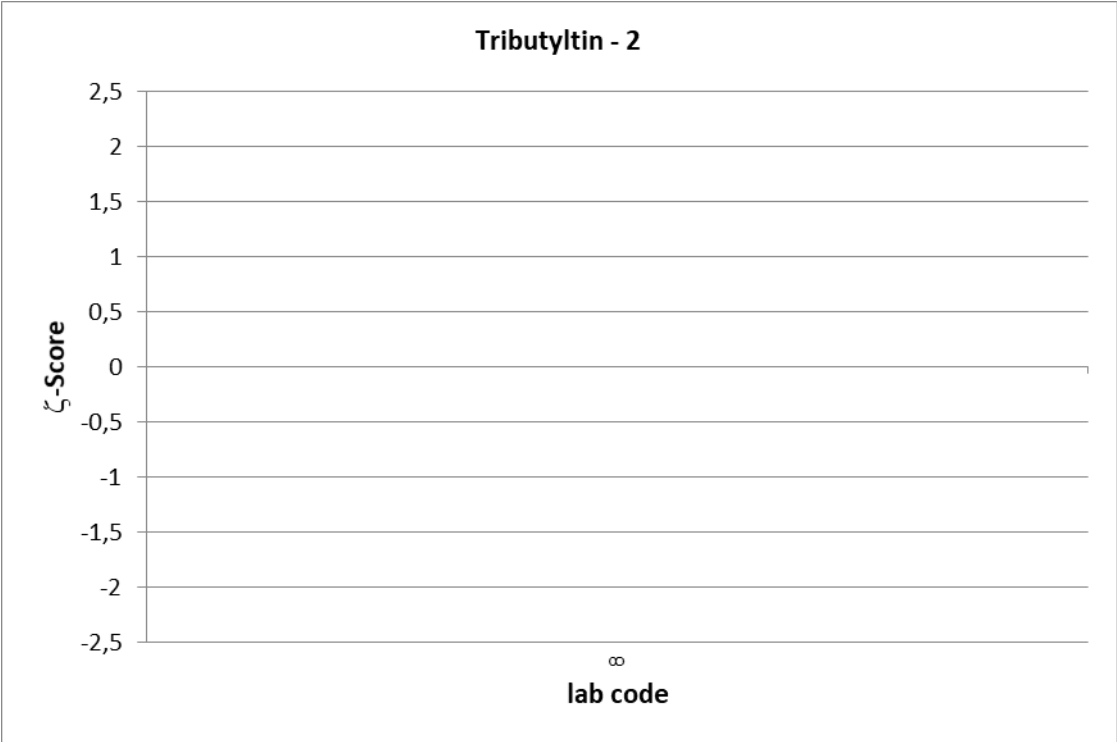
UKWIR PT 7/21		Tributyltin - 2			
assigned value [ng/l]*		0,8342 ± 0,172			
upper tolerance limit [ng/l]		1,251			
lower tolerance limit [ng/l]		0,4171			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	1,11			1,3	s
4	0,761			-0,4	s
7	0,8838			0,2	s
8	0,836	0,169	0,0	0,0	s
14	0,58			-1,2	s

* 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



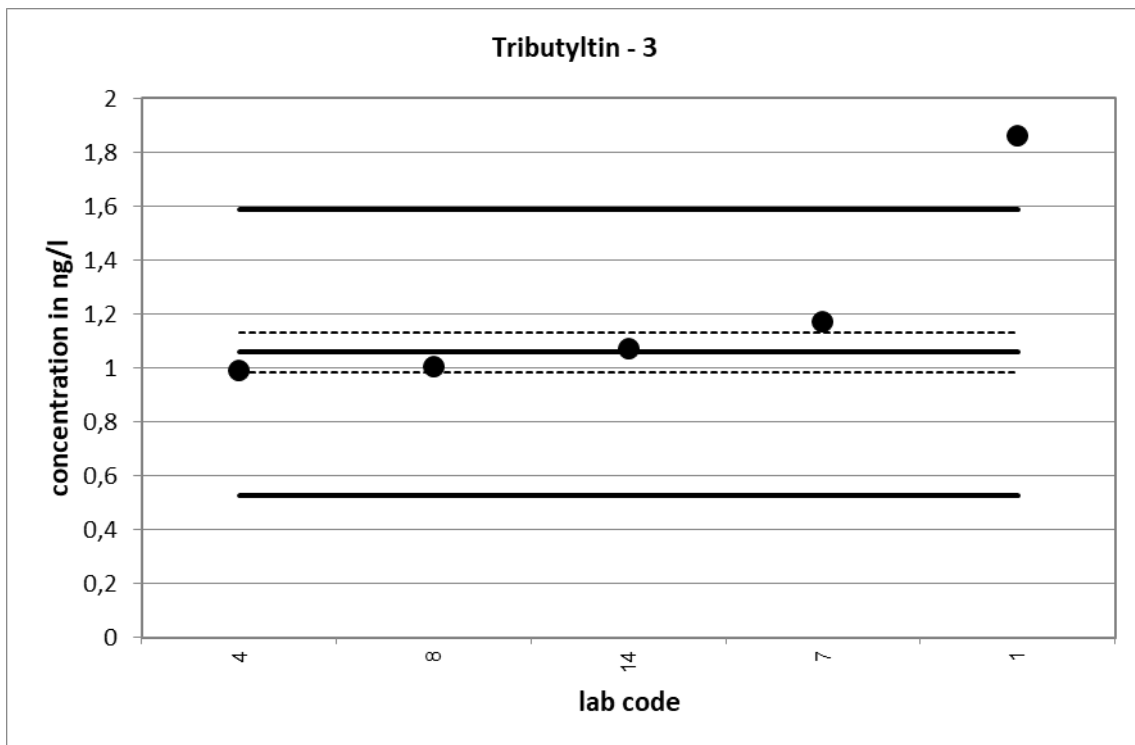


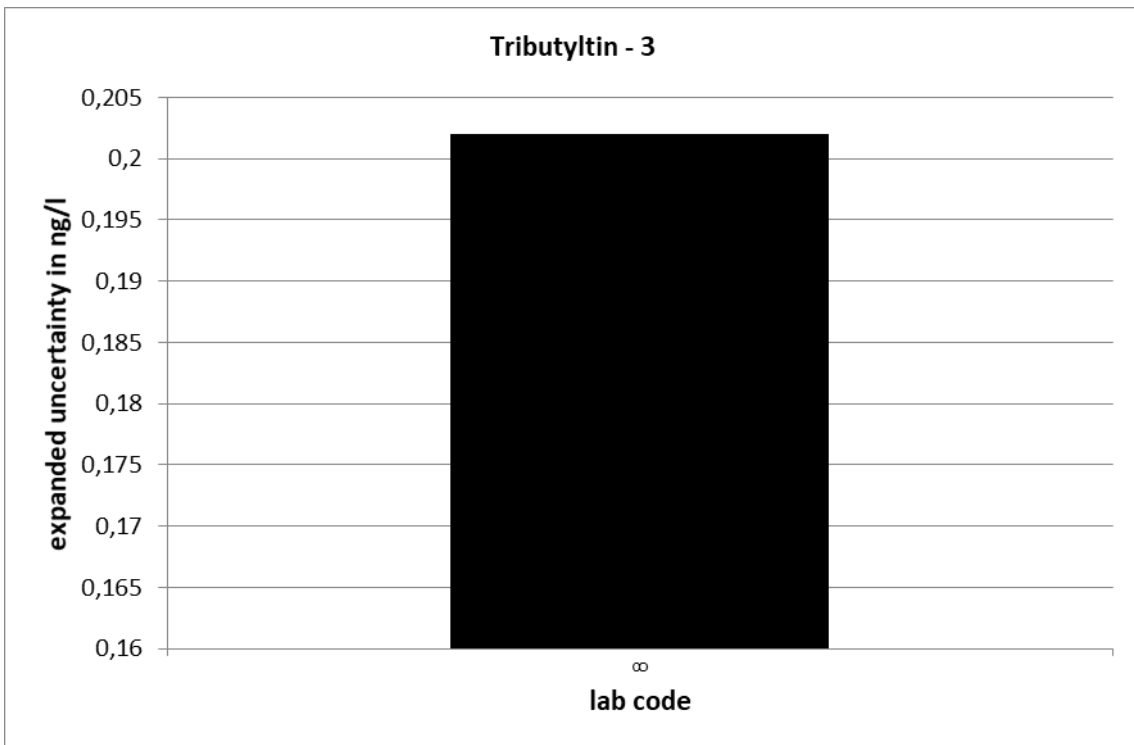
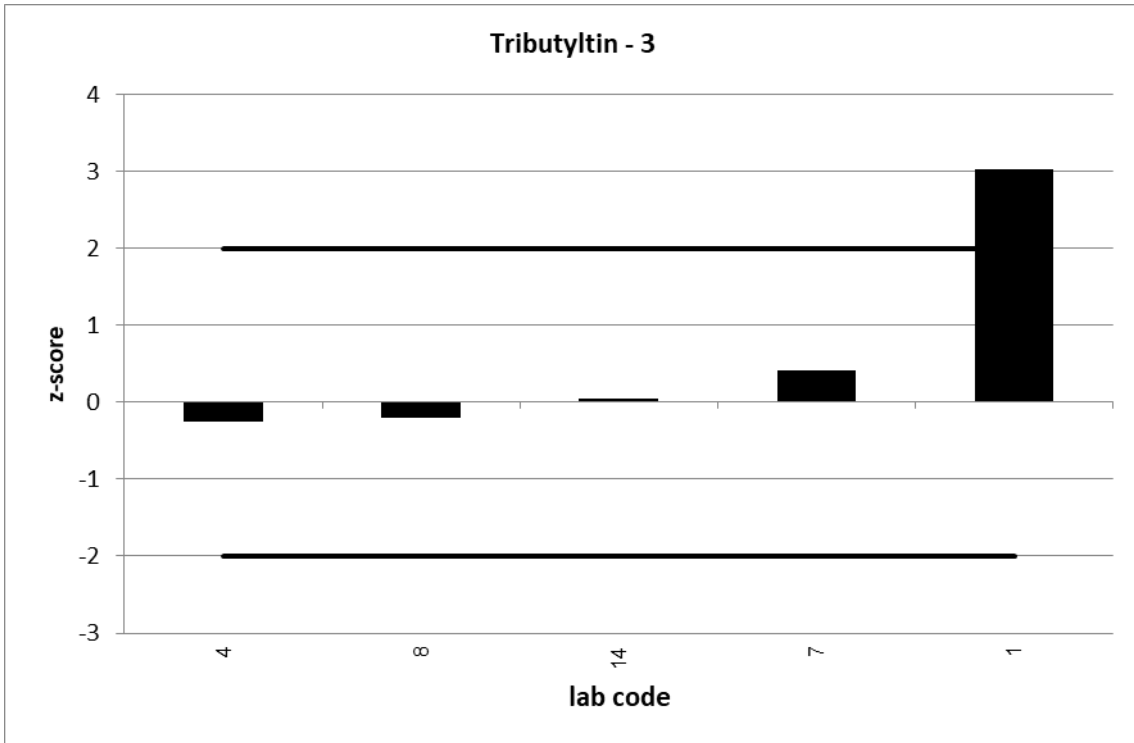


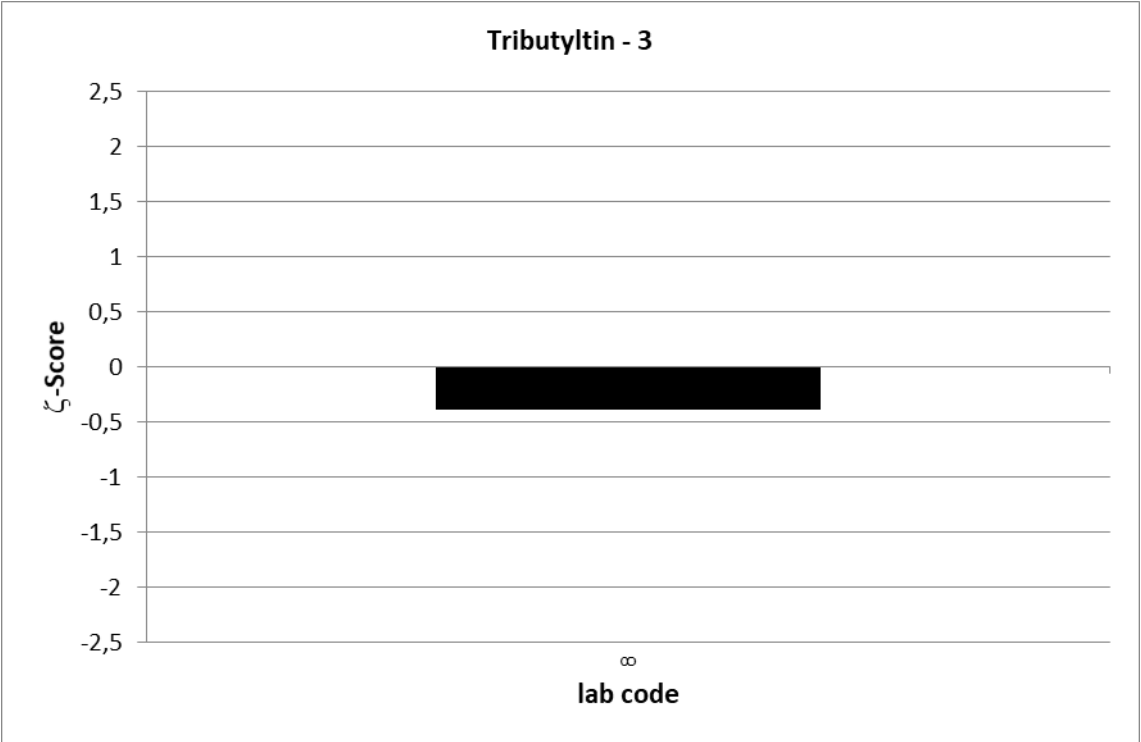
UKWIR PT 7/21		Tributyltin - 3			
assigned value [ng/l]*		1,058 ± 0,073			
upper tolerance limit [ng/l]		1,588			
lower tolerance limit [ng/l]		0,5292			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	1,86			3,0	u
4	0,991			-0,3	s
7	1,1696			0,4	s
8	1,003	0,202	-0,4	-0,2	s
14	1,07			0,0	s

* 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



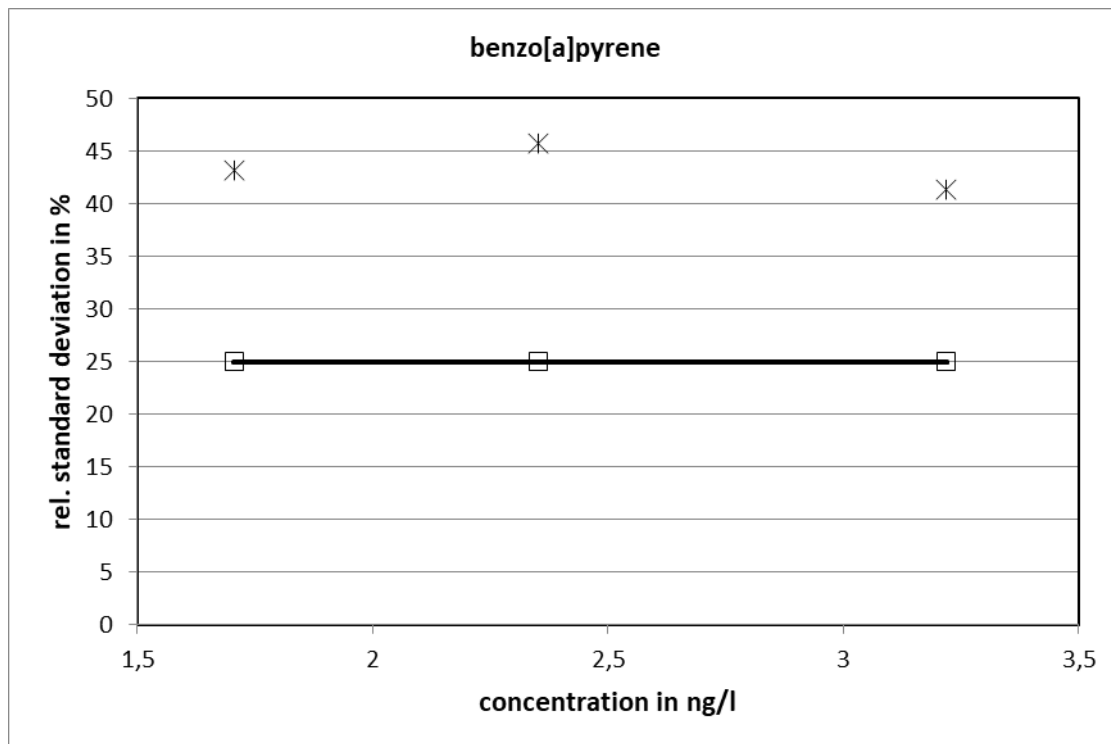




UKWIR 8/21:

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	1,706	35,94	0,7356	0,4265	25,00	2,559	0,8529	50,00	-50,00	9	1	0	11,1
2	2,353	38,12	1,076	0,5882	25,00	3,529	1,176	50,00	-50,00	9	1	0	11,1
3	3,219	34,41	1,329	0,8048	25,00	4,829	1,610	50,00	-50,00	9	0	0	0,0
									sum	27	2	0	7,4

Relative standard deviation

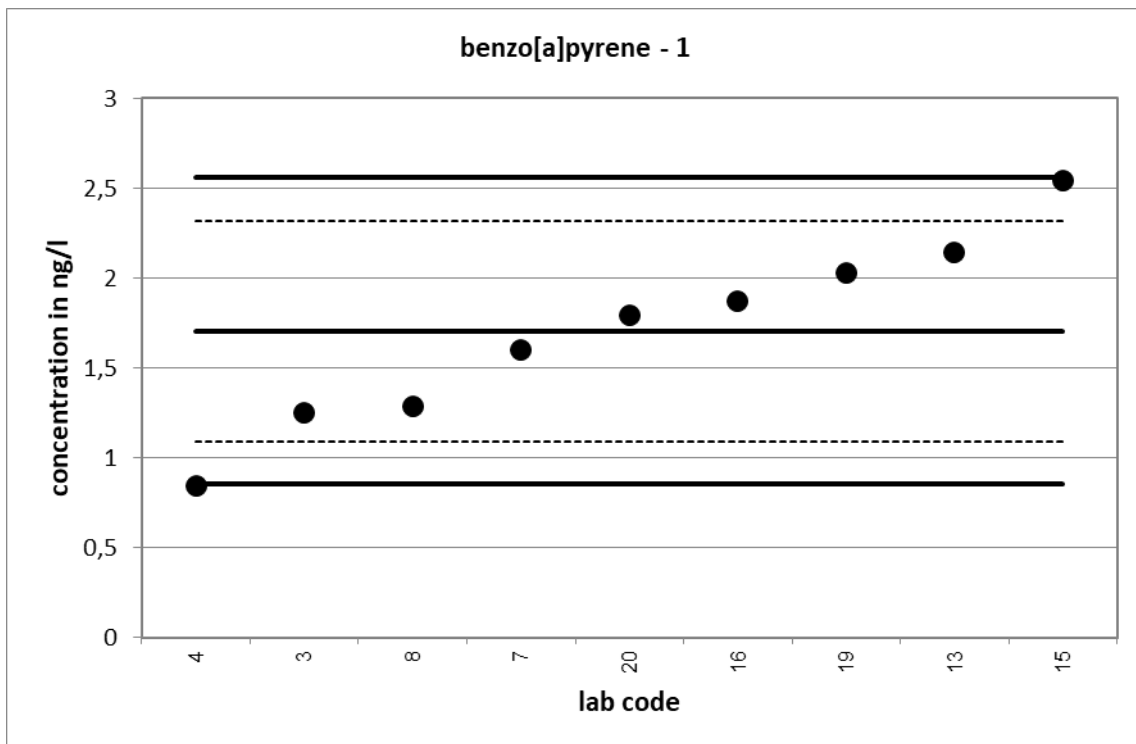


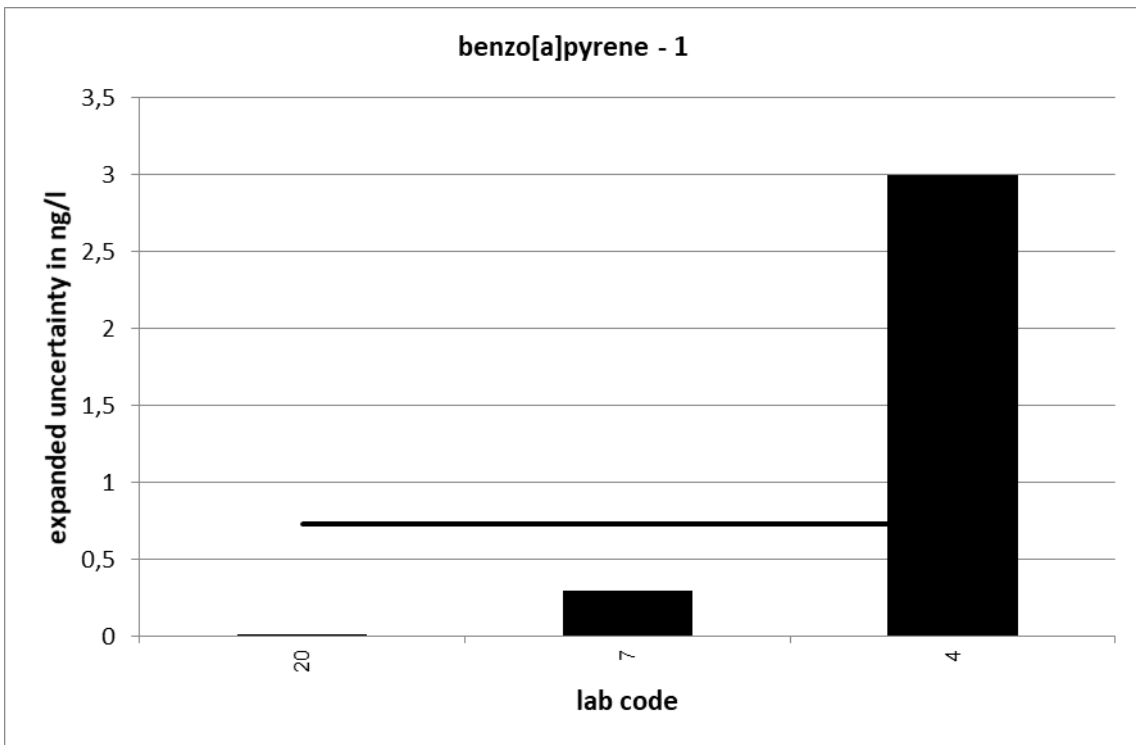
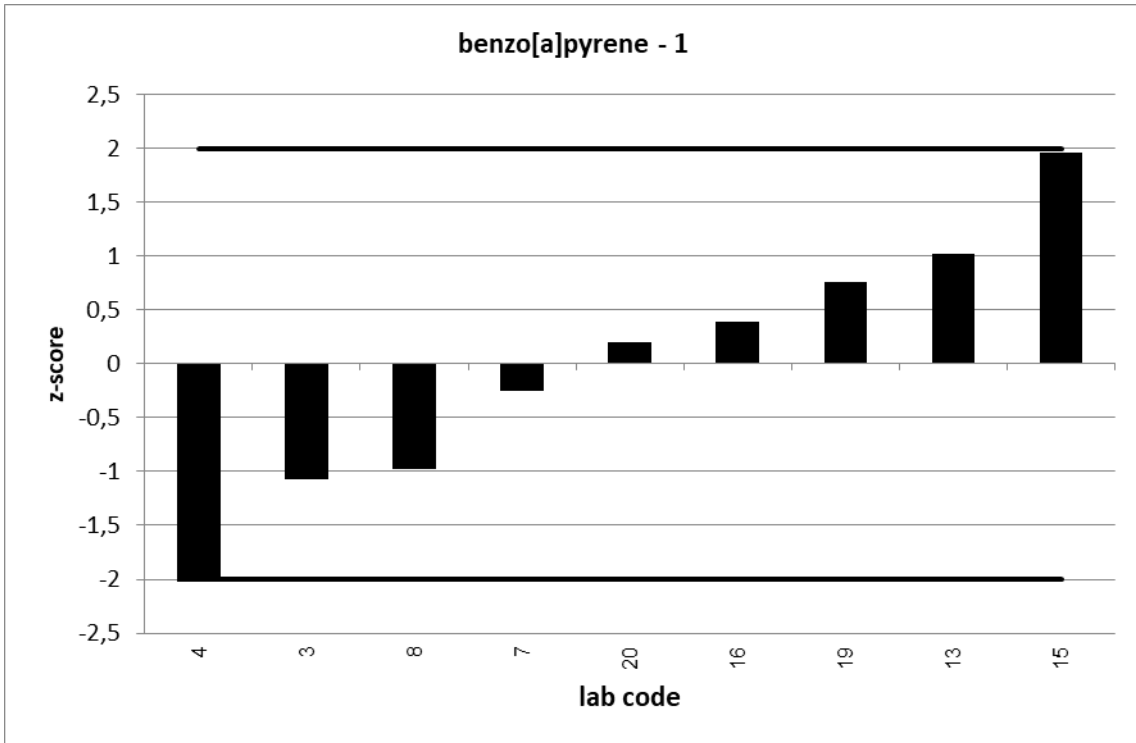
25 % is used as standard deviation for proficiency assessment.

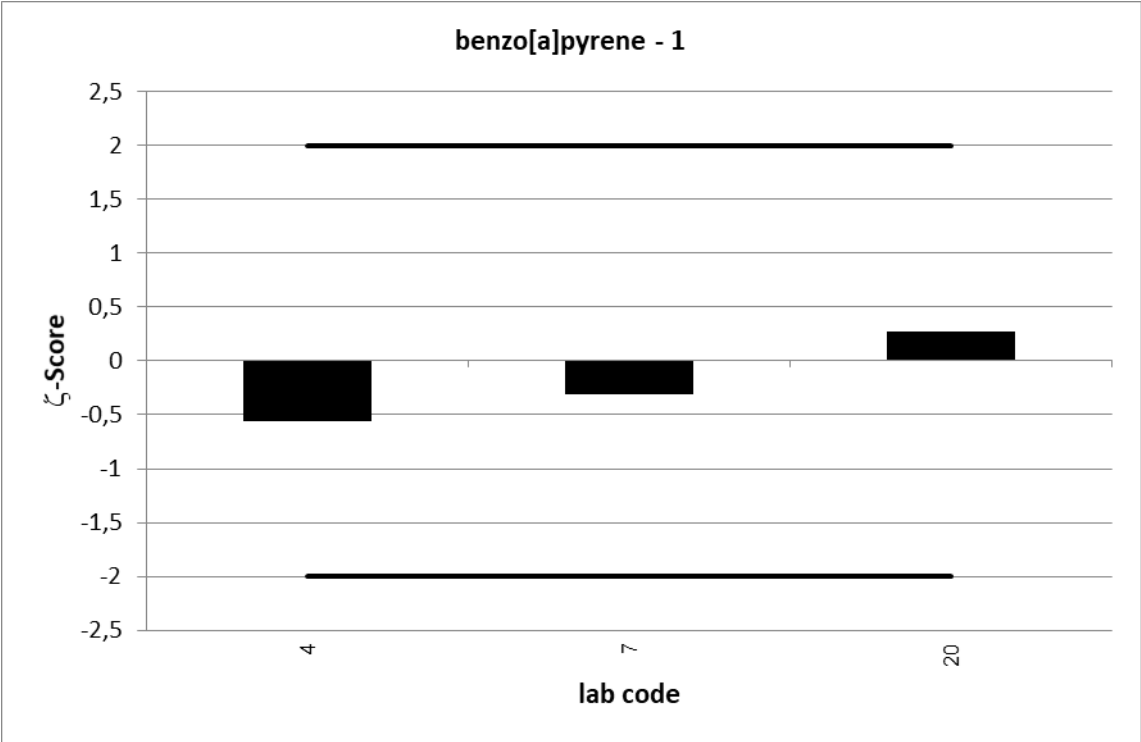
UKWIR 8/21		benzo[a]pyrene - 1			
assigned value [ng/l]*		1,706 ± 0,613			
upper tolerance limit [ng/l]		2,559			
lower tolerance limit [ng/l]		0,8529			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
3	1,25			-1,1	s
4	0,844	3	-0,6	-2,0	s
7	1,6	0,3	-0,3	-0,2	s
8	1,287			-1,0	s
13	2,142			1,0	s
15	2,54			2,0	s
16	1,87			0,4	s
19	2,03			0,8	s
20	1,79	0,02	0,3	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



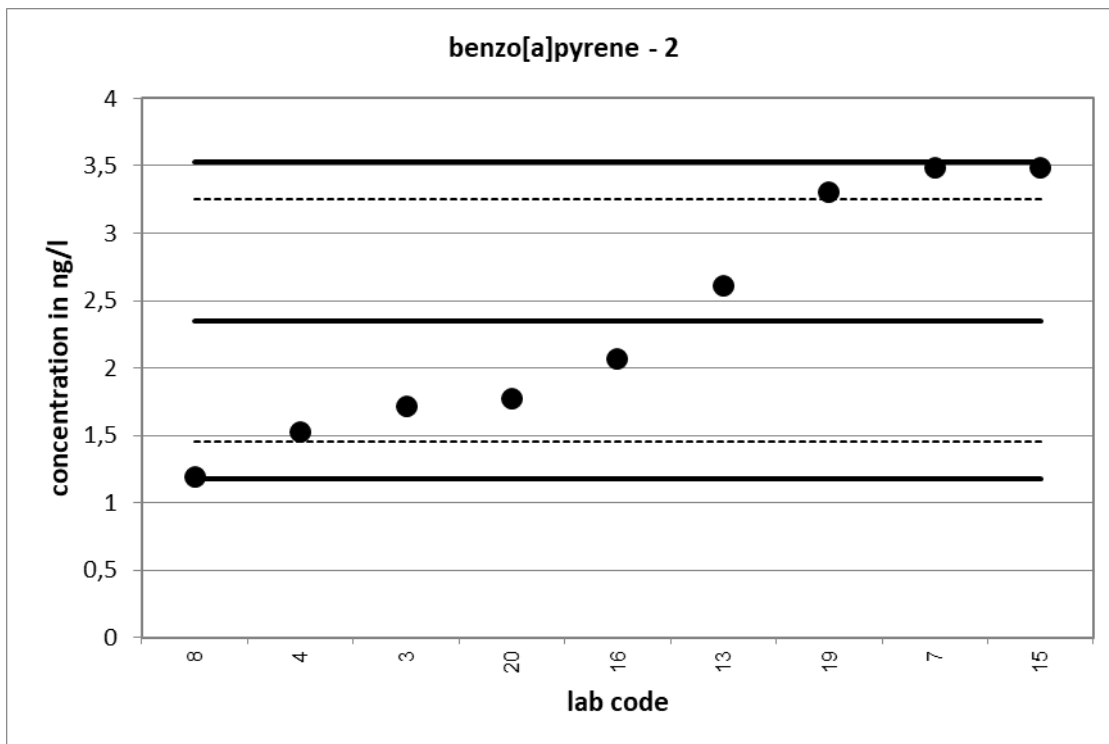


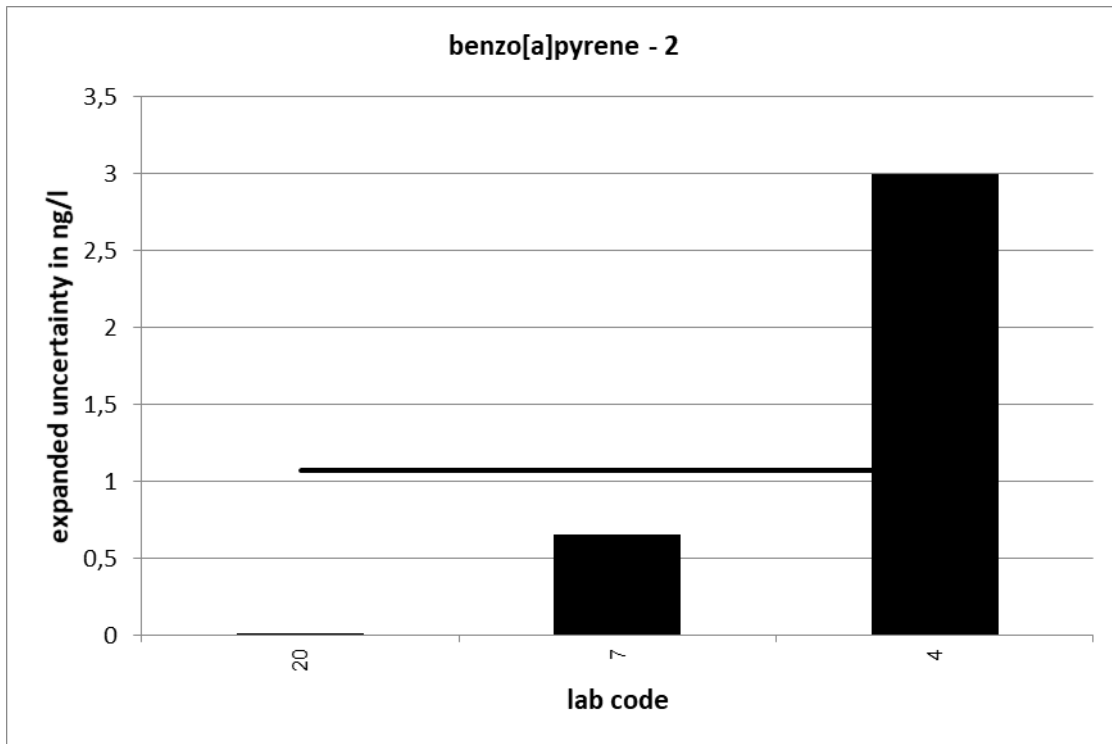
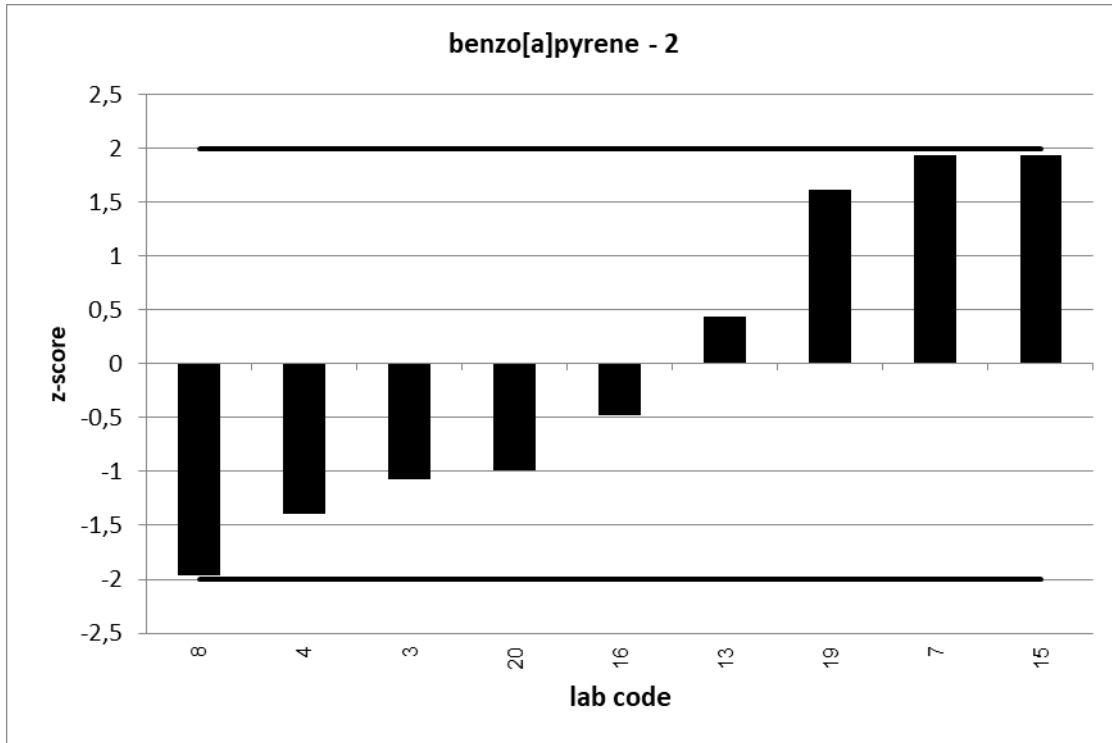


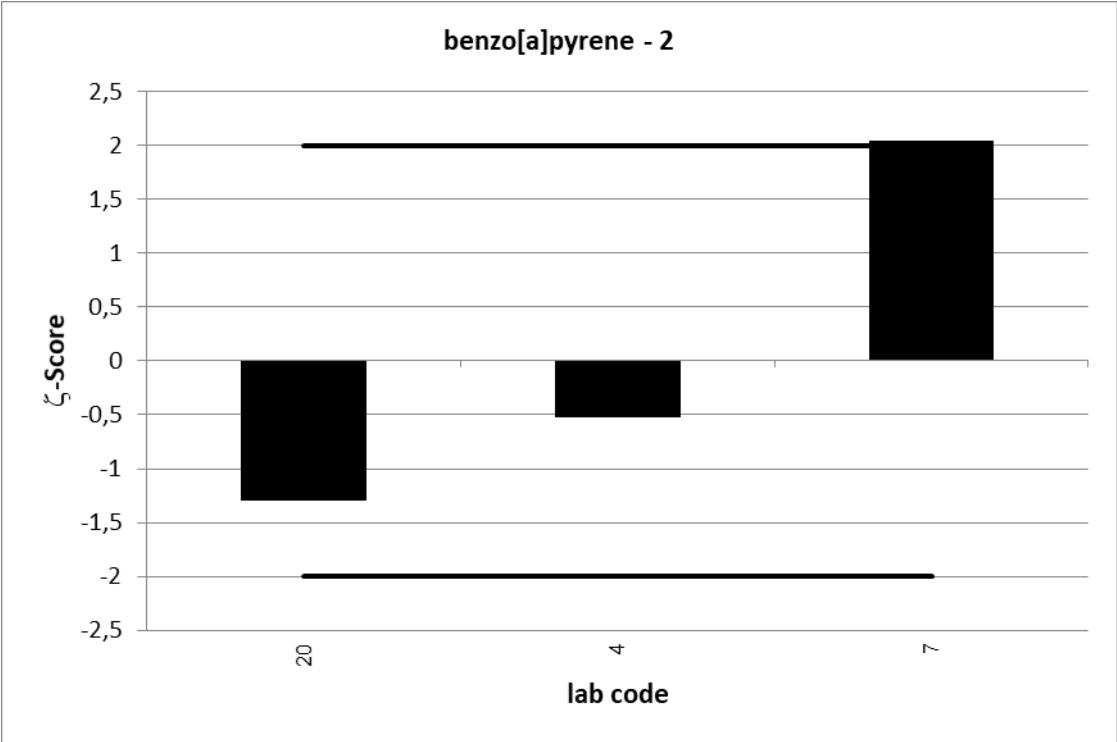
UKWIR 8/21		benzo[a]pyrene - 2			
assigned value [ng/l]*		2,353 ± 0,897			
upper tolerance limit [ng/l]		3,529			
lower tolerance limit [ng/l]		1,176			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
3	1,72			-1,1	s
4	1,53	3	-0,5	-1,4	s
7	3,49	0,66	2,0	1,9	s
8	1,197			-2,0	s
13	2,609			0,4	s
15	3,49			1,9	s
16	2,07			-0,5	s
19	3,3			1,6	s
20	1,77	0,02	-1,3	-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



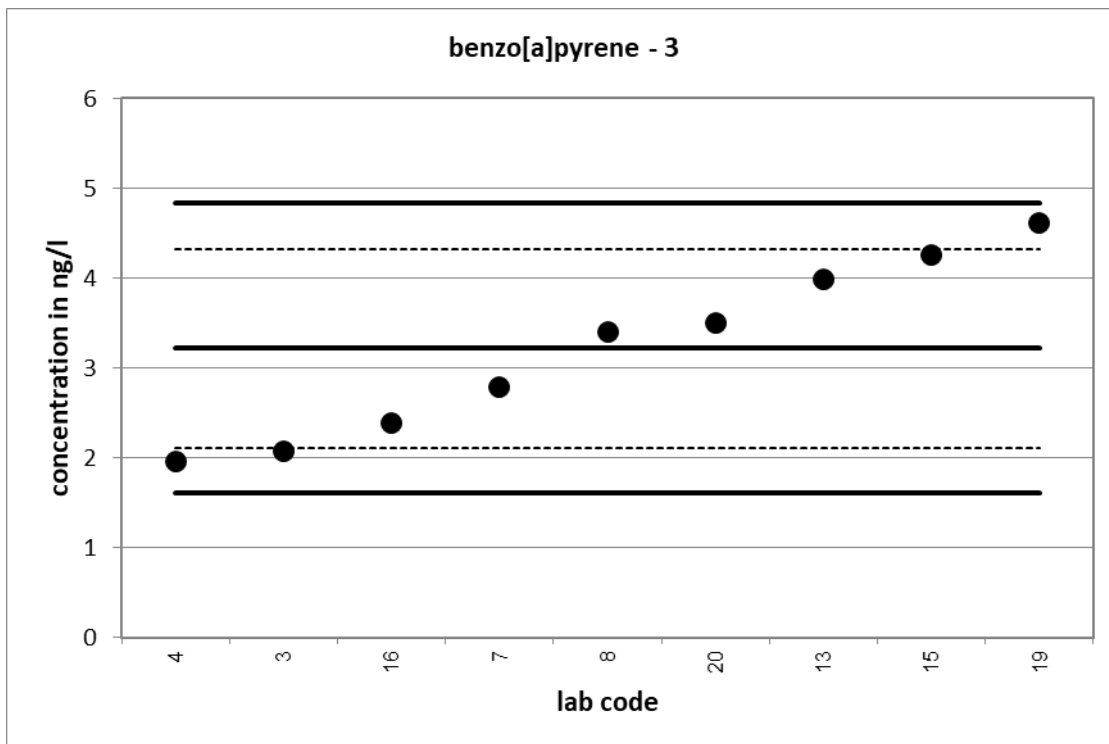


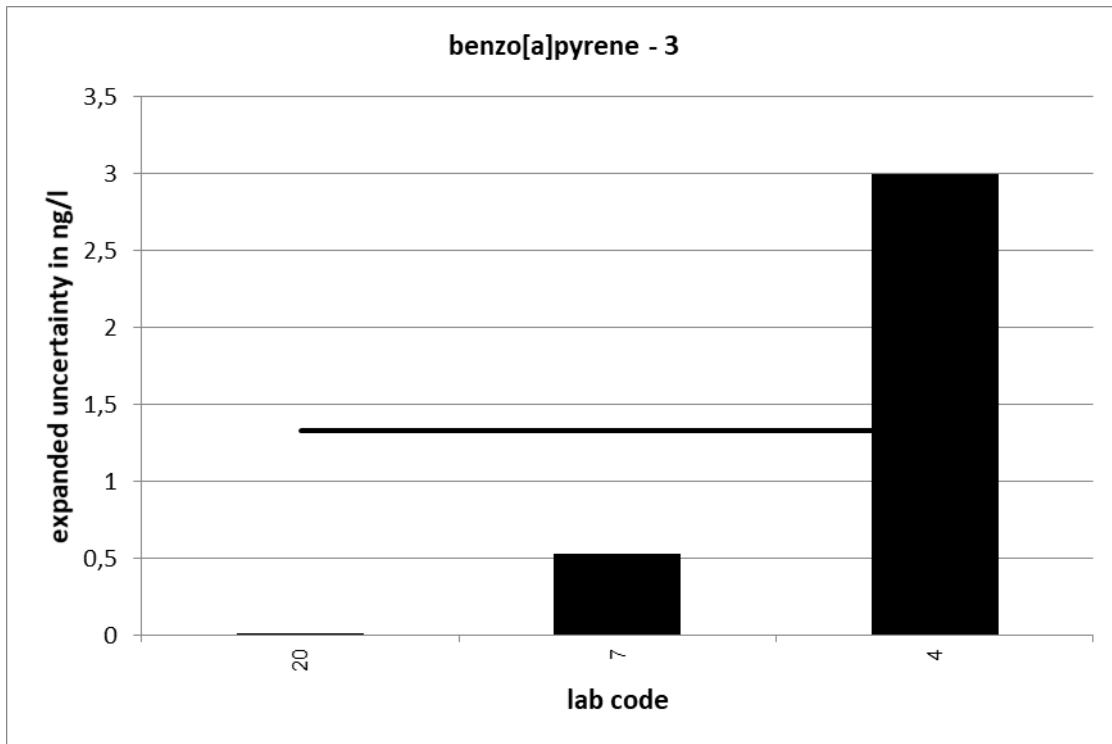
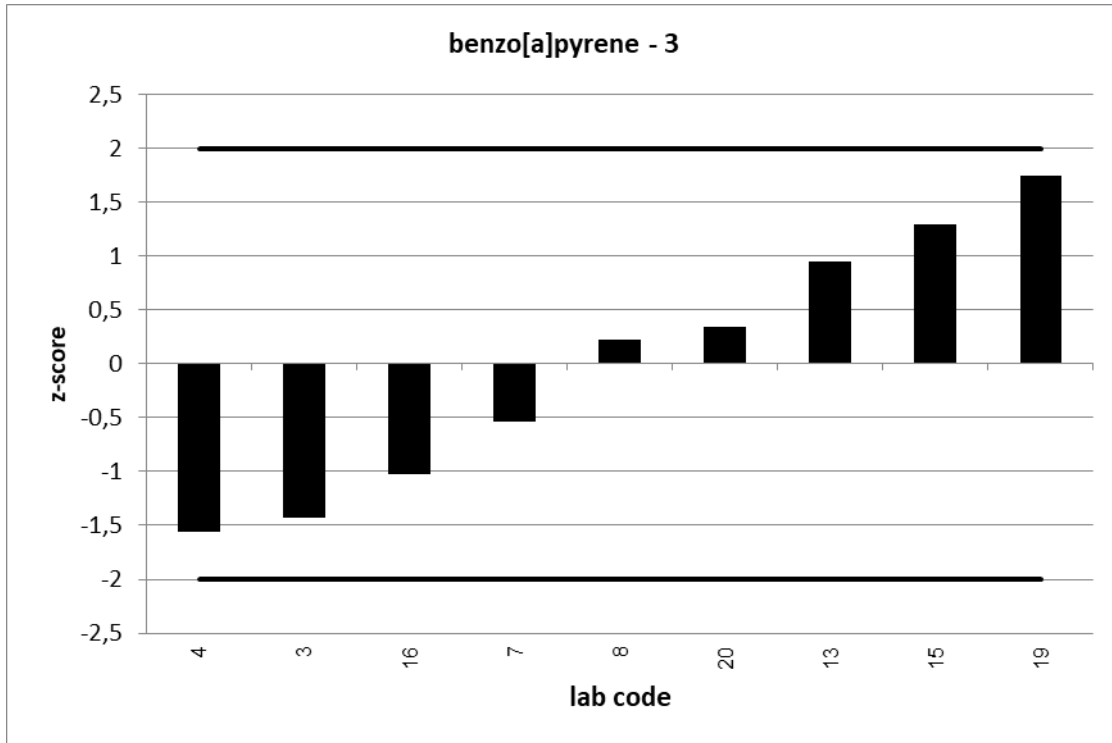


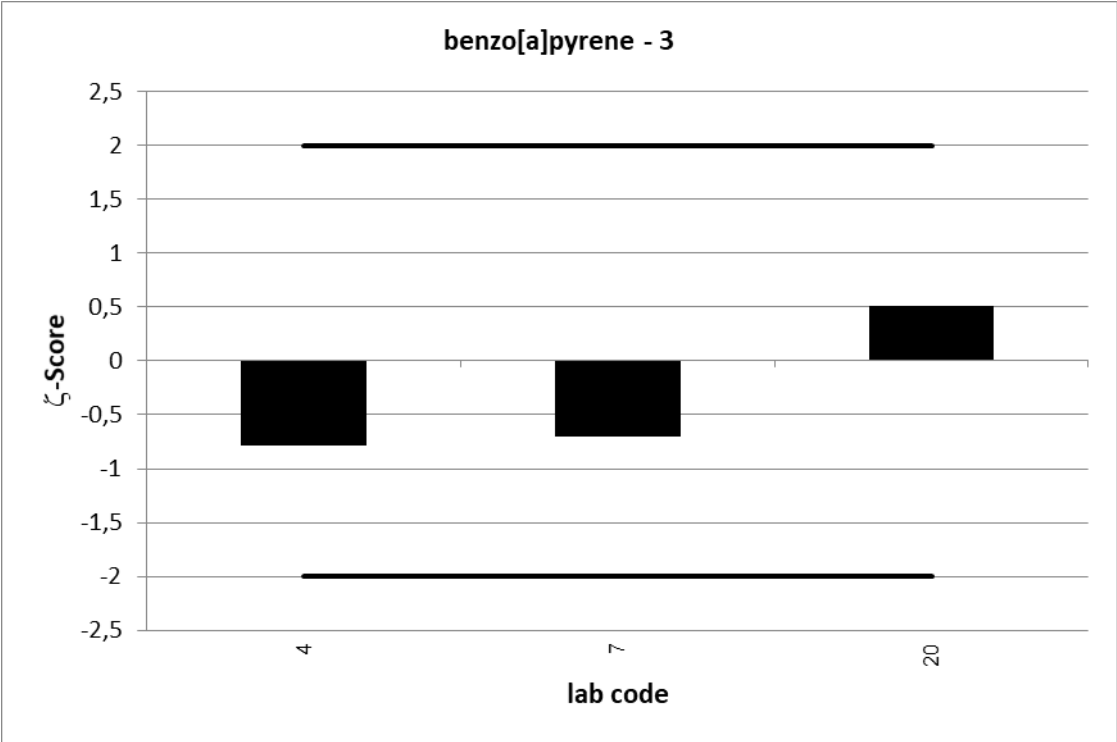
UKWIR 8/21		benzo[a]pyrene - 3			
assigned value [ng/l]*		3,219 ± 1,108			
upper tolerance limit [ng/l]		4,829			
lower tolerance limit [ng/l]		1,61			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
3	2,07			-1,4	s
4	1,96	3	-0,8	-1,6	s
7	2,79	0,53	-0,7	-0,5	s
8	3,396			0,2	s
13	3,988			1,0	s
15	4,26			1,3	s
16	2,39			-1,0	s
19	4,62			1,7	s
20	3,5	0,02	0,5	0,3	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

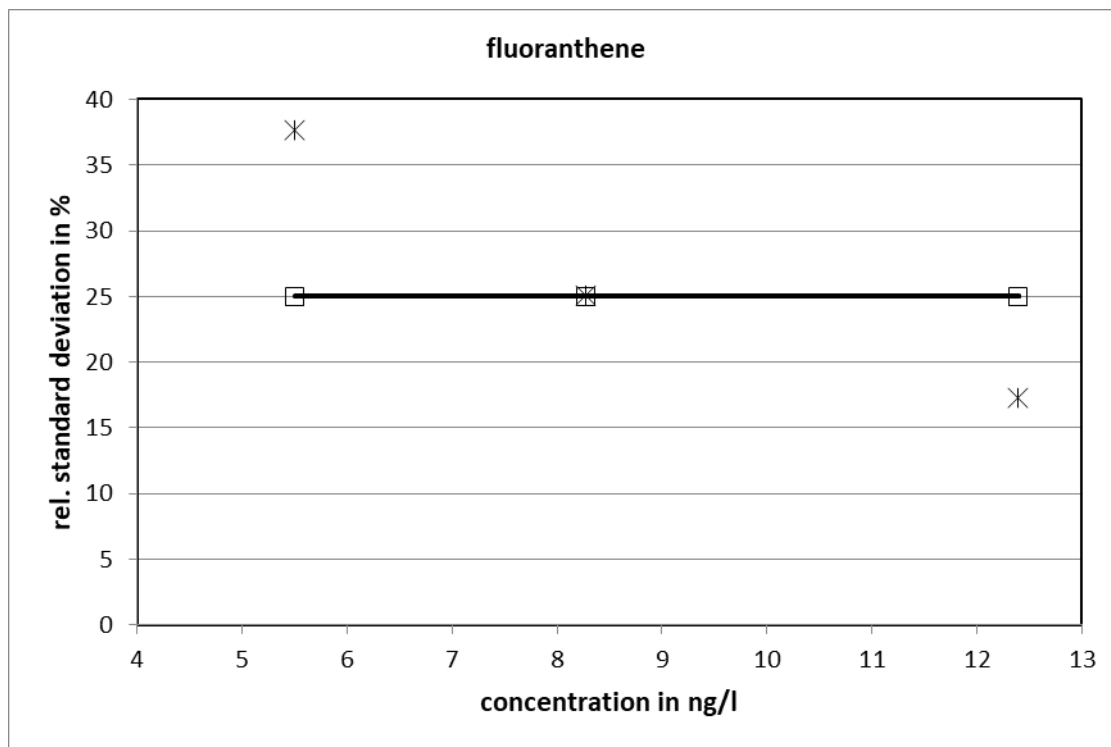






fluoranthene													
level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [ng/l]	standard deviation for proficiency assessment [ng/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [ng/l]	lower tolerance limit [ng/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]
1	5,501	31,38	2,071	1,375	25,00	8,251	2,750	50,00	-50,00	9	0	0	0,0
2	8,269	20,91	2,075	2,067	25,00	12,40	4,135	50,00	-50,00	9	0	0	0,0
3	12,39	14,40	2,141	3,098	25,00	18,59	6,197	50,00	-50,00	9	0	0	0,0
										sum	27	0	0,0

Relative standard deviation

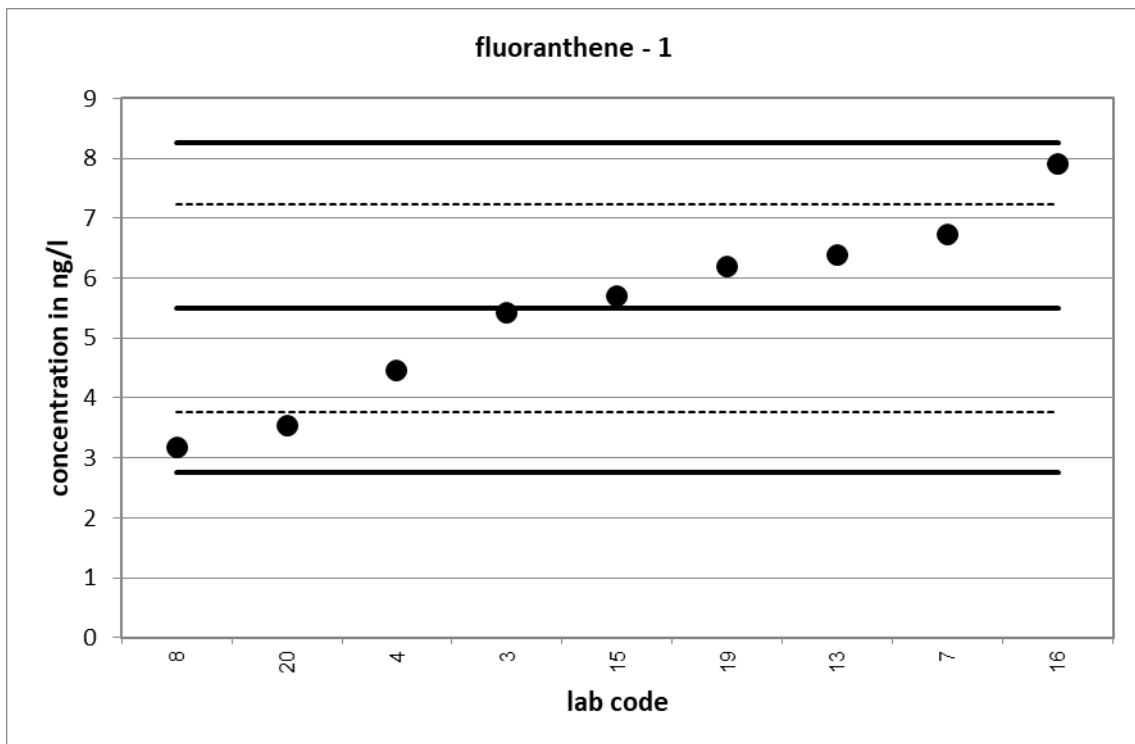


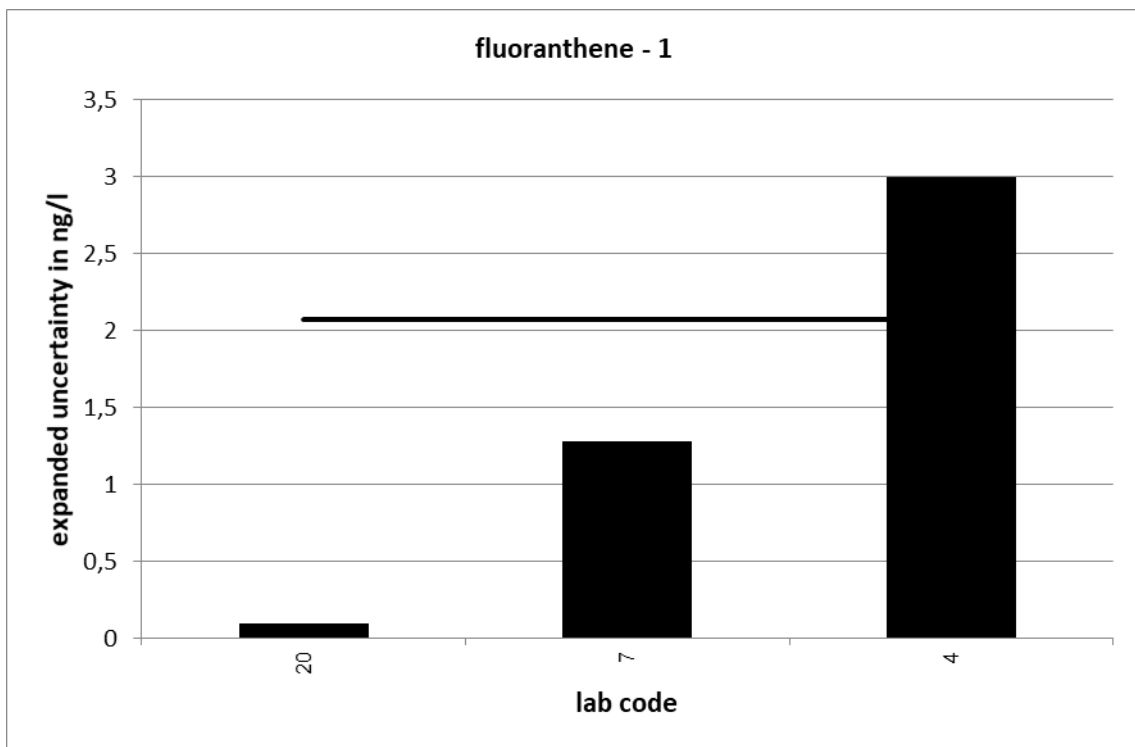
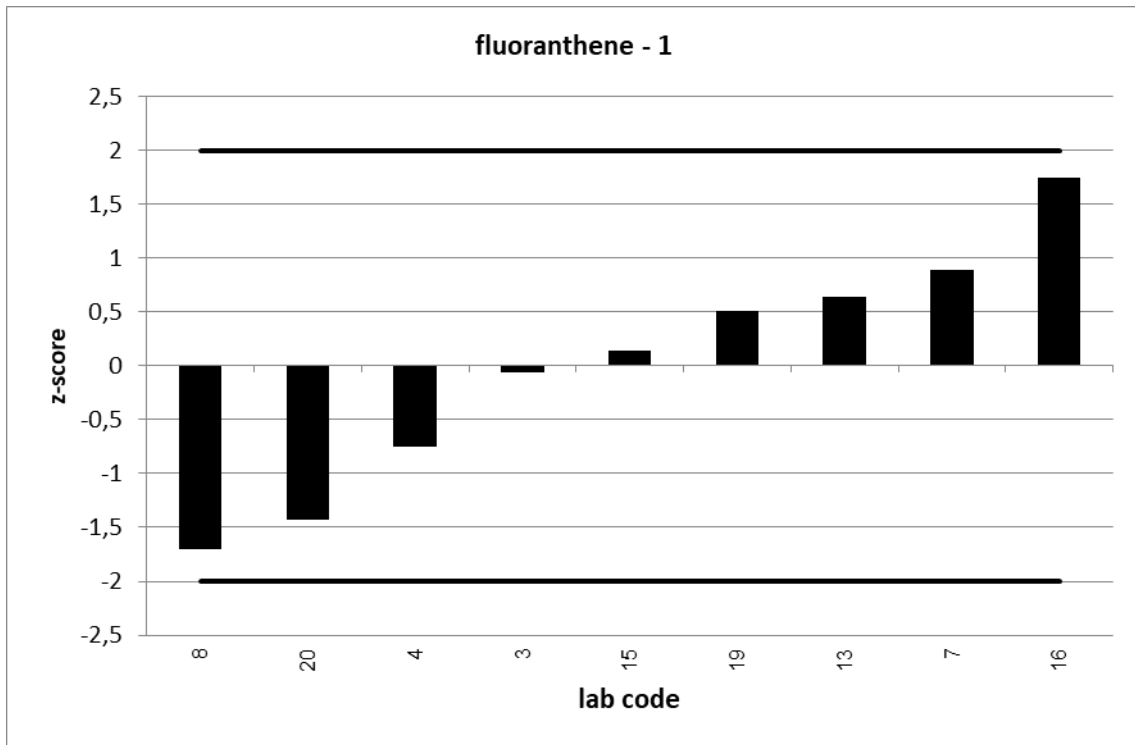
25 % is used as standard deviation for proficiency assessment.

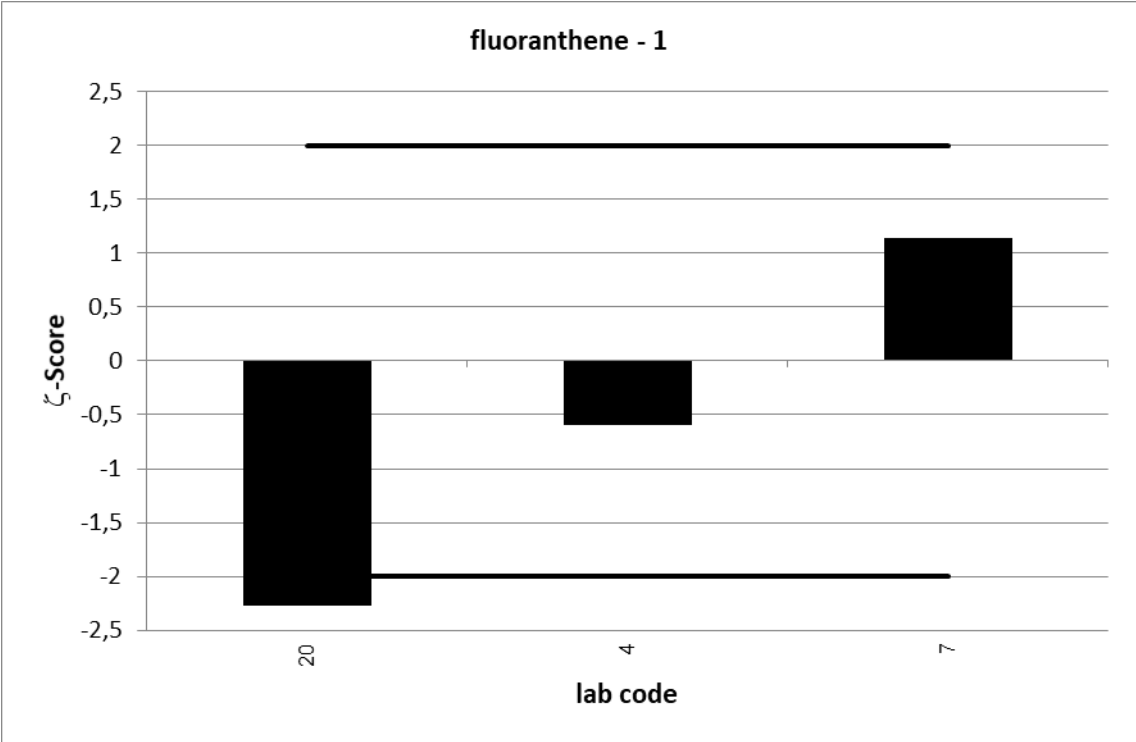
UKWIR 8/21		fluoranthene - 1			
assigned value [ng/l]*		5,501 ± 1,726			
upper tolerance limit [ng/l]		8,251			
lower tolerance limit [ng/l]		2,75			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
3	5,42			-0,1	s
4	4,46	3	-0,6	-0,8	s
7	6,73	1,28	1,1	0,9	s
8	3,166			-1,7	s
13	6,38			0,6	s
15	5,7			0,1	s
16	7,91			1,8	s
19	6,2			0,5	s
20	3,54	0,1	-2,3	-1,4	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



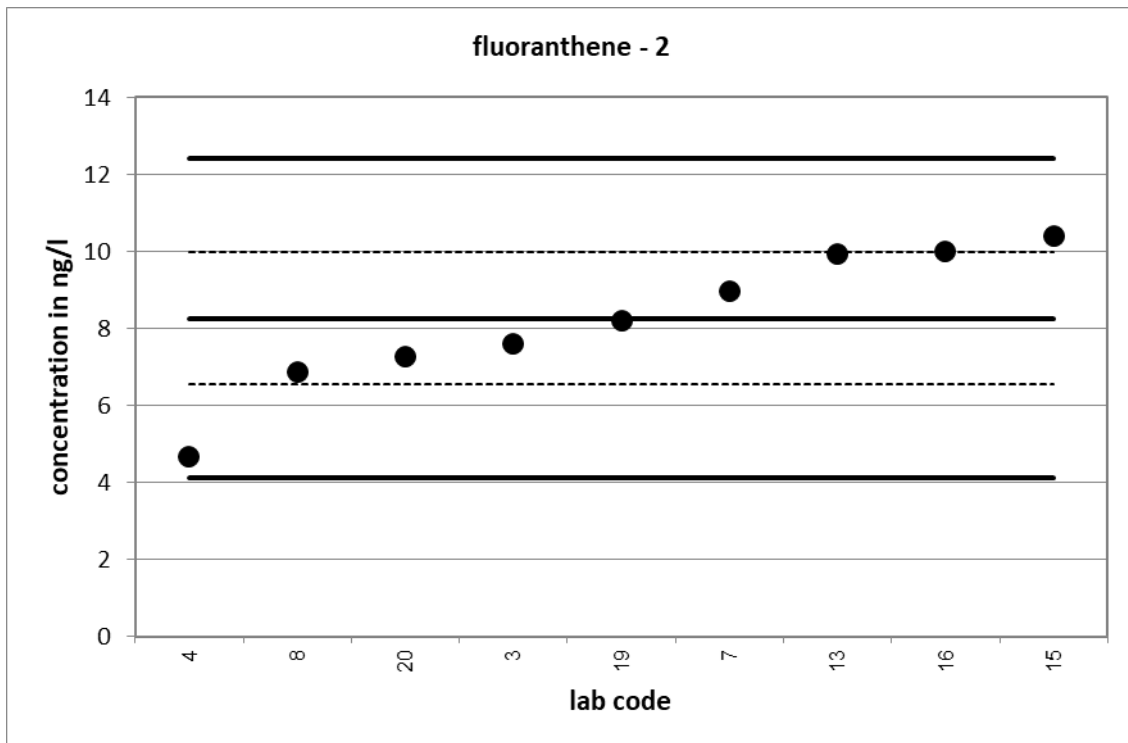


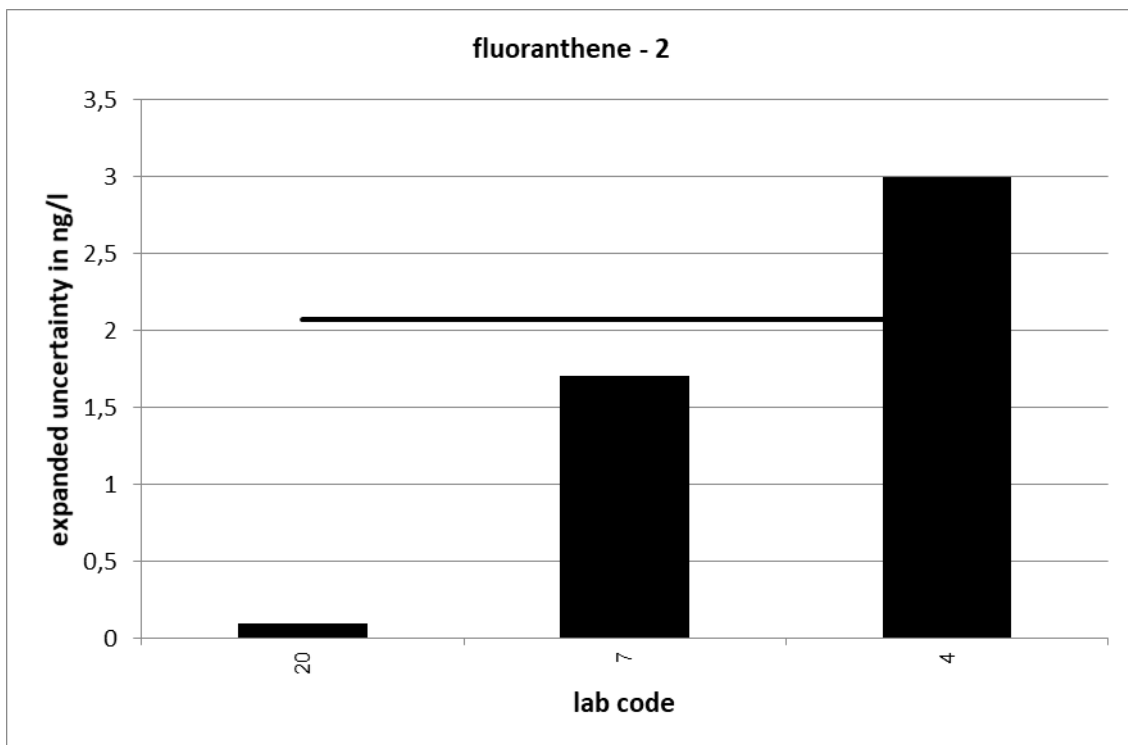
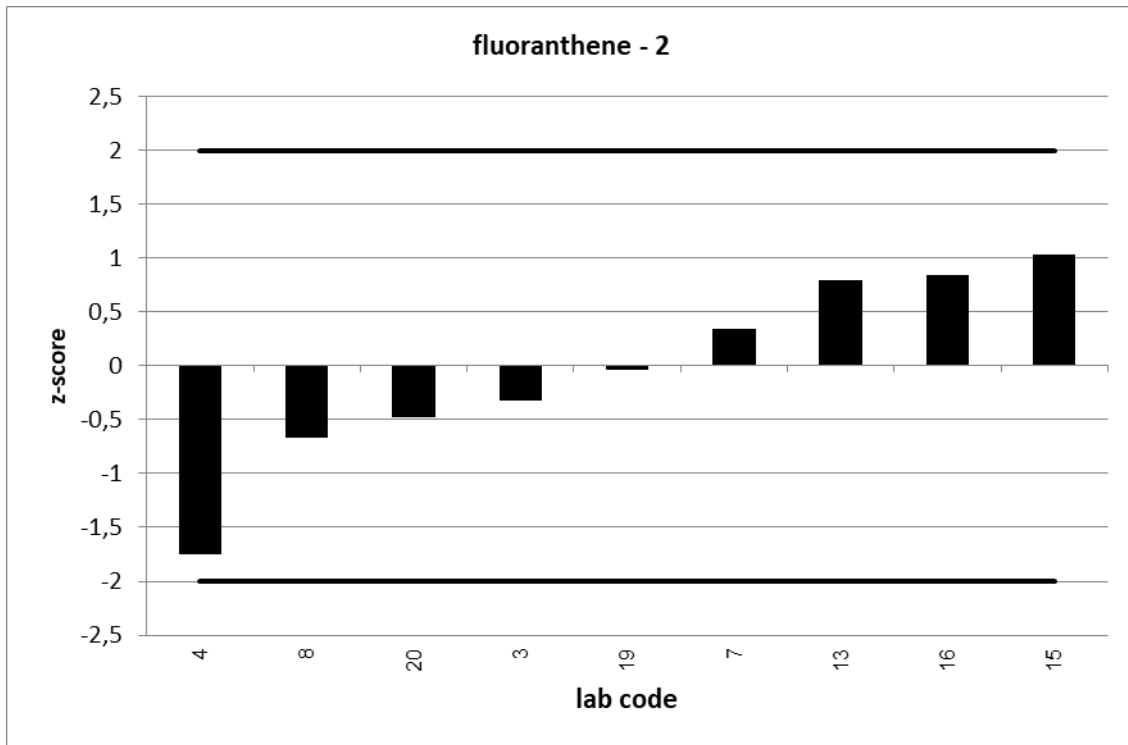


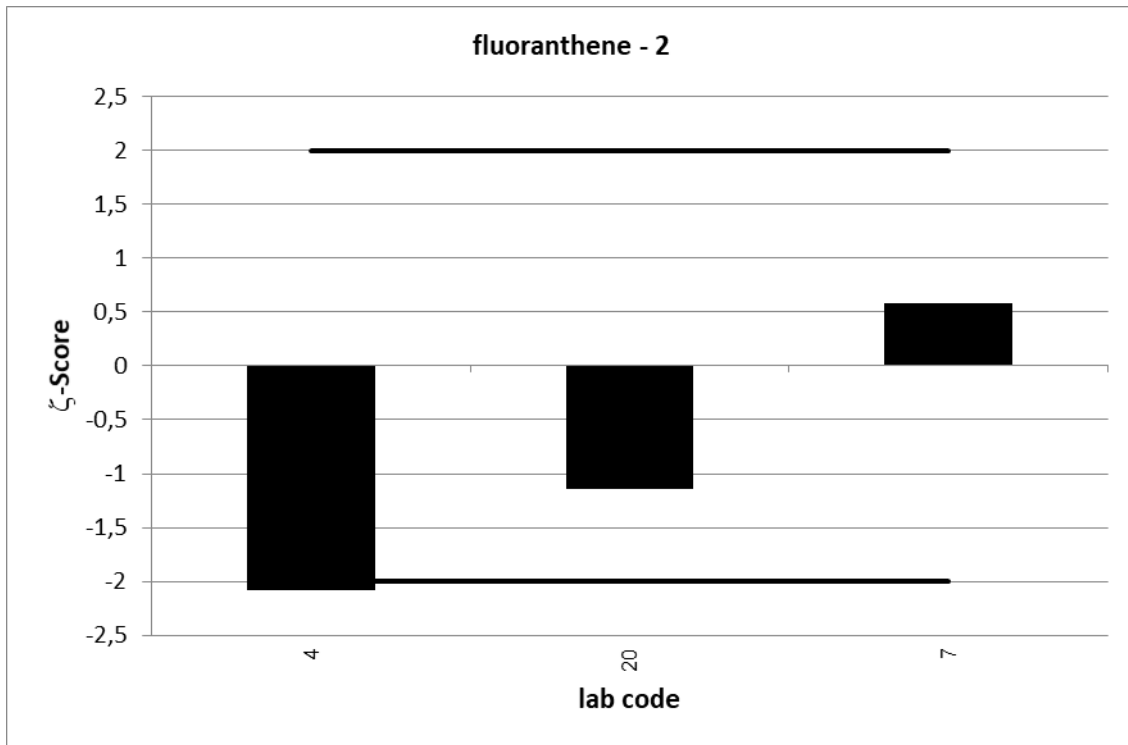
UKWIR 8/21		fluoranthene - 2			
assigned value [ng/l]*		8,269 ± 1,729			
upper tolerance limit [ng/l]		12,4			
lower tolerance limit [ng/l]		4,135			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
3	7,61			-0,3	s
4	4,66	3	-2,1	-1,7	s
7	8,97	1,71	0,6	0,3	s
8	6,886			-0,7	s
13	9,92			0,8	s
15	10,4			1,0	s
16	10			0,8	s
19	8,2			0,0	s
20	7,28	0,1	-1,1	-0,5	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



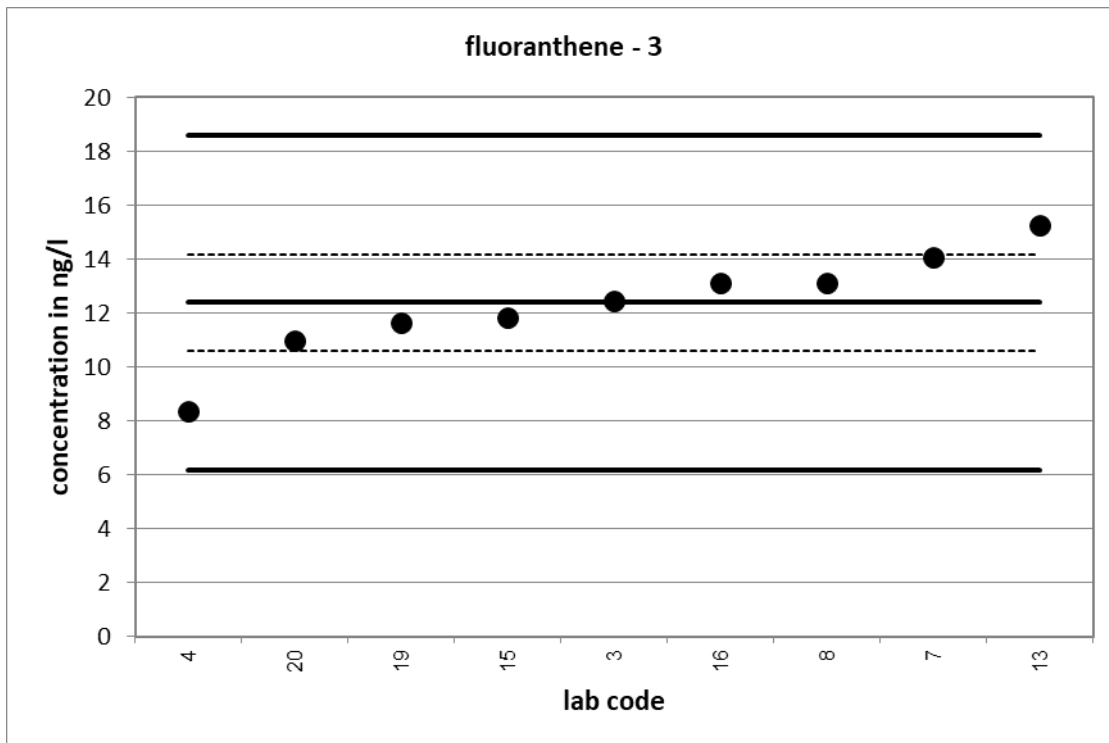


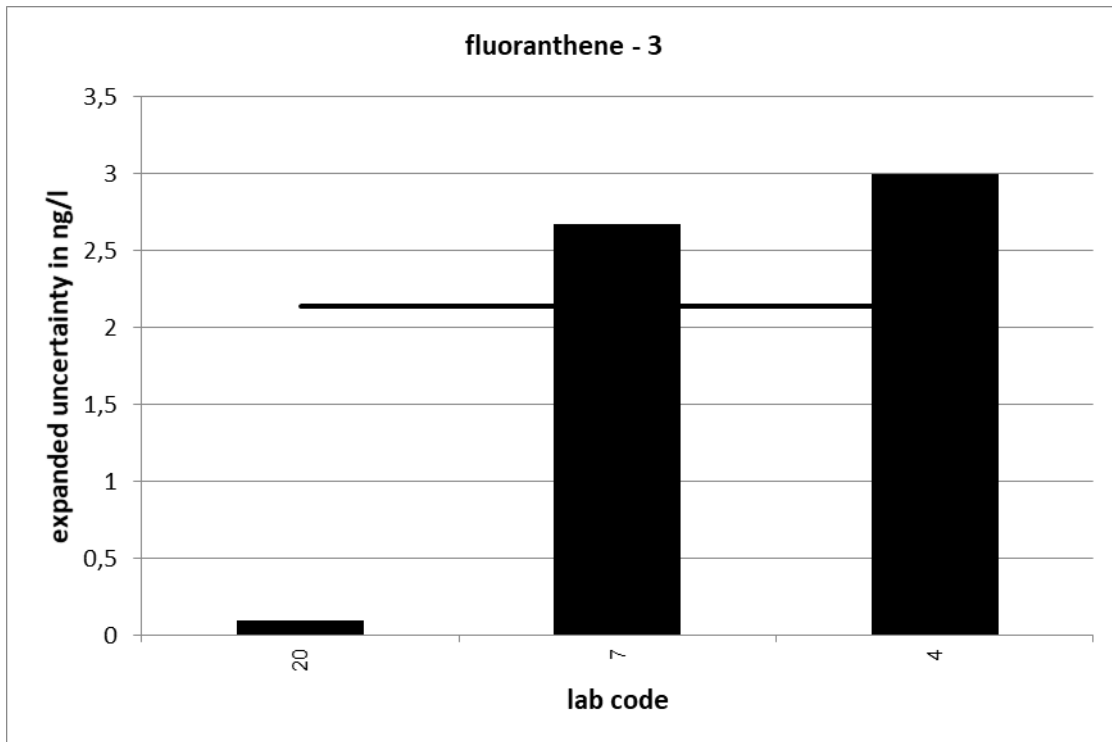
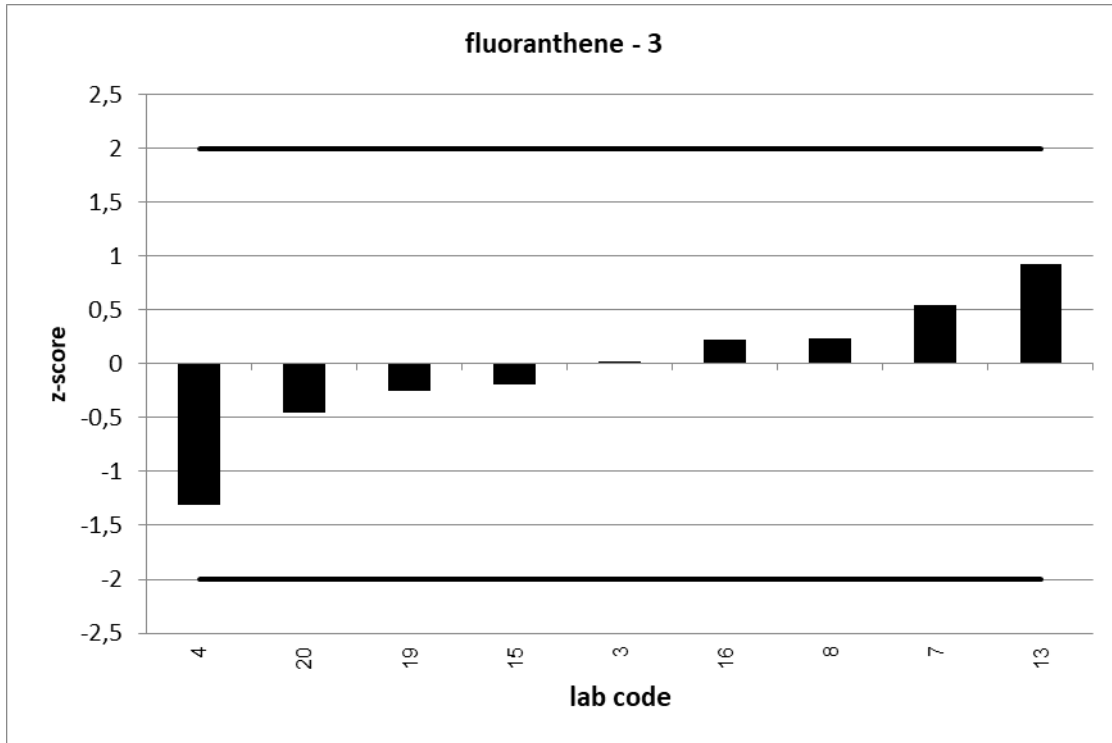


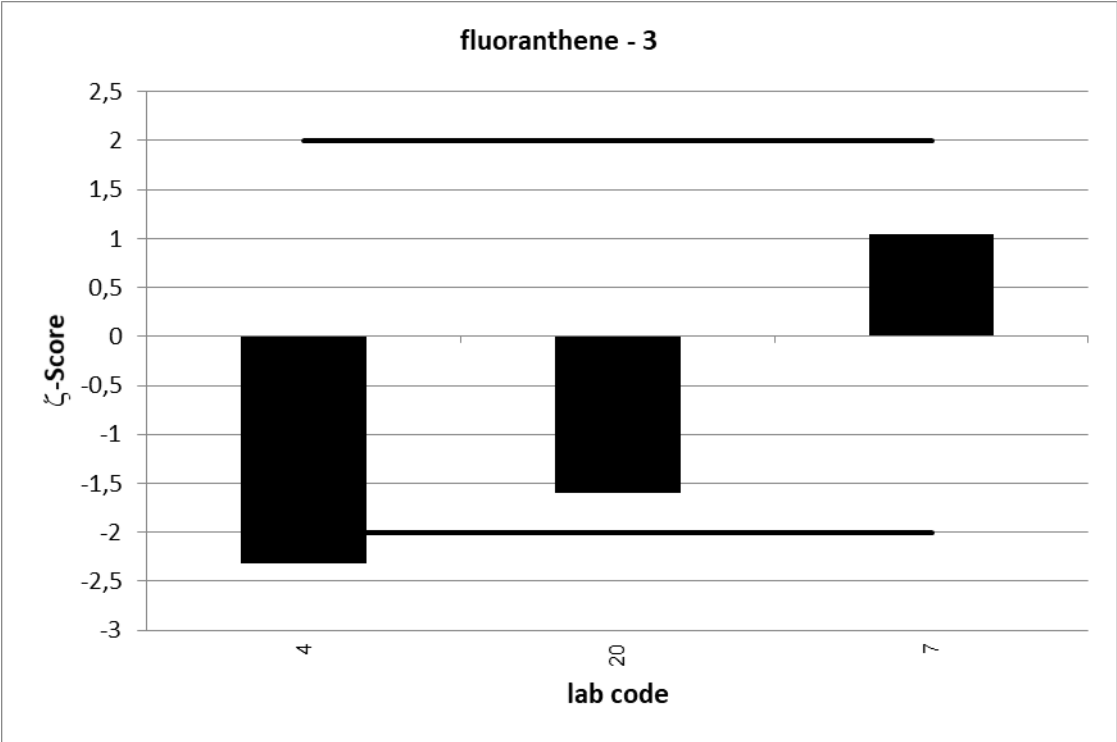
UKWIR 8/21		fluoranthene - 3			
assigned value [ng/l]*		12,39 ± 1,78			
upper tolerance limit [ng/l]		18,59			
lower tolerance limit [ng/l]		6,197			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
3	12,45			0,0	s
4	8,35	3	-2,3	-1,3	s
7	14,07	2,67	1,0	0,5	s
8	13,11			0,2	s
13	15,26			0,9	s
15	11,8			-0,2	s
16	13,1			0,2	s
19	11,6			-0,3	s
20	10,97	0,1	-1,6	-0,5	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

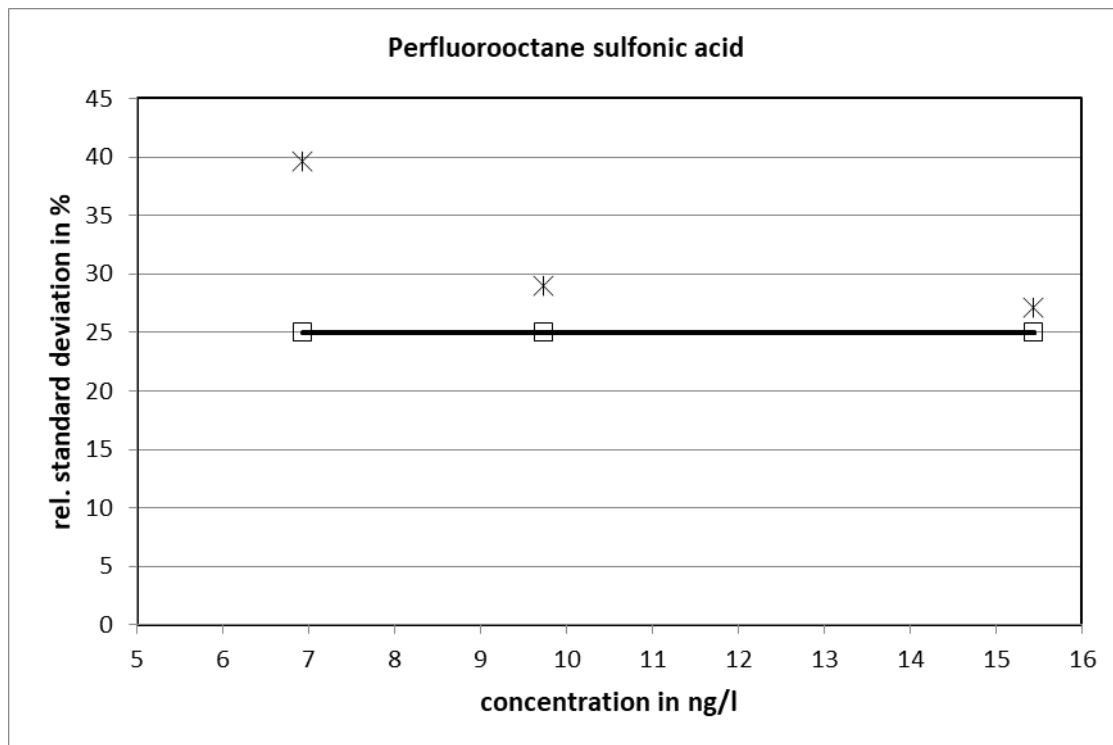






UKWIR 9/21:

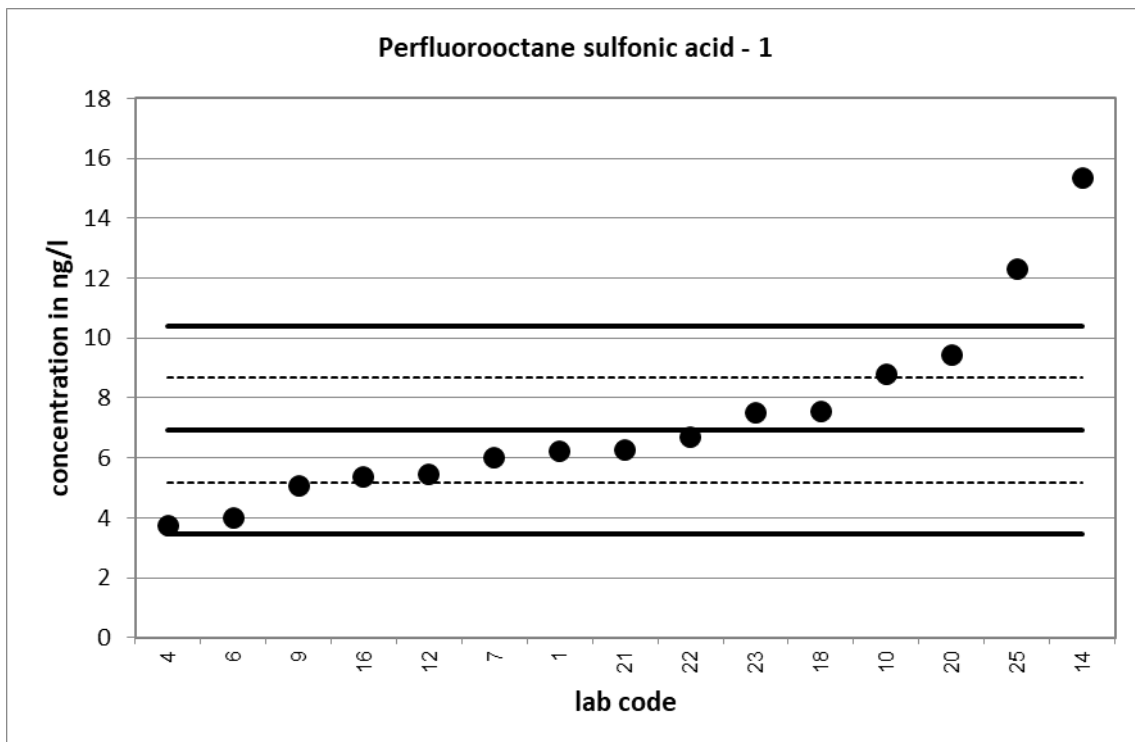
Perfluorooctane sulfonic acid														
level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [ng/l]	standard deviation for proficiency assessment [ng/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [ng/l]	lower tolerance limit [ng/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]	
1	6,930	25,60	2,748	1,733	25,00	10,40	3,465	50,00	-50,00	15	1	2	20,0	
2	9,724	18,74	2,823	2,431	25,00	14,59	4,862	50,00	-50,00	15	0	2	13,3	
3	15,44	17,50	4,188	3,860	25,00	23,16	7,721	50,00	-50,00	15	0	1	6,7	
										sum	45	1	5	13,3

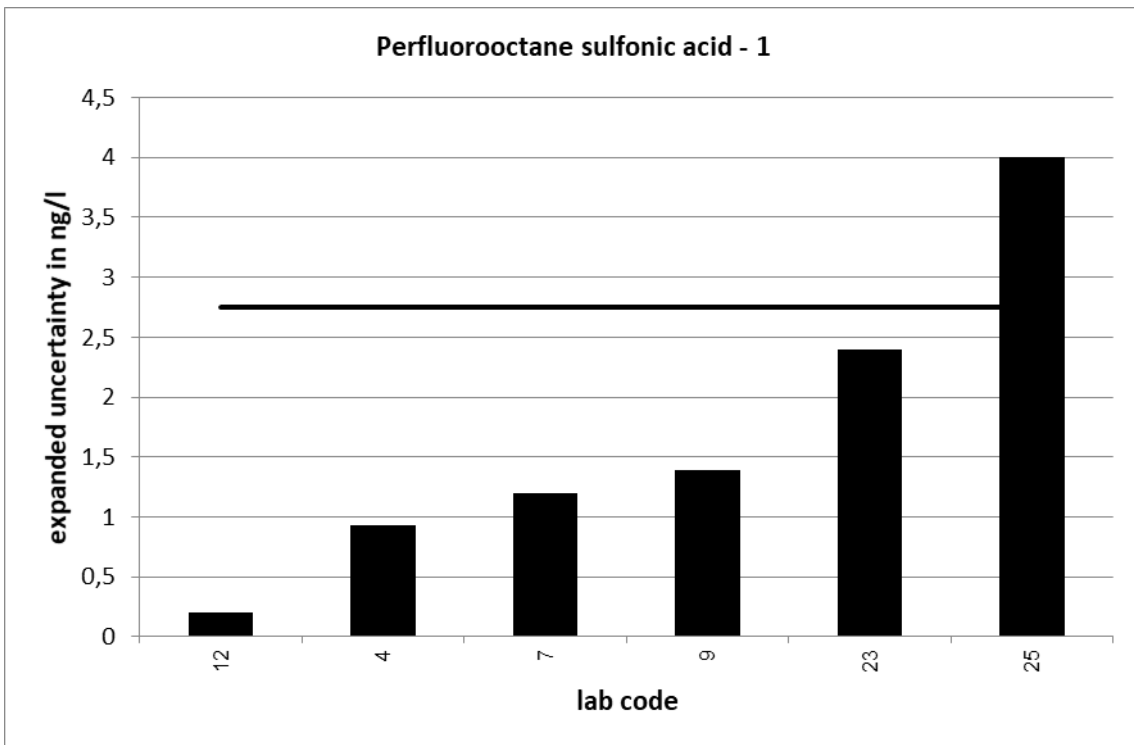
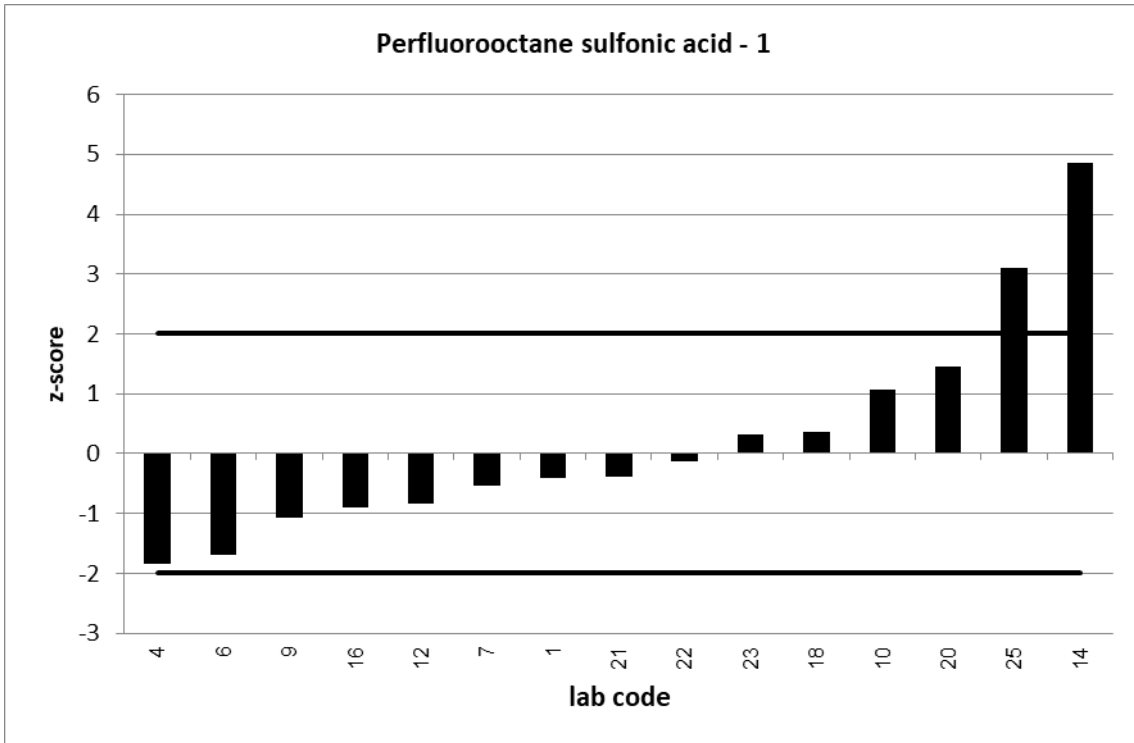


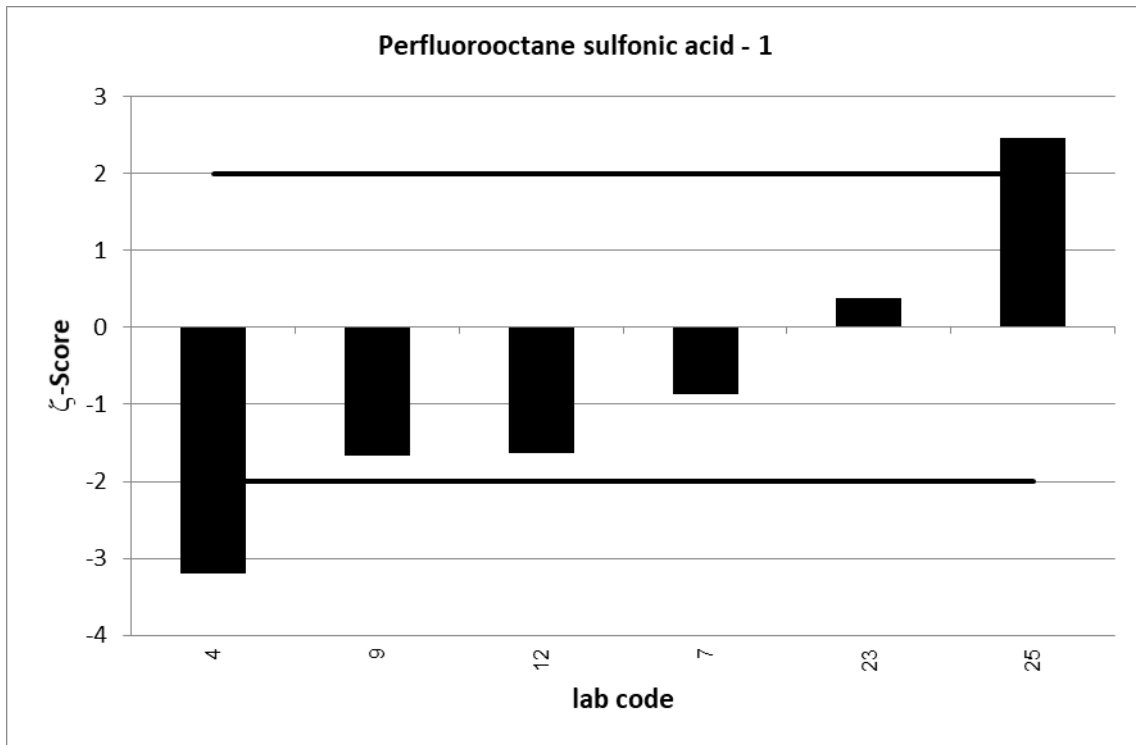
UKWIR PT 9/21		Perfluorooctane sulfonic acid - 1			
assigned value [ng/l]*		6,93 ± 1,774			
upper tolerance limit [ng/l]		10,4			
lower tolerance limit [ng/l]		3,465			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	6,21			-0,4	s
4	3,72	0,93	-3,2	-1,9	s
6	4			-1,7	s
7	5,996	1,2	-0,9	-0,5	s
9	5,058	1,394	-1,7	-1,1	s
10	8,78			1,1	s
12	5,47	0,2	-1,6	-0,8	s
14	15,36			4,9	u
16	5,36			-0,9	s
18	7,54			0,4	s
20	9,43			1,4	s
21	6,27			-0,4	s
22	6,7			-0,1	s
23	7,5	2,4	0,4	0,3	s
25	12,3	4	2,5	3,1	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



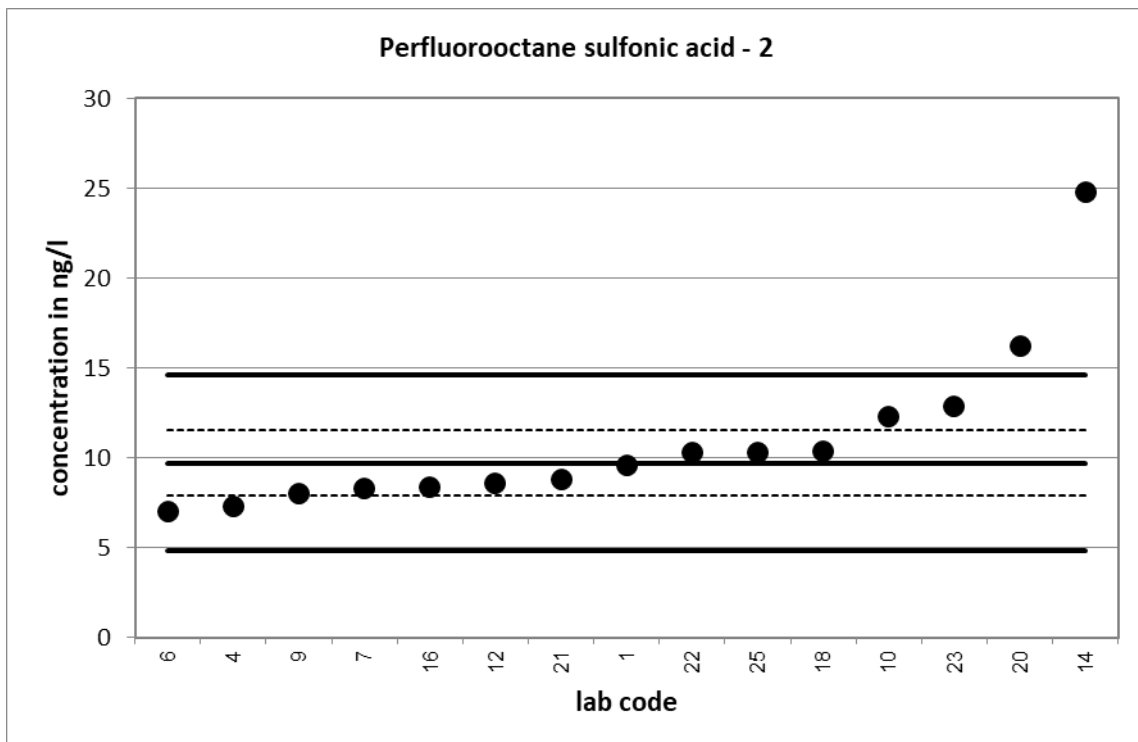


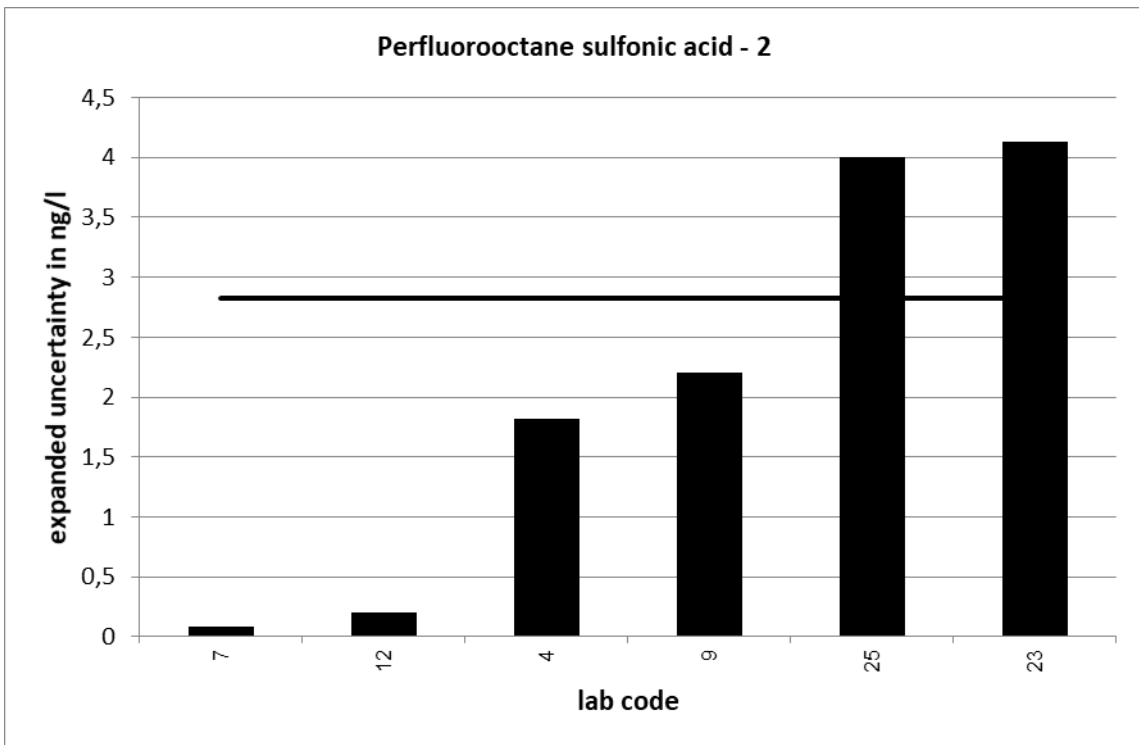
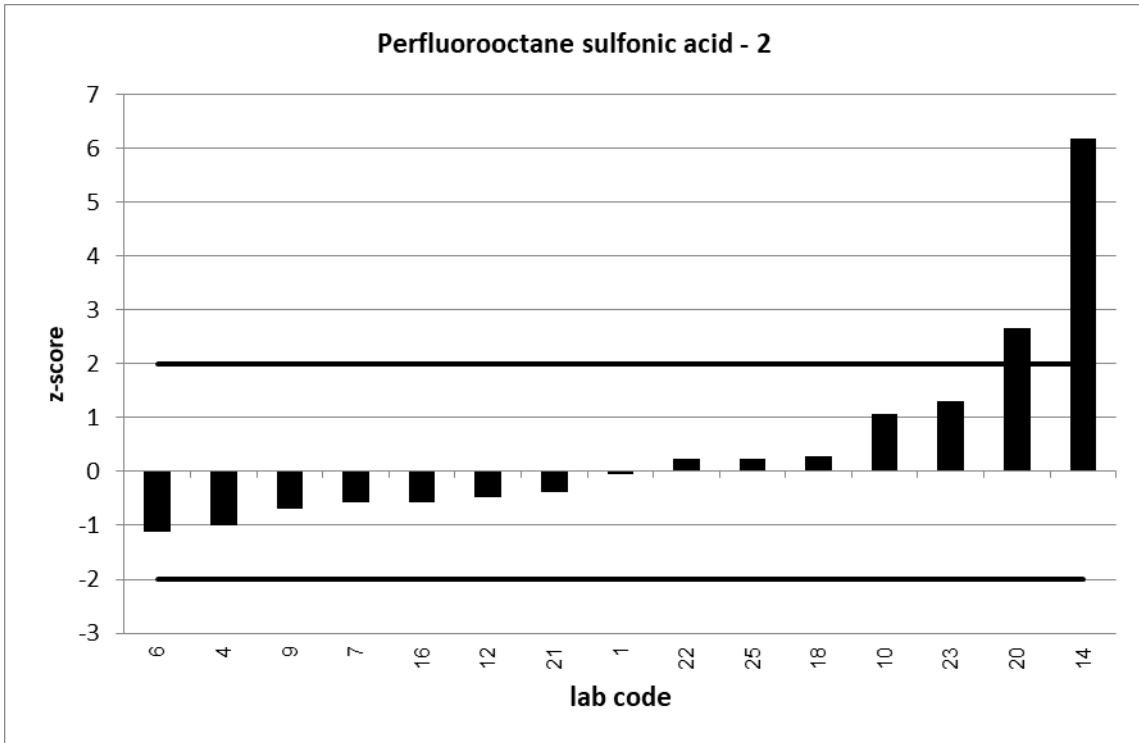


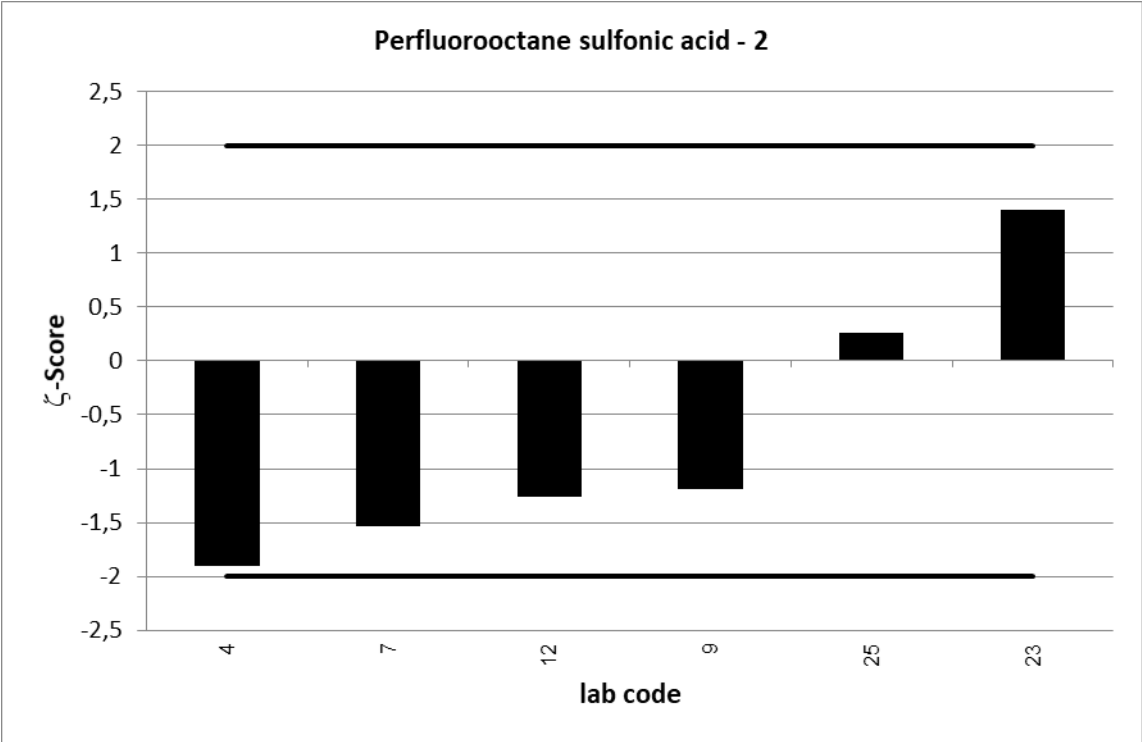
UKWIR PT 9/21		Perfluorooctane sulfonic acid - 2			
assigned value [ng/l]*		9,724 ± 1,823			
upper tolerance limit [ng/l]		14,59			
lower tolerance limit [ng/l]		4,862			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	9,62			0,0	s
4	7,28	1,82	-1,9	-1,0	s
6	7			-1,1	s
7	8,327	0,08	-1,5	-0,6	s
9	8,016	2,209	-1,2	-0,7	s
10	12,3			1,1	s
12	8,57	0,2	-1,3	-0,5	s
14	24,76			6,2	u
16	8,36			-0,6	s
18	10,4			0,3	s
20	16,2			2,7	q
21	8,81			-0,4	s
22	10,3			0,2	s
23	12,9	4,13	1,4	1,3	s
25	10,3	4	0,3	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



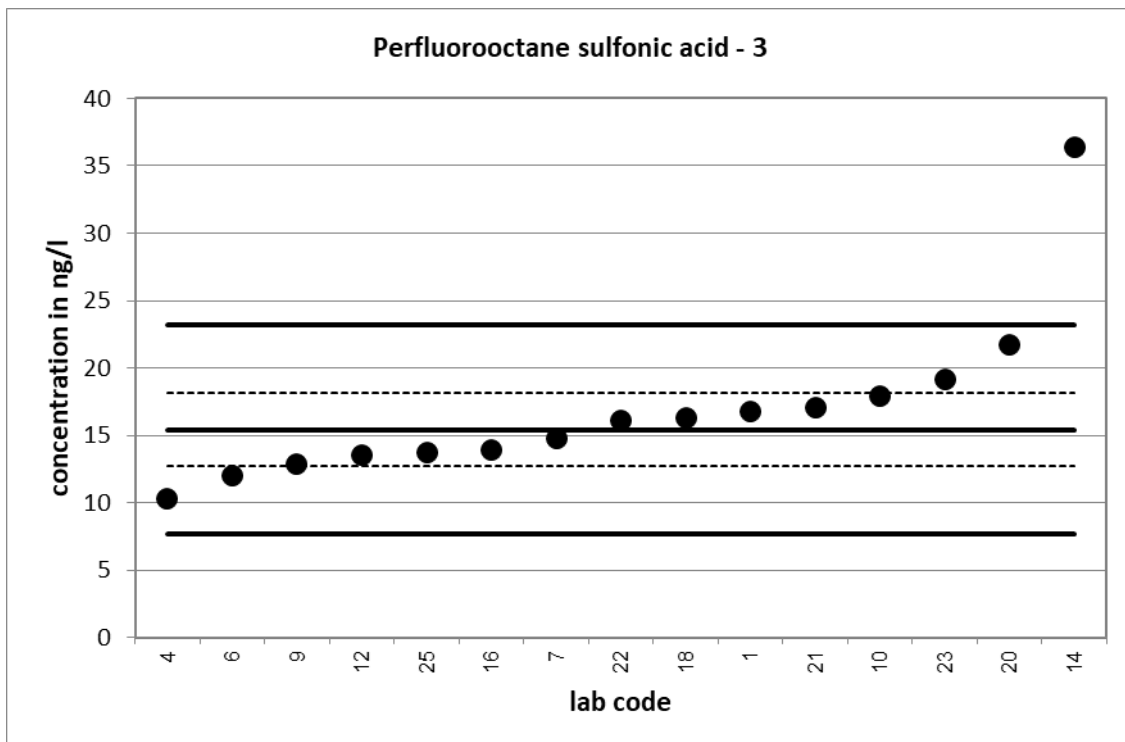


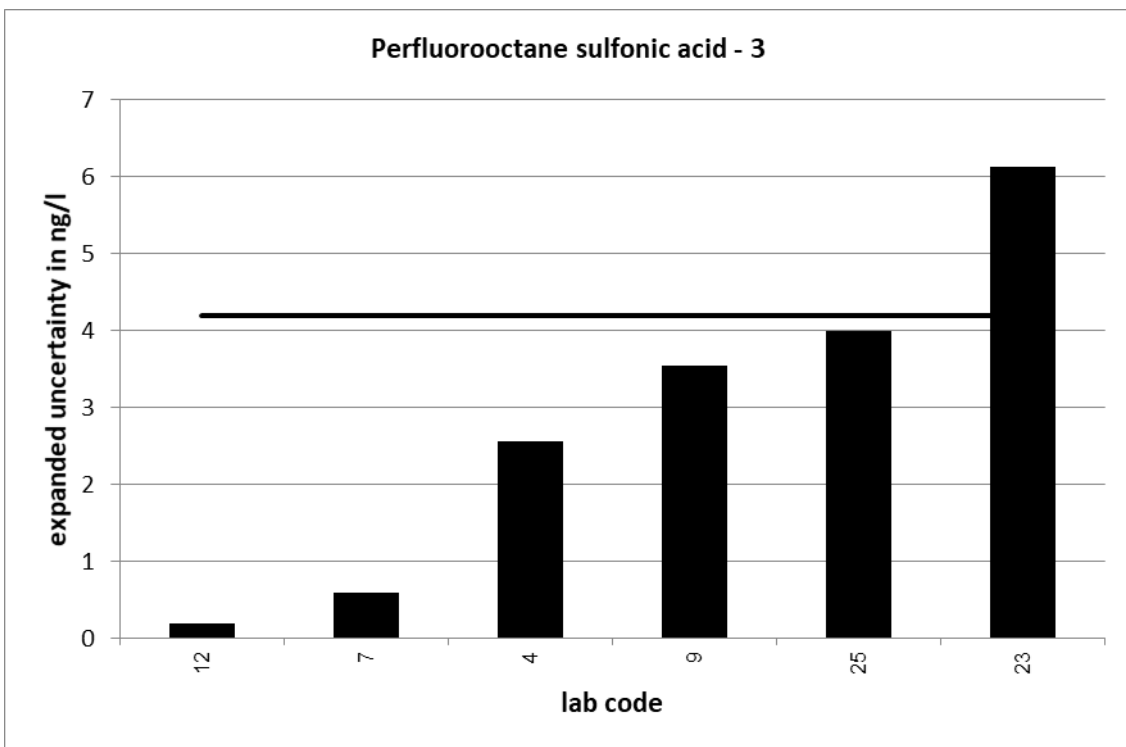
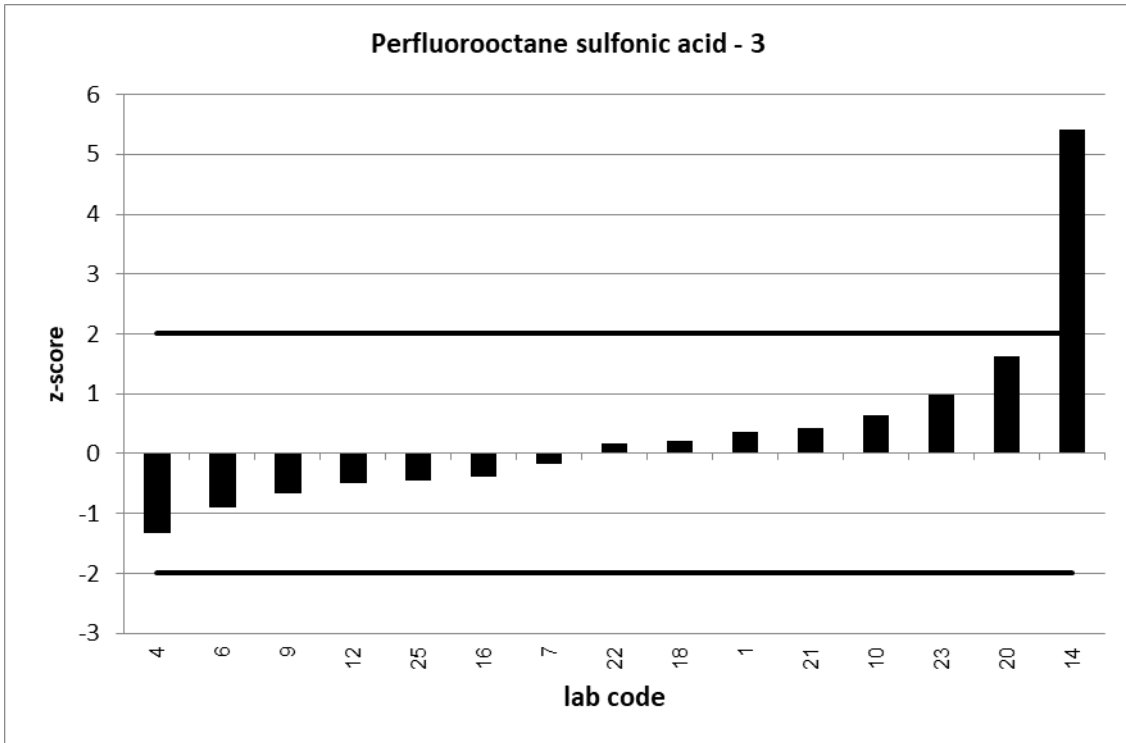


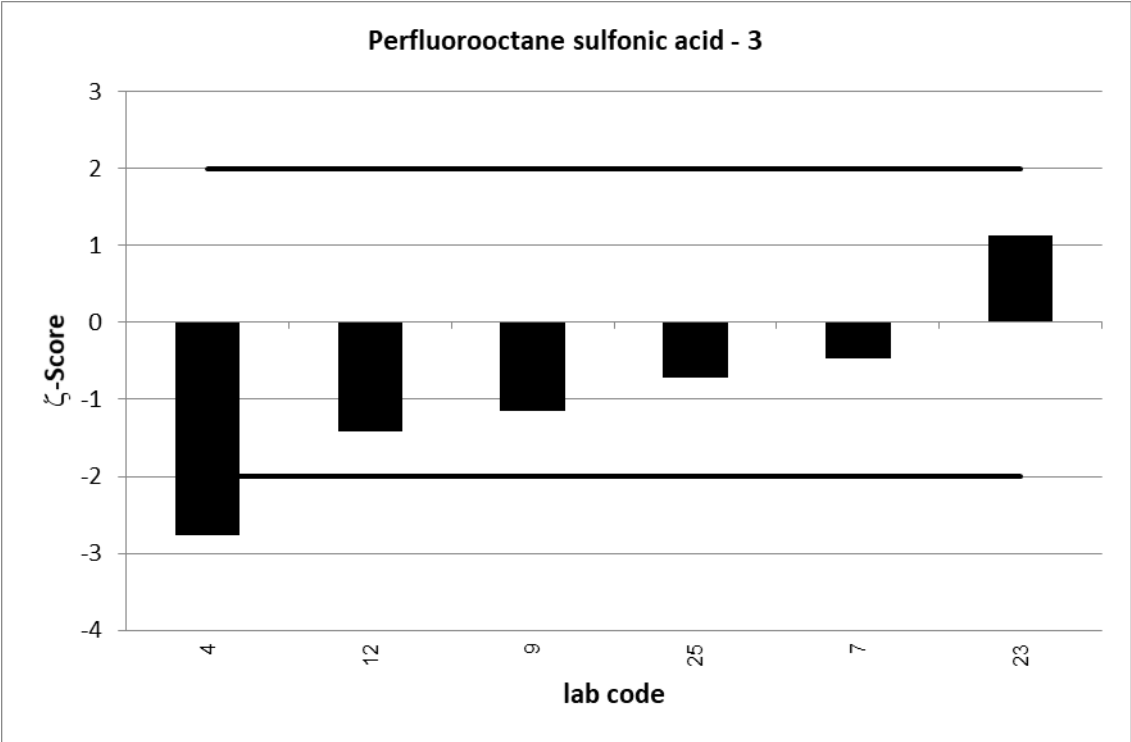
UKWIR PT 9/21		Perfluorooctane sulfonic acid - 3			
assigned value [ng/l]*		15,44 ± 2,7			
upper tolerance limit [ng/l]		23,16			
lower tolerance limit [ng/l]		7,721			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	16,8			0,4	s
4	10,3	2,56	-2,8	-1,3	s
6	12			-0,9	s
7	14,784	0,6	-0,5	-0,2	s
9	12,868	3,546	-1,2	-0,7	s
10	17,9			0,6	s
12	13,51	0,2	-1,4	-0,5	s
14	36,34			5,4	u
16	13,92			-0,4	s
18	16,3			0,2	s
20	21,7			1,6	s
21	17,1			0,4	s
22	16,1			0,2	s
23	19,2	6,13	1,1	1,0	s
25	13,7	4	-0,7	-0,5	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

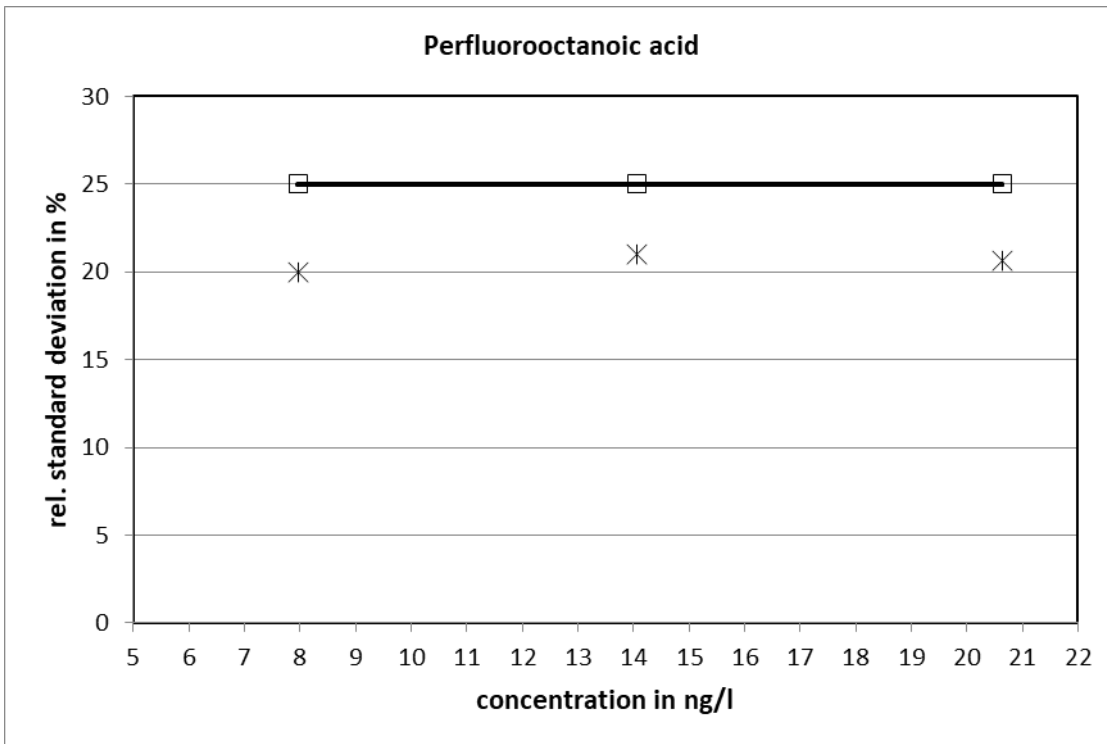






Perfluorooctanoic acid

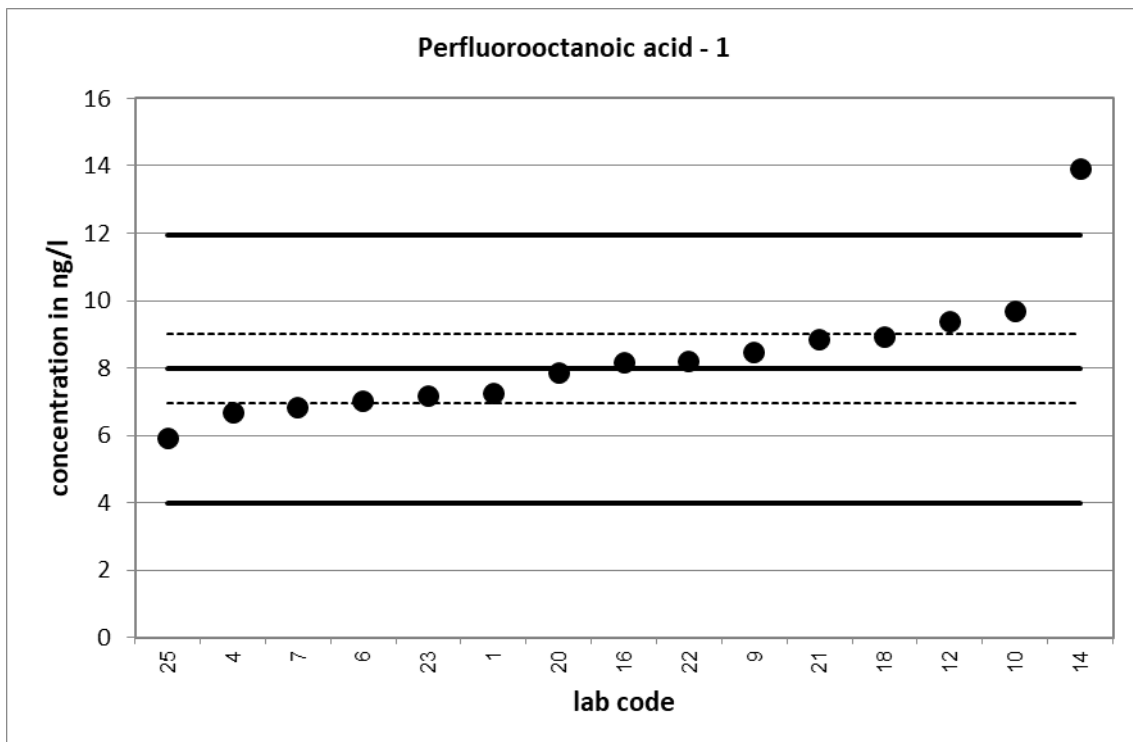
level	assigned value [ng/l]	expanded uncertainty of the assigned value [%]	standard deviation, calculated using robust statistics [ng/l]	standard deviation for proficiency assessment [ng/l]	standard deviation for proficiency assessment [%]	upper tolerance limit [ng/l]	lower tolerance limit [ng/l]	upper tolerance limit [%]	lower tolerance limit [%]	number of results	out below	out above	out [%]
1	7,967	12,90	1,592	1,992	25,00	11,95	3,984	50,00	-50,00	15	0	1	6,7
2	14,06	13,55	2,951	3,516	25,00	21,09	7,031	50,00	-50,00	15	0	1	6,7
3	20,63	13,31	4,253	5,158	25,00	30,95	10,32	50,00	-50,00	15	1	0	6,7
									sum	45	1	2	6,7

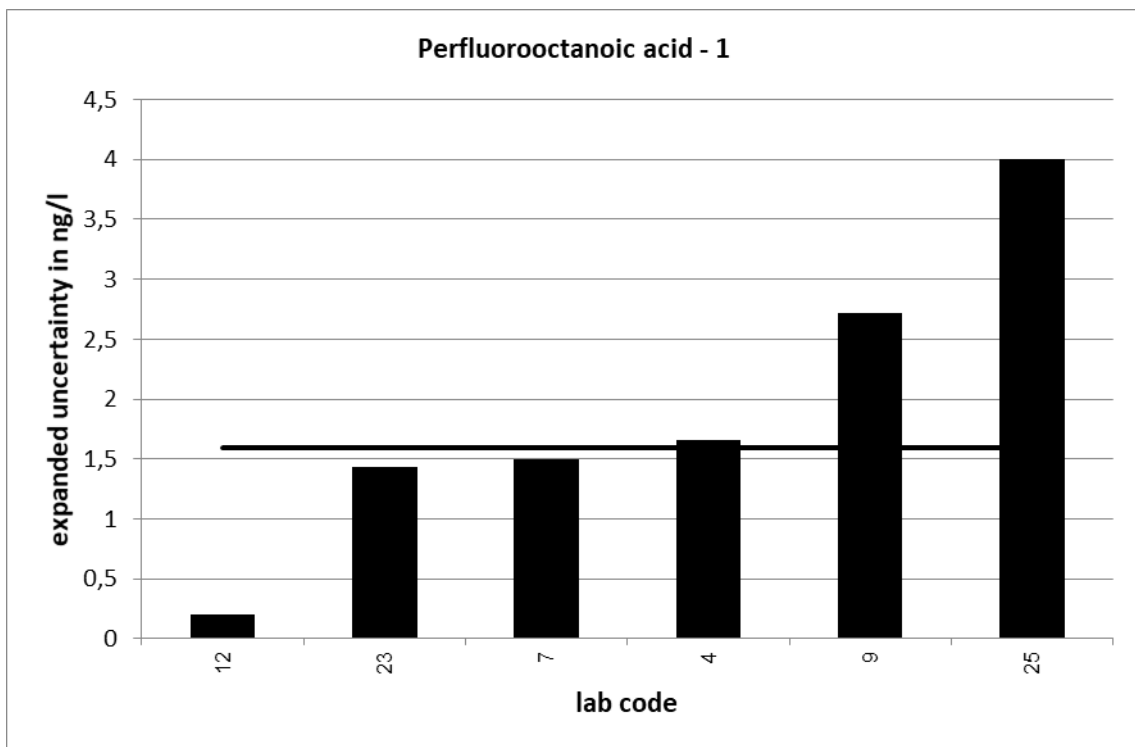
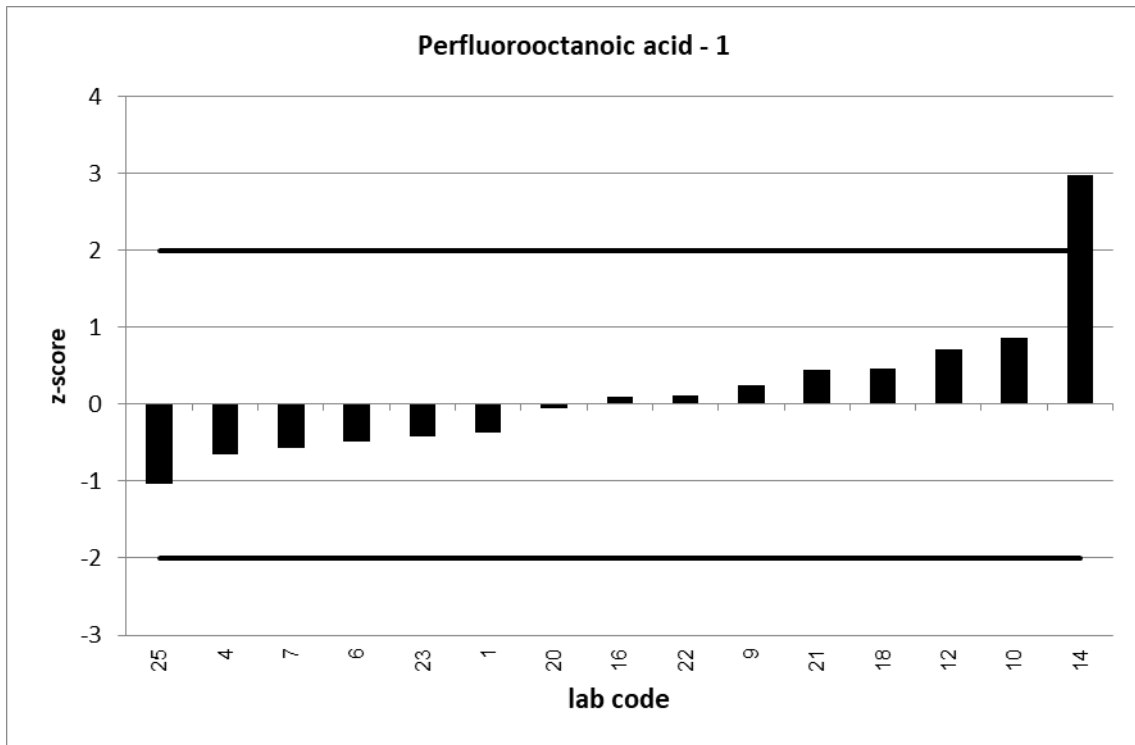


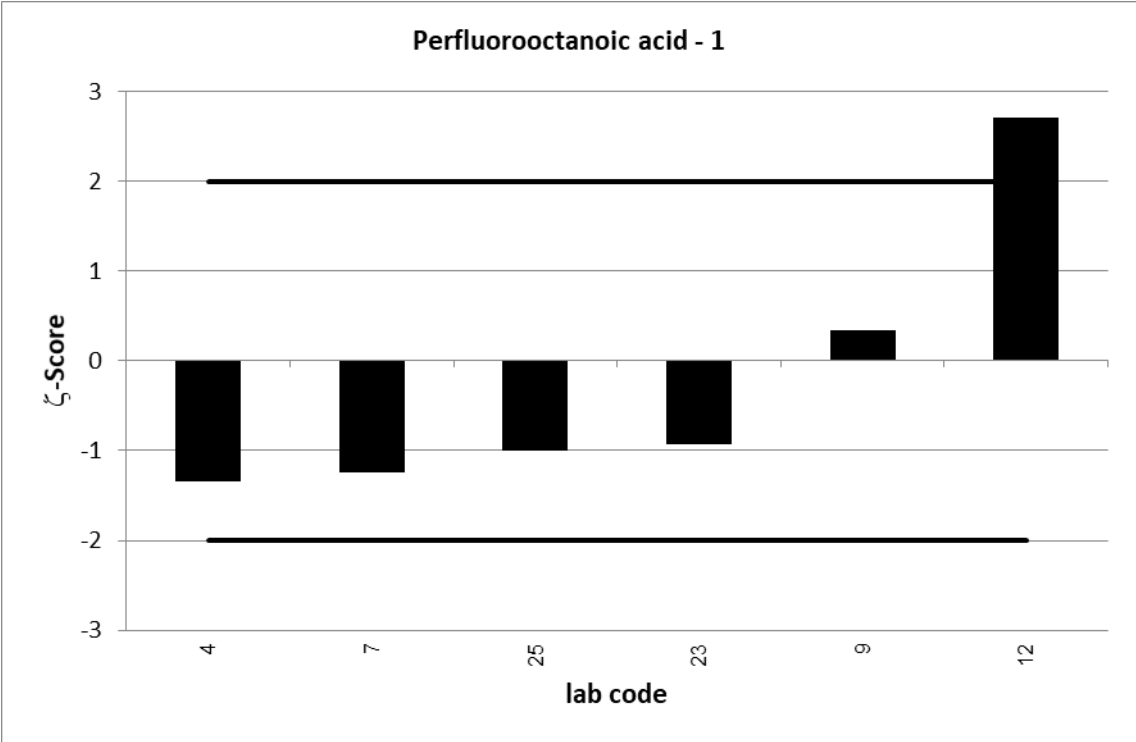
UKWIR PT 9/21		Perfluorooctanoic acid - 1			
assigned value [ng/l]*		7,967 ± 1,028			
upper tolerance limit [ng/l]		11,95			
lower tolerance limit [ng/l]		3,984			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	7,24			-0,4	s
4	6,66	1,66	-1,3	-0,7	s
6	7			-0,5	s
7	6,842	1,5	-1,2	-0,6	s
9	8,46	2,715	0,3	0,2	s
10	9,69			0,9	s
12	9,39	0,2	2,7	0,7	s
14	13,9			3,0	u
16	8,15			0,1	s
18	8,9			0,5	s
20	7,87			0,0	s
21	8,86			0,4	s
22	8,2			0,1	s
23	7,15	1,43	-0,9	-0,4	s
25	5,9	4	-1,0	-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



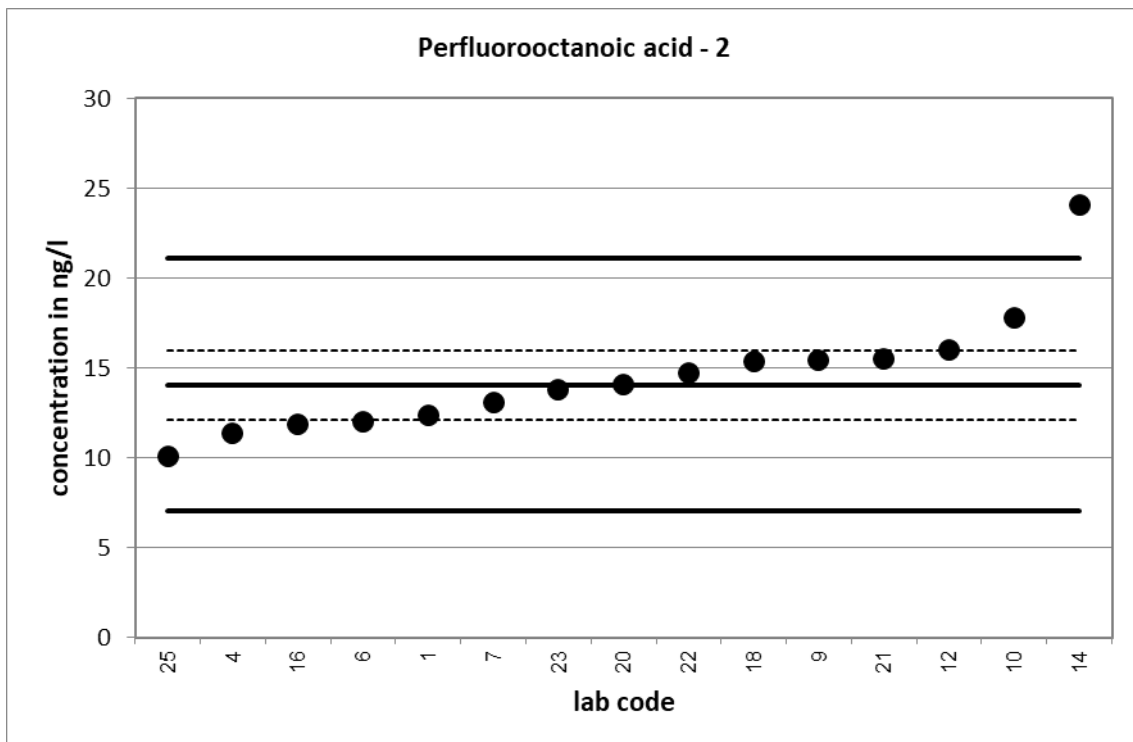


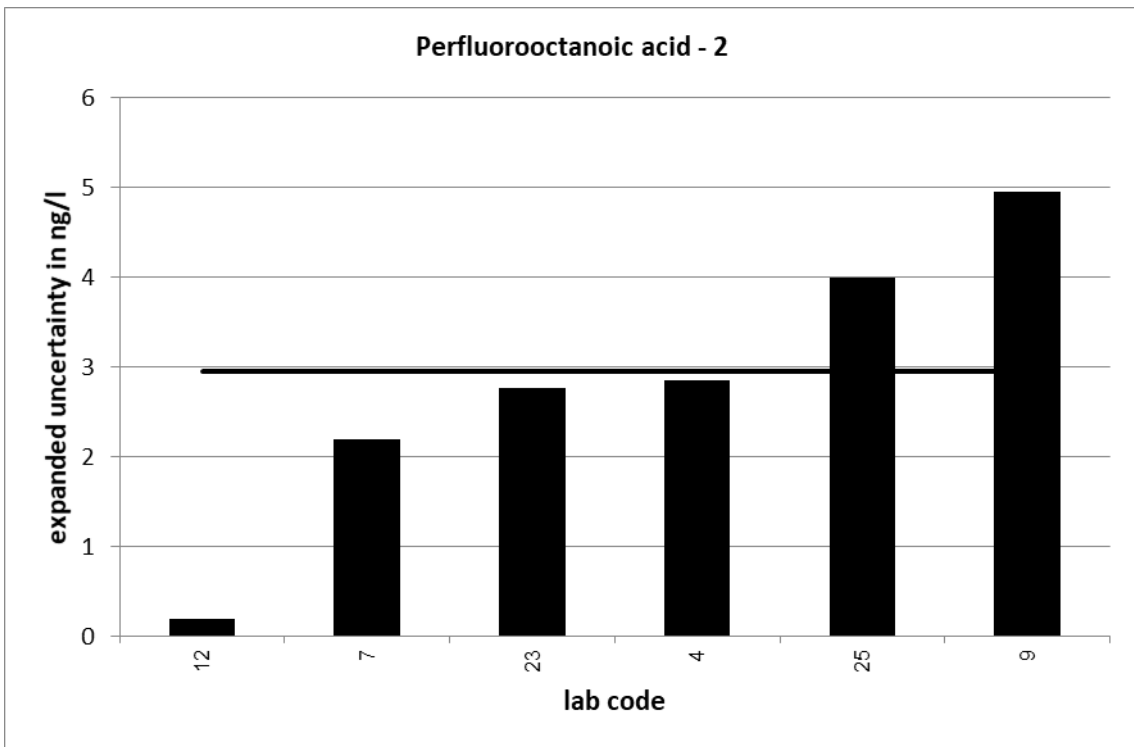
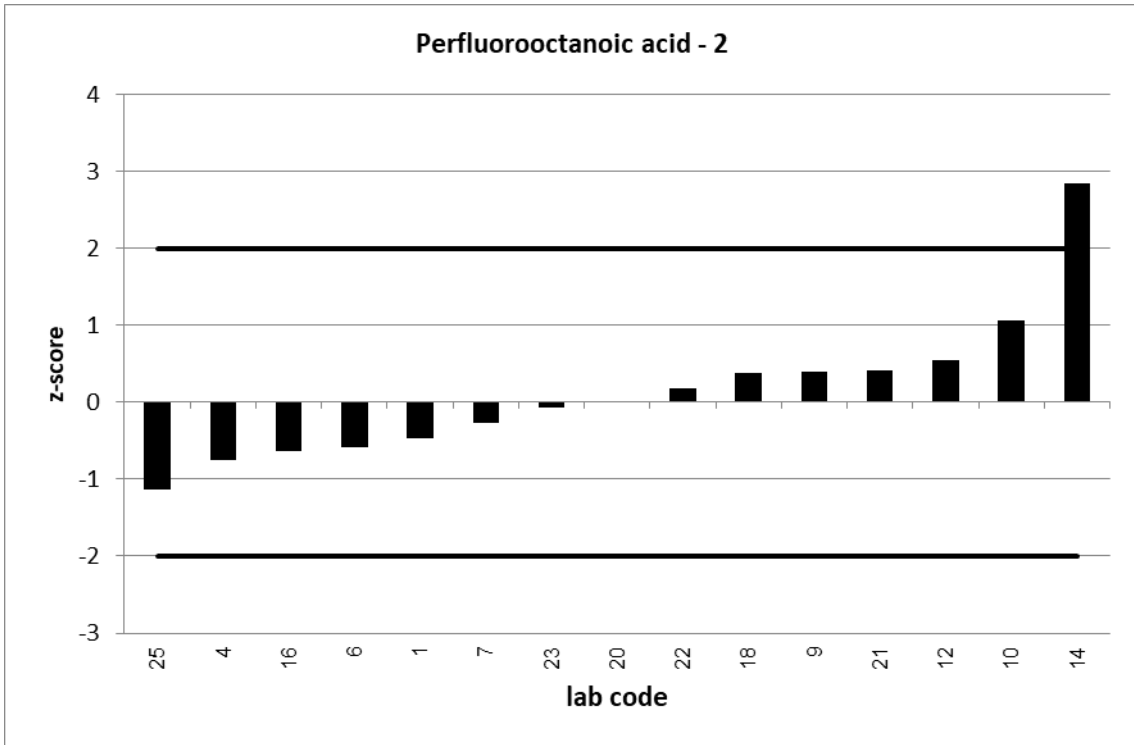


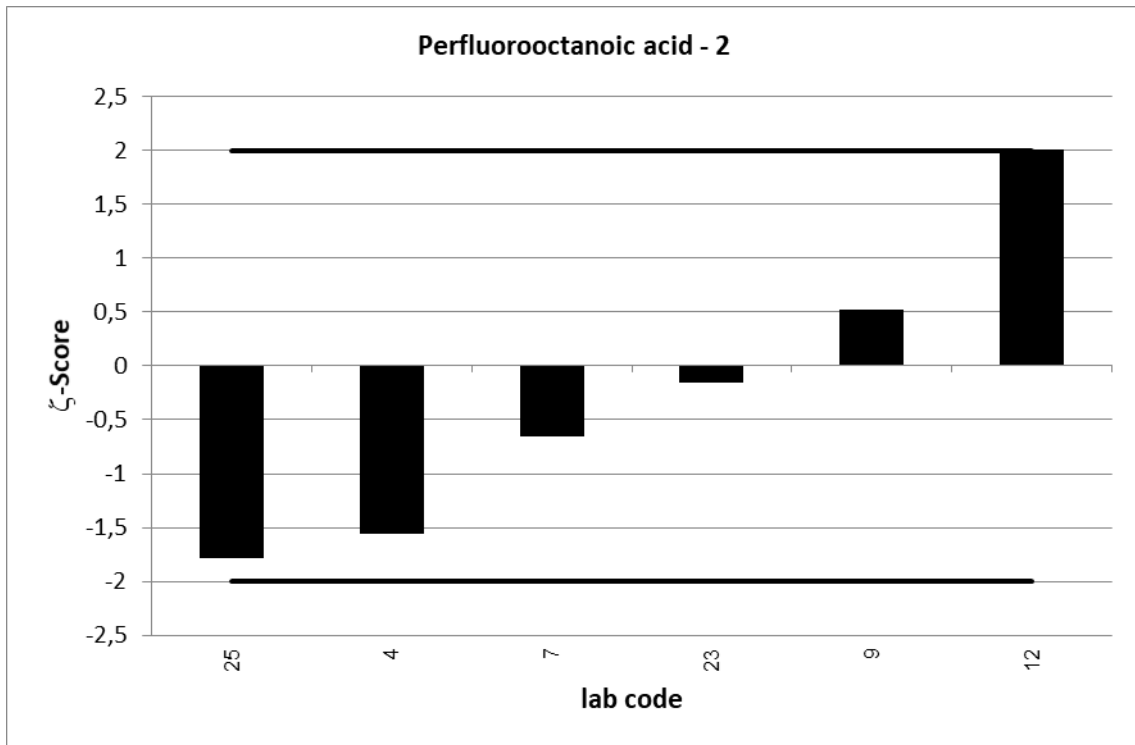
UKWIR PT 9/21		Perfluorooctanoic acid - 2			
assigned value [ng/l]*		14,06 ± 1,91			
upper tolerance limit [ng/l]		21,09			
lower tolerance limit [ng/l]		7,031			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	12,4			-0,5	s
4	11,4	2,85	-1,6	-0,8	s
6	12			-0,6	s
7	13,109	2,2	-0,7	-0,3	s
9	15,436	4,951	0,5	0,4	s
10	17,8			1,1	s
12	15,99	0,2	2,0	0,5	s
14	24,05			2,8	q
16	11,84			-0,6	s
18	15,4			0,4	s
20	14,1			0,0	s
21	15,5			0,4	s
22	14,7			0,2	s
23	13,8	2,77	-0,2	-0,1	s
25	10,1	4	-1,8	-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







UKWIR PT 9/21		Perfluorooctanoic acid - 3			
assigned value [ng/l]*		20,63 ± 2,75			
upper tolerance limit [ng/l]		30,95			
lower tolerance limit [ng/l]		10,32			
lab code	result [ng/l]	±	ζ-score	z-score	assessm.**
1	17,7			-0,6	s
4	16,9	4,23	-1,5	-0,7	s
6	17			-0,7	s
7	18,565	0,9	-1,4	-0,4	s
9	22,028	7,065	0,4	0,3	s
10	19,4			-0,2	s
12	25,26	0,2	3,4	0,9	s
14	32,88			2,4	q
16	19,9			-0,1	s
18	22,9			0,4	s
20	20,6			0,0	s
21	23,2			0,5	s
22	21,3			0,1	s
23	19	3,8	-0,7	-0,3	s
25	3,4	4	-7,1	-3,3	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

