Institute for Interlaboratory Studies

Results of Proficiency Test
Gascondensate
November 2023

Organized by: **Institute for Interlaboratory Studies**
Spijkenisse, the Netherlands

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Report: **iis23R02**

January 2024

CONTENTS

Appendices:

1   INTRODUCTION

Since 2008 the Institute for Interlaboratory Studies (iis) organizes a proficiency scheme for the analysis of Gascondensate every year. During the annual proficiency testing program of 2023 it was decided to continue the round robin for the analysis of Gascondensate.

In this interlaboratory study 29 laboratories in 14 countries registered for participation, see appendix 3 for the number of participants per country. In this report the results of the Gascondensate proficiency test are presented and discussed. This report is also electronically available through the iis website www.iisnl.com.

2   SET UP

The Institute for Interlaboratory Studies (iis) in Spijkenisse, the Netherlands, was the organizer of this proficiency test (PT). Sample analyzes for fit-for-use and homogeneity testing were subcontracted to a laboratory that has performed the tests in accordance with for ISO/IEC17043 relevant requirements of ISO/IEC17025.
It was decided to send one sample of Gascondensate in a 0.5 liter amber glass bottle labelled #23225.
The participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation.

2.1   QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, has implemented a quality system based on ISO/IEC17043:2010. This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Feedback from the participants on the reported data is encouraged and customer's satisfaction is measured on regular basis by sending out questionnaires.

2.2   PROTOCOL

The protocol followed in the organization of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of June 2018 (iis-protocol, version 3.5). This protocol is electronically available through the iis website www.iisnl.com, from the FAQ page.

2.3   CONFIDENTIALITY STATEMENT

All data presented in this report must be regarded as confidential and for use by the participating companies only. Disclosure of the information in this report is only allowed by means of the entire report. Use of the contents of this report for third parties is only allowed by written permission of the Institute for Interlaboratory Studies. Disclosure of the identity of one or more of the participating companies will be done only after receipt of a written agreement of the companies involved.

2.4 SAMPLES

A batch of approximately 40 liters of Gascondensate was selected from retain materials from earlier iis PTs on Gascondensate. After homogenization 50 amber glass bottles of 0.5 L were filled and labelled #23225.
The homogeneity of the subsamples was checked by determination of Density at 15 °C in accordance with ASTM D4052 on 8 stratified randomly selected subsamples.

	Density at 15 °C in kg/L
sample #23225-1	0.74172
sample #23225-2	0.74172
sample #23225-3	0.74172
sample #23225-4	0.74170
sample #23225-5	0.74172
sample #23225-6	0.74171
sample #23225-7	0.74169
sample #23225-8	0.74175

Table 1: homogeneity test results of subsamples #23225

From the above test results the repeatability was calculated and compared with 0.3 times the reproducibility of the reference test method in agreement with the procedure of ISO13528, Annex B2 in the next table.

	Density at 15 °C in kg/L
r (observed)	0.00005
reference test method	ASTM D4052:22
0.3 x R (reference test method)	0.00066

Table 2: evaluation of the repeatability of subsamples #23225

The calculated repeatability is in agreement with 0.3 times the reproducibility of the reference test method. Therefore, homogeneity of the subsamples was assumed.

To each of the participating laboratories one 0.5 L bottle of Gascondensate labelled #23225 was sent on October 18, 2023. An SDS was added to the sample package.

2.5 STABILITY OF THE SAMPLES

The stability of Gascondensate packed in amber glass bottles was checked. The material was found sufficiently stable for the period of the proficiency test.

2.6 ANALYZES

The participants were requested to determine: Color Saybolt, Density at 15 °C, Distillation at 760 mmHg (IBP, Temperature at 5%, 10%, 50%, 90%, 95% recovered, FBP, Distillation Residue and Loss), Methanol, Total Mercury, Total Sulfur and Water.

It was explicitly requested to treat the sample as if it was a routine sample and to report the test results using the indicated units on the report form and not to round the test results, but report as much significant figures as possible. It was also requested not to report 'less than' test results, which are above the detection limit, because such test results cannot be used for meaningful statistical evaluations.

To get comparable test results a detailed report form and a letter of instructions are prepared. On the report form the reporting units are given as well as the reference test methods (when applicable) that will be used during the evaluation. The detailed report form and the letter of instructions are both made available on the data entry portal www.kpmd.co.uk/sgs-iis/. The participating laboratories are also requested to confirm the sample receipt on this data entry portal. The letter of instructions can also be downloaded from the iis website www.iisnl.com.

3 RESULTS

During five weeks after sample dispatch, the test results of the individual laboratories were gathered via the data entry portal www.kpmd.co.uk/sgs-iis/. The reported test results are tabulated per determination in appendix 1 of this report. The laboratories are presented by their code numbers.

Directly after the deadline, a reminder was sent to those laboratories that had not reported test results at that moment. Shortly after the deadline, the available test results were screened for suspect data. A test result was called suspect in case the Huber Elimination Rule (a robust outlier test) found it to be an outlier. The laboratories that produced these suspect data were asked to check the reported test results (no reanalyzes). Additional or corrected test results are used for data analysis and the original test results are placed under 'Remarks' in the result tables in appendix 1. Test results that came in after the deadline were not taken into account in this screening for suspect data and thus these participants were not requested for checks.

3.1 STATISTICS

The protocol followed in the organization of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of June 2018 (iis-protocol, version 3.5).
For the statistical evaluation the *unrounded* (when available) figures were used instead of the rounded test results. Test results reported as '<…' or '>…' were not used in the statistical evaluation.

First, the normality of the distribution of the various data sets per determination was checked by means of the Lilliefors-test, a variant of the Kolmogorov-Smirnov test and by the calculation of skewness and kurtosis. Evaluation of the three normality indicators in combination with the visual evaluation of the graphic Kernel density plot, lead to judgement of the normality being either 'unknown', 'OK', 'suspect' or 'not OK'. After removal of outliers, this check was repeated. If a data set does not have a normal distribution, the (results of the) statistical evaluation should be used with due care.

The assigned value is determined by consensus based on the test results of the group of participants after rejection of the statistical outliers and/or suspect data.

According to ISO13528 all (original received or corrected) results per determination were submitted to outlier tests. In the iis procedure for proficiency tests, outliers are detected prior to calculation of the mean, standard deviation and reproducibility. For small data sets, Dixon (up to 20 test results) or Grubbs (up to 40 test results) outlier tests can be used. For larger data sets (above 20 test results) Rosner's outlier test can be used. Outliers are marked by D(0.01) for the Dixon's test, by G(0.01) or DG(0.01) for the Grubbs' test and by R(0.01) for the Rosner's test. Stragglers are marked by D(0.05) for the Dixon's test, by G(0.05) or DG(0.05) for the Grubbs' test and by R(0.05) for the Rosner's test. Both outliers and stragglers were not included in the calculations of averages and standard deviations.

For each assigned value the uncertainty was determined in accordance with ISO13528. Subsequently the calculated uncertainty was evaluated against the respective requirement based on the target reproducibility in accordance with ISO13528. In this PT the criterion of ISO13528, paragraph 9.2.1, was met for all evaluated tests. Therefore, the uncertainty of all assigned values may be negligible and need not be included in the PT report.

Finally, the reproducibilities were calculated from the standard deviations by multiplying them with a factor of 2.8.

3.2 GRAPHICS

In order to visualize the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported test results are plotted. The corresponding laboratory numbers are on the X-axis. The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected reference test method. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle.

Furthermore, Kernel Density Graphs were made. This is a method for producing a smooth density approximation to a set of data that avoids some problems associated with histograms. Also, a normal Gauss curve (dotted line) was projected over the Kernel Density Graph (smooth line) for reference. The Gauss curve is calculated from the consensus value and the corresponding standard deviation.

3.3　Z-SCORES

To evaluate the performance of the participating laboratories the z-scores were calculated. As it was decided to evaluate the performance of the participants in this proficiency test (PT) against the literature requirements (derived from e.g. ISO or ASTM test methods), the z-scores were calculated using a target standard deviation. This results in an evaluation independent of the variation in this interlaboratory study.

The target standard deviation was calculated from the literature reproducibility by division with 2.8. In case no literature reproducibility was available, other target values were used, like Horwitz or an estimated reproducibility based on former iis proficiency tests.

When a laboratory did use a test method with a reproducibility that is significantly different from the reproducibility of the reference test method used in this report, it is strongly advised to recalculate the z-score, while using the reproducibility of the actual test method used, this in order to evaluate whether the reported test result is fit-for-use.

The z-scores were calculated according to:

$$z_{(target)} = (\text{test result - average of PT}) / \text{target standard deviation}$$

The $z_{(target)}$ scores are listed in the test result tables in appendix 1.

Absolute values for z<2 are very common and absolute values for z>3 are very rare. Therefore, the usual interpretation of z-scores is as follows:

$$|z| < 1 \quad \text{good}$$
$$1 < |z| < 2 \quad \text{satisfactory}$$
$$2 < |z| < 3 \quad \text{questionable}$$
$$3 < |z| \quad \text{unsatisfactory}$$

4　EVALUATION

In this proficiency test some problems were encountered with the dispatch of the samples. Therefore, the reporting time on the data entry portal was extended with another week. Seven participants reported test results after the extended reporting date and two other participants did not report any test results. Not all participants were able to report all tests requested.
In total 27 participants reported 178 numerical test results. Observed were 4 outlying test results, which is 2.2%. In proficiency tests outlier percentages of 3% - 7.5% are quite normal.

All data sets proved to have a normal Gaussian distribution.

4.1   EVALUATION PER TEST

In this section the reported test results are discussed per test. The test methods which were used by the various laboratories were taken into account for explaining the observed differences when possible and applicable. These test methods are also in the tables together with the original data in appendix 1. The abbreviations, used in these tables, are explained in appendix 4.

In the iis PT reports ASTM test methods are referred to with a number (e.g. D6304) and if appropriate an indication of sub test method (e.g. D6304-A) and an added designation for the year that the test method was adopted or revised (e.g. D6304-A:20).

Color Saybolt: The group of participants had difficulty to meet the target requirements. No statistical outliers were observed. The calculated reproducibility is not in agreement with the requirements of ASTM D6045:20.

Density at 15 °C: The group of participants met the target requirements. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D4052:22.
It should be taken into account that the reproducibility from ASTM D4052:22 is applicable to petroleum distillates and viscous oils only. Therefore, no precision data are stated in the 2022 version for Gascondensate. However, Gascondensate may contain relatively high concentrations of light ends and therefore should be treated as Gasoline, i.e. cooling the sample prior to analysis to prevent loss of light ends.

Distillation at 760 mmHg: The group of participants may have had difficulty to meet the target requirements. No statistical outliers were observed over seven parameters. The calculated reproducibilities of Initial Boiling Point, 5%, 10% and 50% recovered are in agreement with the requirements of the manual mode of ASTM D86:23. The calculated reproducibilities of 90%, 95% recovered and Final Boiling Point are not in agreement with the requirements of the manual mode of ASTM D86:23.
It should be noted that the scope of ASTM D86 does not include Gascondensate, but only products with a limited boiling range like distillate fuels, so the target reproducibilities as used in this report may not be applicable. The use of a simulated distillation determination may be more appropriate.

Methanol: Only two participants reported a test result. Therefore, no statistical evaluation could be done.

Total Mercury: The precision requirements of Table B3 in test method UOP938 is approximately 6 times stricter than the Horwitz estimate. This means that these requirements will not be met easily. Furthermore, the reproducibility of UOP938 is only available for very low concentrations (0.28 and 12.14 µg/**L**) and conversion and extrapolation will lead to extra uncertainty. Therefore, it was decided to use the estimated reproducibility calculated with the Horwitz equation for evaluation of the test results.
The group of participants may have had difficulty to meet the target requirements. No statistical outliers were observed. The calculated reproducibility is not in agreement with the estimated reproducibility calculated with the Horwitz equation.

Total Sulfur: The group of participants had difficulty to meet the target requirements. No statistical outliers were observed. The calculated reproducibility is not in agreement with the requirements of ASTM D5453:19a.

Water: The group of participants met the target requirements. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is in agreement with the requirements of ASTM D6304-A:20.

4.2   PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibility as declared by the reference test method and the reproducibility as found for the group of participating laboratories. The number of significant test results, the average, the calculated reproducibility (2.8 * standard deviation) and the target reproducibility derived from reference methods are presented in the next table.

Parameter	unit	n	average	2.8 * sd	R(lit)
Color Saybolt		15	17.0	1.8	1.2
Density at 15 ˚C	kg/L	26	0.7420	0.0011	0.0022
Initial Boiling Point	°C	11	32.1	5.9	7.5
5% recovered	°C	11	57.2	5.4	6.6
10% recovered	°C	11	67.9	3.4	3.7
50% recovered	°C	11	122.5	3.0	4.8
90% recovered	°C	11	248.1	13.2	6.7
95% recovered	°C	9	289.8	19.4	12.9
Final Boiling Point	°C	11	302.3	7.5	4.1
Methanol	mg/kg	2	n.e.	n.e.	n.e.
Total Mercury	µg/kg	17	277.2	187.5	150.6
Total Sulfur	mg/kg	19	34.0	9.6	8.2
Water	mg/kg	22	40.1	21.9	31.6

Table 3: reproducibilities of tests on sample #23225

Without further statistical calculations it can be concluded that for some tests there is a good compliance of the group of participants with the reference test methods. The problematic tests have been discussed in paragraph 4.1.

4.3   COMPARISON OF THE PROFICIENCY TEST OF NOVEMBER 2023 WITH PREVIOUS PTS

	November 2023	November 2022	November 2021	November 2020	November 2019
Number of reporting laboratories	27	31	35	33	32
Number of test results	178	204	257	229	236
Number of statistical outliers	4	7	14	10	15
Percentage of statistical outliers	2.2%	3.4%	5.4%	4.4%	6.4%

Table 4: comparison with previous proficiency tests

In proficiency tests outlier percentages of 3% - 7.5% are quite normal.

The performance of the determinations of the proficiency tests was compared to the requirements of the reference test methods. The conclusions are given in the following table.

Determination	November 2023	November 2022	November 2021	November 2020	November 2019
Color Saybolt	-	-	-	-	--
Density at 15 °C	+	+	+	++	+
Distillation at 760 mmHg	+/-	+/-	+/-	-	-
Methanol	n.e.	n.e.	(--)	n.e.	n.e.
Total Mercury	-	+/-	+	-	+/-
Total Sulfur	-	-	+	-	-
Water	+	+	+/-	++	++

Table 5: comparison determinations to the reference test methods

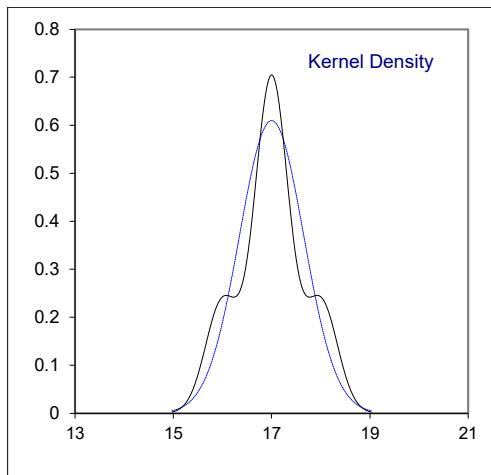For results between brackets no z-scores are calculated.
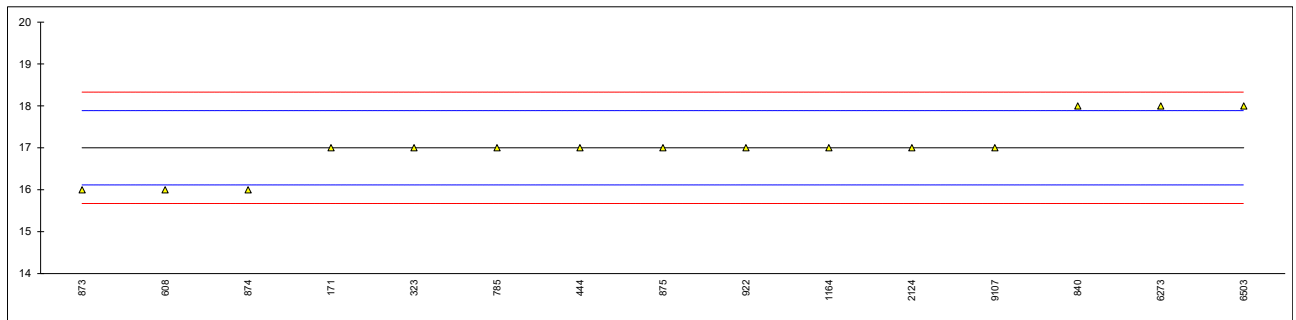
The following performance categories were used:
- ++   : group performed much better than the reference test method
- +   : group performed better than the reference test method
- +/-   : group performance equals the reference test method
- -   : group performed worse than the reference test method
- --   : group performed much worse than the reference test method
- n.e. : not evaluated

APPENDIX 1

Determination of Color Saybolt on sample #23225;

lab	method	value	mark	z(targ)	remarks
140	D6045	>30	C	>29.35	first reported 0.2, possibly a false positive test result?
171	D6045	17		0.00	
311		-----		-----	
323	D6045	17		0.00	
442		-----		-----	
444	D6045	17		0.00	
600		-----		-----	
608	D156	16		-2.26	
609		-----		-----	
657		-----		-----	
785	D6045	17		0.00	
840	D6045	18.0		2.26	
873	D6045	16		-2.26	
874	D6045	16		-2.26	
875	D6045	17		0.00	
922	D6045	17		0.00	
1164	D6045	17		0.00	
1696		-----		-----	
1815		-----		-----	
1957		-----		-----	
1960		-----		-----	
2124	D156	17		0.00	
6087		-----		-----	
6273	D6045	18		2.26	
6447		-----		-----	
6486		-----		-----	
6503	D6045	18		2.26	
9061		-----		-----	
9107	D156	17		0.00	

normality	OK
n	15
outliers	0
mean (n)	17.00
st.dev. (n)	0.655
R(calc.)	1.83
st.dev.(D6045:20)	0.443
R(D6045:20)	1.24

Kernel Density

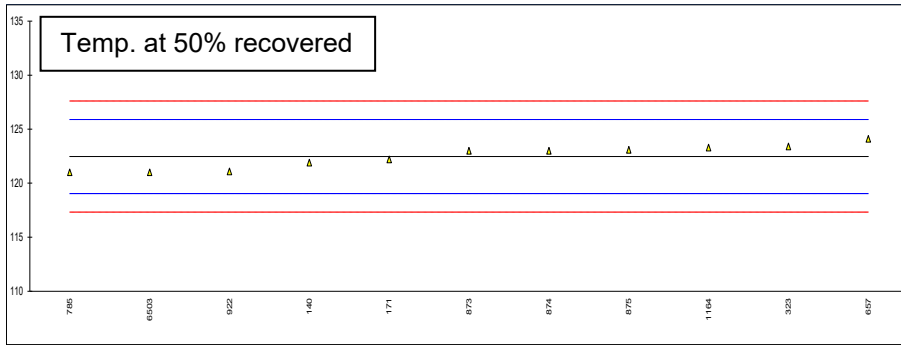## Determination of Density at 15 °C on sample #23225; results in kg/L

lab	method	value	mark	z(targ)	remarks
140	D4052	0.7429		1.10	
171	D4052	0.7450	R(0.01)	3.77	
311	D4052	0.7419		-0.18	
323	D4052	0.7417		-0.43	
442	IP365	0.7415		-0.68	
444	D4052	0.7417		-0.43	
600	D4052	0.7420		-0.05	
608	D4052	0.7430		1.22	
609	D4052	0.7420		-0.05	
657	D4052	0.7419		-0.18	
785	D4052	0.7416		-0.56	
840	D4052	0.74174		-0.38	
873	D4052	0.7417		-0.43	
874	D4052	0.7416		-0.56	
875	D4052	0.7418		-0.30	
922	D4052	0.7420		-0.05	
1164	D4052	0.74237		0.42	
1696		-----		-----	
1815	ISO12185	0.74205		0.02	
1957	D4052	0.74196		-0.10	
1960		-----		-----	
2124	D4052	0.7425		0.59	
6087	D4052	0.741812		-0.29	
6273	D4052	0.7426		0.71	
6447	D4052	0.74243		0.50	
6486	D4052	0.742475		0.56	
6503	D4052	0.7421		0.08	
9061	D4052	0.741745		-0.37	
9107	D4052	0.74191		-0.16	

normality	OK
n	26
outliers	1
mean (n)	0.74204
st.dev. (n)	0.000401
R(calc.)	0.00112
st.dev.(D4052:22)	0.000786
R(D4052:22)	0.00220
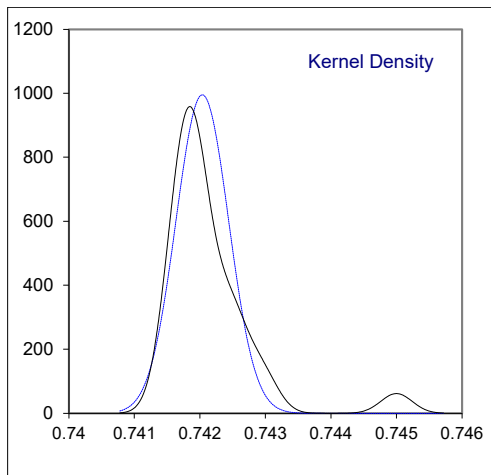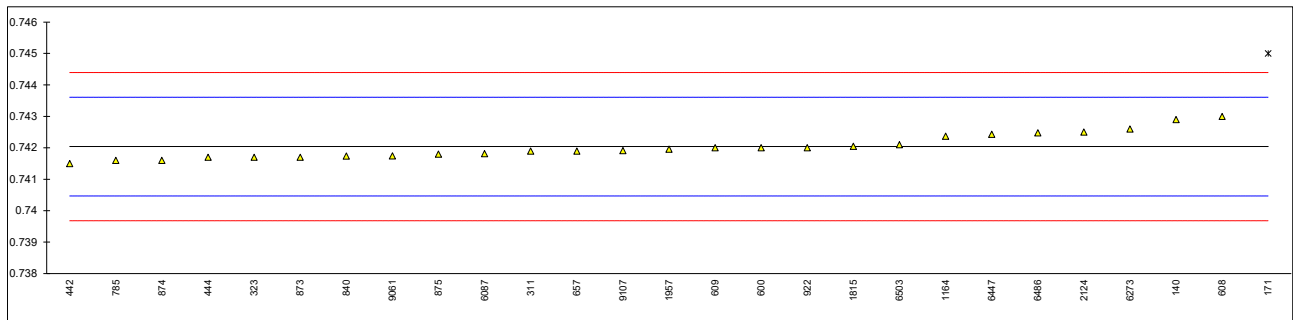
Determination of Distillation at 760 mmHg on sample #23225; results in °C

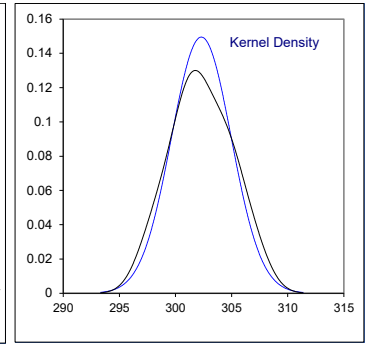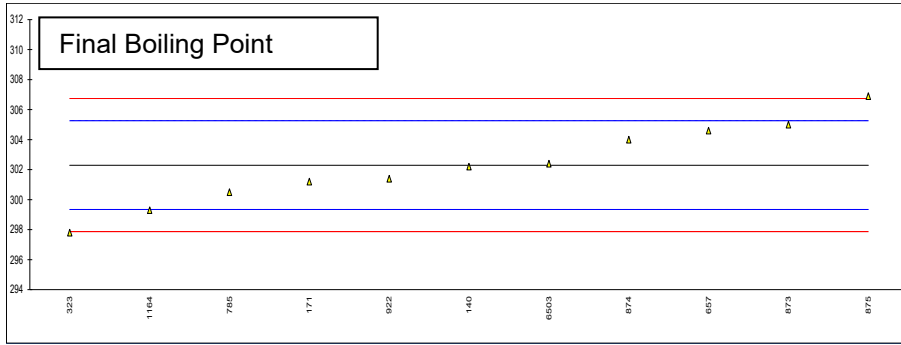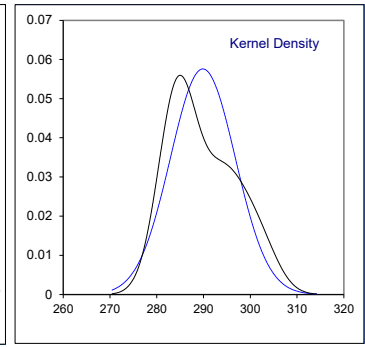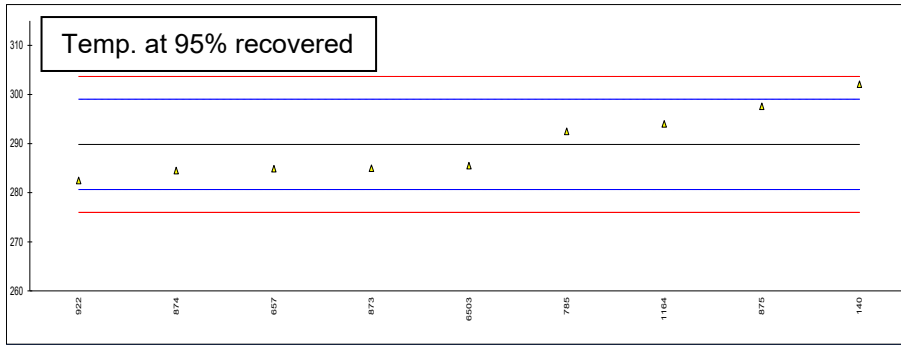| lab	method	IBP	5% rec	10% rec	50% rec	90% rec	95% rec	FBP	residue (%V/V)	loss (%V/V)
140	D86-automated	29.9	57.2	68.3	121.9	247.0	302.1	302.2	1.3	3.7
171	D86-automated	27.5	54.1	66.1	122.2	249.4	-----	301.2	-----	-----
311		-----	-----	-----	-----	-----	-----	-----	-----	-----
323	D86-automated	33.4	58.6	69.2	123.4	252.7	-----	297.8	1.3	5.8
442		-----	-----	-----	-----	-----	-----	-----	-----	-----
444		-----	-----	-----	-----	-----	-----	-----	-----	-----
600		-----	-----	-----	-----	-----	-----	-----	-----	-----
608		-----	-----	-----	-----	-----	-----	-----	-----	-----
609		-----	-----	-----	-----	-----	-----	-----	-----	-----
657	D86-automated	31.2	59.2	69.8	124.1	244.6	284.9	304.6 C	1.8	1.5
785	D86-manual	33.0	56.0	67.0	121.0	248.0	292.5	300.5	1.5	0.7
840		-----	-----	-----	-----	-----	-----	-----	-----	-----
873	D86-manual	33.0	58.0	68.0	123.0	250.0	285.0	305.0	1.5	0.7
874	D86-manual	34.0	58.0	68.0	123.0	250.5	284.5	304.0	1.5	0.5
875	D86-automated	34.5	60.3	68.5	123.1	257.0	297.6	306.9	97.5	0.8
922	D86-automated	30.5	54.9	66.3	121.1	241.0	282.5	301.4	1.3	2.9
1164	D86-automated	33.5	57.8	68.8	123.3	247.5	294.0	299.3	3	1.2
1696		-----	-----	-----	-----	-----	-----	-----	-----	-----
1815		-----	-----	-----	-----	-----	-----	-----	-----	-----
1957		-----	-----	-----	-----	-----	-----	-----	-----	-----
1960		-----	-----	-----	-----	-----	-----	-----	-----	-----
2124		-----	-----	-----	-----	-----	-----	-----	-----	-----
6087		-----	-----	-----	-----	-----	-----	-----	-----	-----
6273		-----	-----	-----	-----	-----	-----	-----	-----	-----
6447		-----	-----	-----	-----	-----	-----	-----	-----	-----
6486		-----	-----	-----	-----	-----	-----	-----	-----	-----
6503	D86-automated	32.1	55.4	66.6	121.0	241.3	285.5	302.4	1.3	0.03
9061		-----	-----	-----	-----	-----	-----	-----	-----	-----
9107		-----	-----	-----	-----	-----	-----	-----	-----	-----
	normality	OK	OK	OK	OK	OK	OK	OK		
	n	11	11	11	11	11	9	11		
	outliers	0	0	0	0	0	0	0		
	mean (n)	32.05	57.23	67.87	122.46	248.09	289.84	302.30		
	st.dev. (n)	2.097	1.918	1.222	1.085	4.711	6.928	2.668		
	R(calc.)	5.87	5.37	3.42	3.04	13.19	19.40	7.47		
	st.dev.(D86-M:23)	2.672	2.344	1.331	1.713	2.410	4.609	1.481		
	R(D86-M:23)	7.48	6.56	3.73	4.80	6.75	12.91	4.15		
	compare									
	R(D86-A:23)	1.76	1.72	1.49	3.0	3.72	6.15	7.1		

Lab 657 first reported 307.8

Initial Boiling Point — Kernel Density

Temp. at 5% recovered — Kernel Density

Temp. at 10% recovered — Kernel Density

Temp. at 50% recovered — Kernel Density

Temp. at 90% recovered — Kernel Density

Temp. at 95% recovered

Kernel Density

Final Boiling Point

Kernel Density
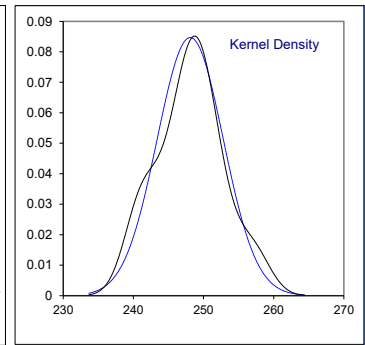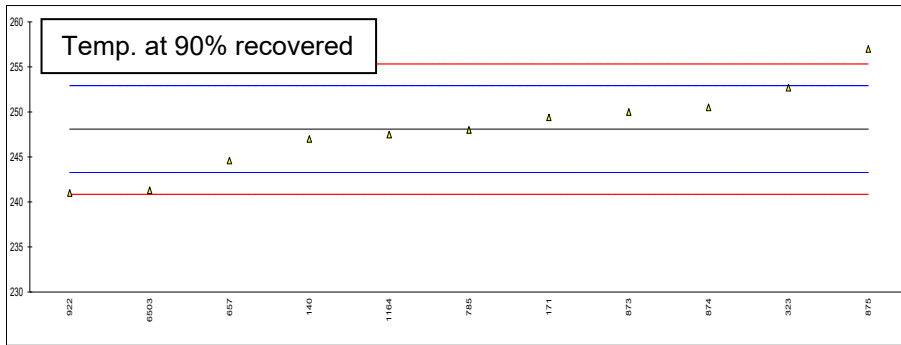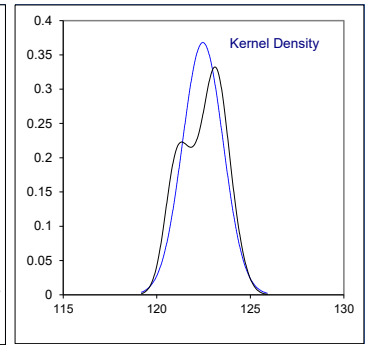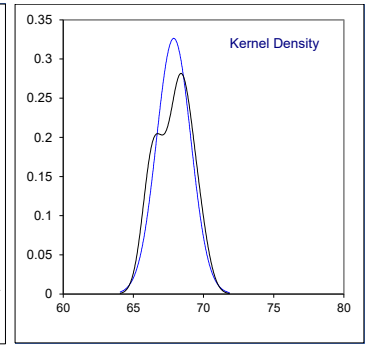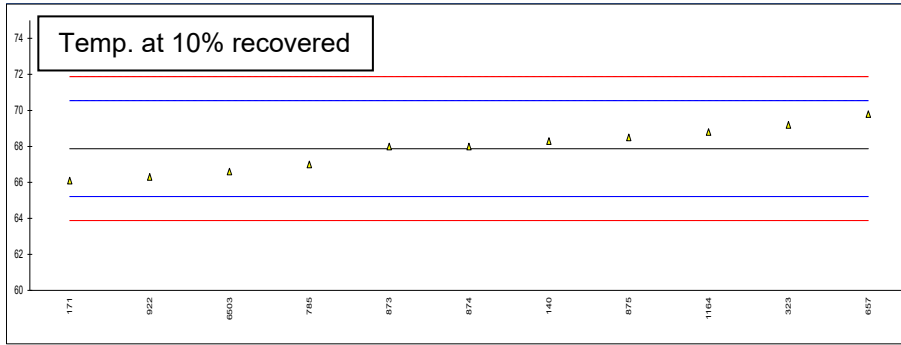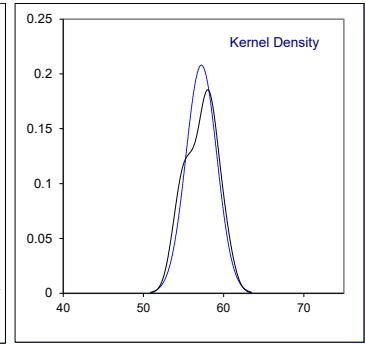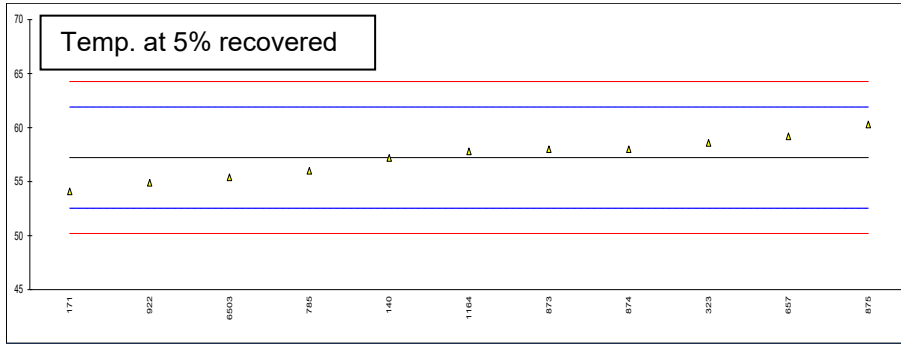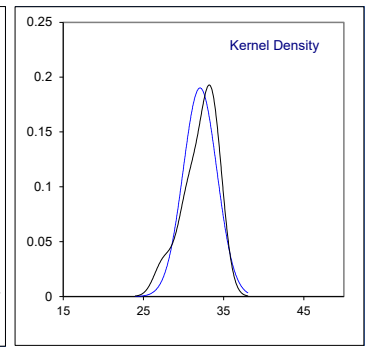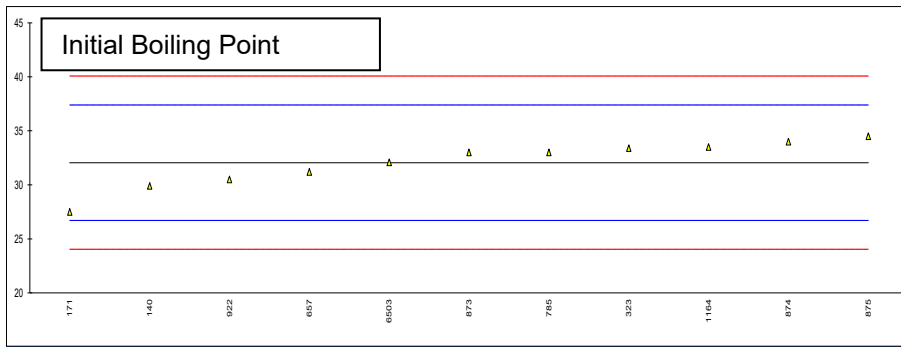
Determination of Methanol on sample #23225; results in mg/kg

lab	method	value	mark	z(targ)	remarks
140		-----		-----	
171		-----		-----	
311		-----		-----	
323	INH-304	15		-----	
442		-----		-----	
444		-----		-----	
600		-----		-----	
608		-----		-----	
609		-----		-----	
657	INH-0130	28.5		-----	
785		-----		-----	
840		-----		-----	
873		-----		-----	
874		-----		-----	
875		-----		-----	
922		-----		-----	
1164		-----		-----	
1696		-----		-----	
1815		-----		-----	
1957		-----		-----	
1960		-----		-----	
2124		-----		-----	
6087		-----		-----	
6273		-----		-----	
6447		-----		-----	
6486		-----		-----	
6503		-----		-----	
9061		-----		-----	
9107		-----		-----	

Determination of Total Mercury on sample #23225; results in µg/kg

lab	method	value	mark	z(targ)	remarks
140		-----		-----	
171	UOP938	185		-1.71	
311	UOP938	355		1.45	
323	UOP938	341		1.19	
442		-----		-----	
444	UOP938	149.55		-2.37	
600	D7622	219		-1.08	
608		-----		-----	
609	D7622	316.6		0.73	
657	UOP938	358		1.50	
785		-----		-----	
840	UOP938	267.29		-0.18	
873	UOP938	309		0.59	
874	UOP938	307		0.55	
875		-----		-----	
922	UOP938	366		1.65	
1164		-----		-----	
1696		-----		-----	
1815		-----		-----	
1957	UOP938	228.925		-0.90	
1960		-----		-----	
2124	In house	266.24		-0.20	
6087	UOP938	214.4748		-1.17	
6273	UOP938	224		-0.99	
6447		-----		-----	
6486	D7622	352.68125		1.40	
6503	UOP938	252.7		-0.46	
9061		-----		-----	
9107		-----		-----	

normality	OK
n	17
outliers	0
mean (n)	277.204
st.dev. (n)	66.9808
R(calc.)	187.546
st.dev.(Horwitz)	53.8005
R(Horwitz)	150.641
compare	
R(UOP938:20)	26.031
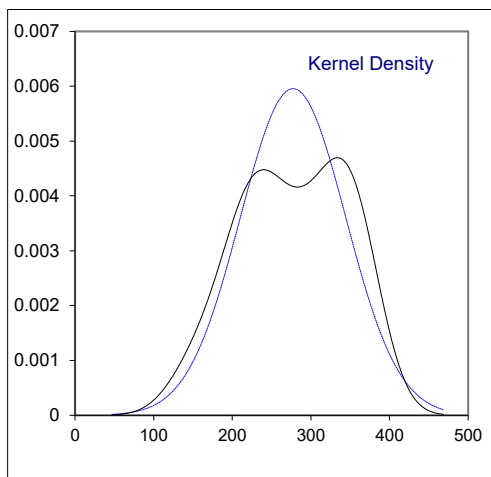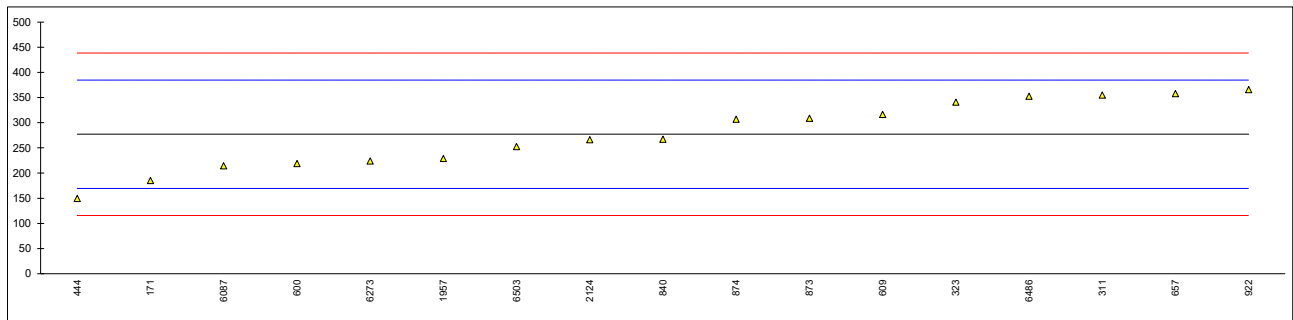
Determination of Total Sulfur on sample #23225; results in mg/kg

lab	method	value	mark	z(targ)	remarks
140	D5453	35.97		0.67	
171	D5453	36		0.68	
311		-----		-----	
323	D5453	33		-0.35	
442		-----		-----	
444	D5453	38.482		1.53	
600		-----		-----	
608	D5453	31		-1.03	
609		-----		-----	
657	D5453	34.7		0.23	
785	D4294	41		2.40	
840	D5453	31.5		-0.86	
873	ISO20846	36.5		0.85	
874	ISO20846	36.0		0.68	
875	ISO20846	37.0		1.02	
922	D4294	33		-0.35	
1164	D5453	31.03		-1.02	
1696		-----		-----	
1815	D5453	34.9		0.30	
1957		-----		-----	
1960		-----		-----	
2124	D5453	33		-0.35	
6087	D5453	28.9318		-1.74	
6273		-----		-----	
6447	D5453	36.3		0.78	
6486	D5453	30.4681		-1.22	
6503	D5453	27.5		-2.23	
9061		-----		-----	
9107		-----		-----	

normality	OK
n	19
outliers	0
mean (n)	34.015
st.dev. (n)	3.4180
R(calc.)	9.570
st.dev.(D5453:19a)	2.9161
R(D5453:19a)	8.165
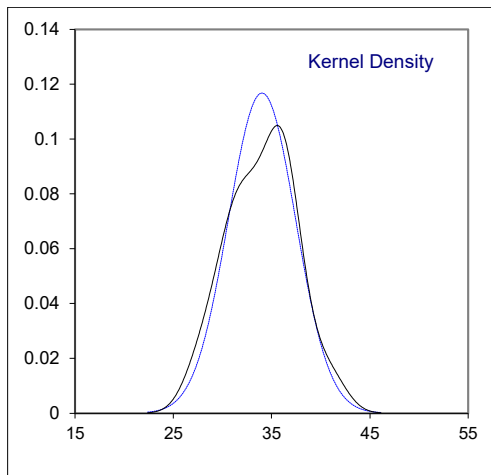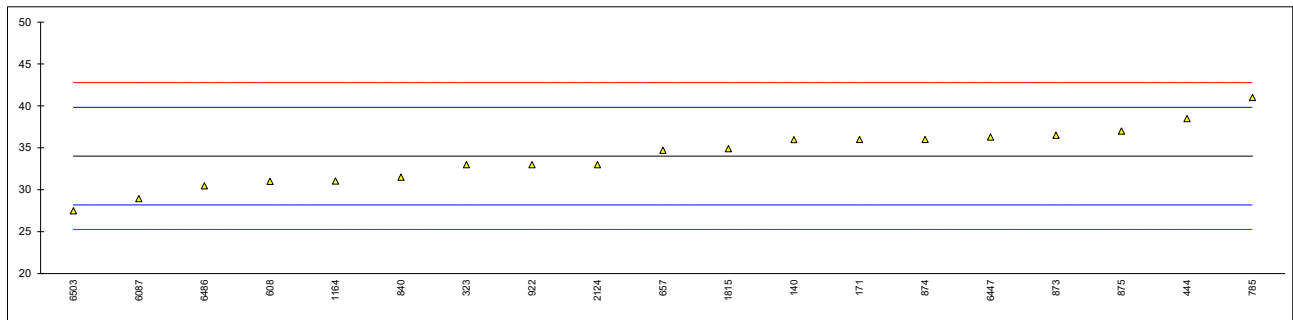
Determination of Water on sample #23225; results in mg/kg

lab	method	value	mark	z(targ)	remarks
140	D4928	73	G(0.05)	2.91	
171	D6304-A:20	41		0.08	
311		-----		-----	
323	D1064	28		-1.08	
442	IP438	33		-0.63	
444	D6304-A:20	36		-0.37	
600	D6304-A:20	34.2		-0.53	
608	D6304-A:20	44		0.34	
609	D4928	49.16		0.80	
657	D6304-A:20	51.6		1.02	
785	D6304-A:20	30		-0.90	
840	D6304-A:20	34.5		-0.50	
873	D6304	48		0.70	
874	D6304-A	47		0.61	
875	D6304-A	35		-0.46	
922	D6304-A:20	41		0.08	
1164	D6304-A:20	38		-0.19	
1696		-----		-----	
1815	ISO12937	32.63		-0.67	
1957	D4928	40.3		0.01	
1960		-----		-----	
2124		-----	W	-----	test result withdrawn, reported 0.145%M/M
6087	D4928	46.75		0.59	
6273	D6304-A:20	58		1.58	
6447		-----		-----	
6486		-----		-----	
6503	D6304-A:16e1	42.42		0.20	
9061	D4928	30		-0.90	
9107	D6304	42.5		0.21	

normality	OK
n	22
outliers	1
mean (n)	40.139
st.dev. (n)	7.8285
R(calc.)	21.920
st.dev.(D6304-A:20)	11.2893
R(D6304-A:20)	31.610
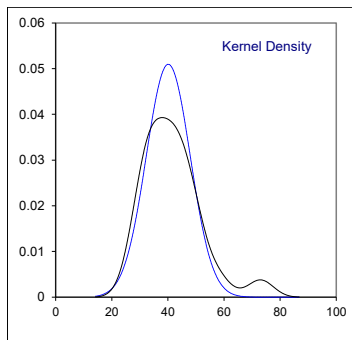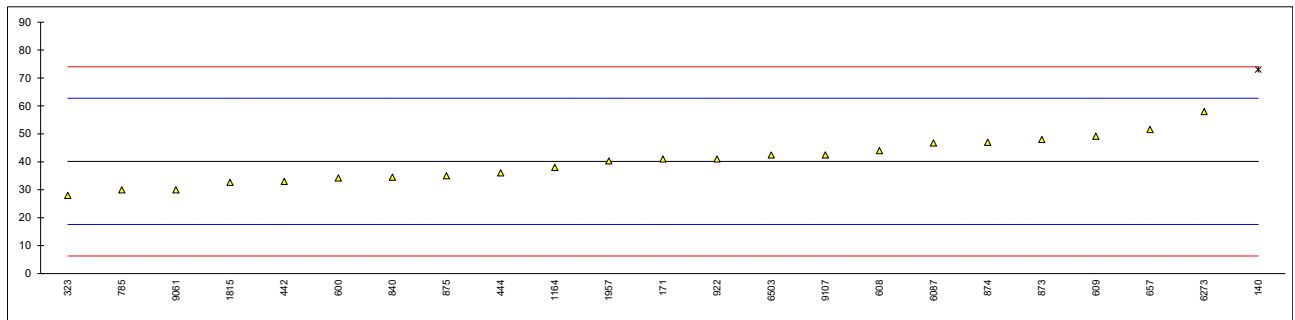
APPENDIX 2

z-scores of Determination of Distillation at 760 mmHg

lab	IBP	5% rec	10% rec	50% rec	90% rec	95% rec	FBP
140	-0.81	-0.01	0.32	-0.33	-0.45	2.66	-0.07
171	-1.70	-1.33	-1.33	-0.15	0.54	-----	-0.74
311	-----	-----	-----	-----	-----	-----	-----
323	0.50	0.59	1.00	0.55	1.91	-----	-3.04
442	-----	-----	-----	-----	-----	-----	-----
444	-----	-----	-----	-----	-----	-----	-----
600	-----	-----	-----	-----	-----	-----	-----
608	-----	-----	-----	-----	-----	-----	-----
609	-----	-----	-----	-----	-----	-----	-----
657	-0.32	0.84	1.45	0.96	-1.45	-1.07	1.55
785	0.35	-0.52	-0.66	-0.85	-0.04	0.58	-1.22
840	-----	-----	-----	-----	-----	-----	-----
873	0.35	0.33	0.10	0.31	0.79	-1.05	1.82
874	0.73	0.33	0.10	0.31	1.00	-1.16	1.15
875	0.92	1.31	0.47	0.37	3.70	1.68	3.11
922	-0.58	-0.99	-1.18	-0.80	-2.94	-1.59	-0.61
1164	0.54	0.24	0.70	0.49	-0.25	0.90	-2.03
1696	-----	-----	-----	-----	-----	-----	-----
1815	-----	-----	-----	-----	-----	-----	-----
1957	-----	-----	-----	-----	-----	-----	-----
1960	-----	-----	-----	-----	-----	-----	-----
2124	-----	-----	-----	-----	-----	-----	-----
6087	-----	-----	-----	-----	-----	-----	-----
6273	-----	-----	-----	-----	-----	-----	-----
6447	-----	-----	-----	-----	-----	-----	-----
6486	-----	-----	-----	-----	-----	-----	-----
6503	0.02	-0.78	-0.96	-0.85	-2.82	-0.94	0.07
9061	-----	-----	-----	-----	-----	-----	-----
9107	-----	-----	-----	-----	-----	-----	-----

APPENDIX 3

Number of participants per country

4 labs in	AUSTRALIA
1 lab in	BELGIUM
1 lab in	INDONESIA
6 labs in	MALAYSIA
2 labs in	NETHERLANDS
2 labs in	NORWAY
1 lab in	PAKISTAN
1 lab in	POLAND
4 labs in	RUSSIAN FEDERATION
1 lab in	SINGAPORE
1 lab in	UNITED ARAB EMIRATES
2 labs in	UNITED KINGDOM
2 labs in	UNITED STATES OF AMERICA
1 lab in	VIETNAM

APPENDIX 4

Abbreviations

C	= final test result after checking of first reported suspect test result
D(0.01)	= outlier in Dixon's outlier test
D(0.05)	= straggler in Dixon's outlier test
G(0.01)	= outlier in Grubbs' outlier test
G(0.05)	= straggler in Grubbs' outlier test
DG(0.01)	= outlier in Double Grubbs' outlier test
DG(0.05)	= straggler in Double Grubbs' outlier test
R(0.01)	= outlier in Rosner's outlier test
R(0.05)	= straggler in Rosner's outlier test
E	= calculation difference between reported test result and result calculated by iis
W	= test result withdrawn on request of participant
ex	= test result excluded from statistical evaluation
n.a.	= not applicable
n.e.	= not evaluated
n.d.	= not detected
fr.	= first reported
f+?	= possibly a false positive test result?
f-?	= possibly a false negative test result?
SDS	= Safety Data Sheet

Literature

1   iis Interlaboratory Studies, Protocol for the Organisation, Statistics & Evaluation, June 2018
2   ISO5725:86
3   ISO5725 parts 1-6:94
4   ISO13528:05
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7   P.L. Davies, Fr. Z. Anal. Chem, 331, 513, (1988)
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9   Analytical Methods Committee, Technical Brief, No 4, January 2001
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11   W. Horwitz and R. Albert, J. AOAC Int, 79.3, 589-621, (1996)
12   Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, Technometrics, 25(2), 165-172, (1983)

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