Results of Proficiency Test
Mono Propylene glycol (MPG)
October 2023

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

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CONTENTS

Appendices:

1   INTRODUCTION

Since 2004 the Institute for Interlaboratory Studies (iis) organizes a proficiency scheme for the analysis of Mono Propylene glycol (MPG) based on the latest version of ASTM E202 once every two years. During the annual proficiency testing program of 2023 it was decided to continue the round robin for the analysis of Mono Propylene glycol.

In this interlaboratory study 22 laboratories in 14 countries registered for participation, see appendix 2 for the number of participants per country. In this report the results of the Mono Propylene glycol 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 MPG in a 0.5 liter glass bottle labelled #23195.
The participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation.

2.1   ACCREDITATION

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, is accredited in agreement with ISO/IEC17043:2010 (R007), since January 2000, by the Dutch Accreditation Council (Raad voor Accreditatie). This PT falls under the accredited scope. 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 25 liters of MPG was obtained from a local supplier. After homogenization 35 amber glass bottles of 0.5 L were filled and labelled #23195.
The homogeneity of the subsamples was checked by determination of Density at 20 °C in accordance with ASTM D4052 on 8 stratified randomly selected subsamples.

	Density at 20 °C in kg/L
sample #23195-1	1.03609
sample #23195-2	1.03611
sample #23195-3	1.03611
sample #23195-4	1.03611
sample #23195-5	1.03611
sample #23195-6	1.03612
sample #23195-7	1.03612
sample #23195-8	1.03615

Table 1: homogeneity test results of subsamples #23195

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 20 °C in kg/L
r (observed)	0.00005
reference test method	ISO12185:96
0.3 x R (reference test method)	0.00015

Table 2: evaluation of the repeatabilities of subsamples #23195

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 MPG labelled #23195 was sent on September 20, 2023. An SDS was added to the sample package.

2.5 STABILITY OF THE SAMPLES

The stability of Mono Propylene glycol (MPG) 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: Acidity as Acetic Acid, Appearance, Inorganic Chloride as Cl, Color Pt/Co, Density at 20 °C, Distillation (IBP, 50% recovered, Dry Point), Iron as Fe, Purity by GC as received, Dipropylene glycol, Specific Gravity 20/20 °C 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:

$$
\begin{array}{rll}
& |z| < 1 & \text{good} \\
1 < & |z| < 2 & \text{satisfactory} \\
2 < & |z| < 3 & \text{questionable} \\
3 < & |z| & \text{unsatisfactory}
\end{array}
$$

4 EVALUATION

In this proficiency test some problems were encountered with the dispatch of the samples. All participants reported test results, only two participants reported test results after the final reporting date. Not all participants were able to report all tests requested.
In total 22 participants reported 209 numerical test results. Observed were 10 outlying test results, which is 4.8%. In proficiency tests outlier percentages of 3% - 7.5% are quite normal.

Not all data sets proved to have a normal Gaussian distribution. These are referred to as "not OK" or "suspect". The statistical evaluation of these data sets should be used with due care, see also paragraph 3.1.

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 3.

In the iis PT reports ASTM test methods are referred to with a number (e.g. D1613) and an added designation for the year that the test method was adopted or revised (e.g. D1613:17). When a method has been reapproved an "R" will be added and the year of approval (e.g. D1613:17R23).

Acidity as Acetic Acid: The group of participants met the target requirements. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D1613:17R23.

Appearance: All reporting participants agreed about the appearance of the sample as Pass (Clear & Bright).

Inorganic Chloride as Cl: Almost all reporting participants agreed on a value of <0.5 mg/kg. Therefore, no z-scores are calculated.

Color Pt/Co: The group of participants met the target requirements. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D1209:05R19 and ASTM D5386:16.

Density at 20 °C: 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 ISO12185:96.

Distillation: The group of participants met the target requirements. No statistical outliers were observed over three distillation parameters. All three calculated reproducibilities are in agreement with the requirements of ASTM D1078:11R19 automated and manual modes.

Iron: 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 E394:22.

Purity by GC as received: The group of participants met the target requirements. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements ASTM E202:18.

Dipropylene glycol: The group of participants met the target requirements. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements ASTM E202:18.

Specific Gravity 20/20 °C: 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 E202:18.

Water: The group of participants had difficulty to meet the target requirements. Five statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM E1064:23.

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)
Acidity as Acetic Acid	%M/M	17	0.0006	0.0007	0.0014
Appearance		21	Pass (Cl&Br)	n.a.	n.a.
Inorganic Chloride as Cl	mg/kg	11	<0.5	n.e.	n.e.
Color Pt/Co		19	2.3	3.4	7
Density at 20 °C	kg/L	20	1.0361	0.0002	0.0005
Initial Boiling Point	°C	15	186.7	1.1	2.9
50% recovered	°C	14	187.4	0.7	1.3
Dry Point	°C	15	187.9	1.1	2.0
Iron as Fe	mg/kg	19	0.11	0.05	0.03
Purity by GC as received	%M/M	20	99.936	0.069	0.17
Dipropylene glycol	%M/M	18	0.037	0.035	0.14
Specific Gravity 20/20 °C		19	1.0380	0.0001	0.0005
Water	mg/kg	17	246	75	39

Table 3: reproducibilities of tests on sample #23195

Without further statistical calculations it can be concluded that for many 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 OCTOBER 2023 WITH PREVIOUS PTS

	October 2023	October 2021	October 2019	October 2017	October 2015
Number of reporting labs	22	23	22	21	23
Number of test results	209	191	181	177	207
Number of statistical outliers	10	8	4	2	4
Percentage of statistical outliers	4.8%	4.2%	2.2%	1.1%	1.9%

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 the following table.

	October 2023	October 2021	October 2019	October 2017	October 2015
Acidity as Acetic Acid	+	+	+	+	+
Inorganic Chloride as Cl	n.e.	+/-	n.e.	--	+
Color Pt/Co	++	++	++	++	++
Density at 20°C	++	+	+	+/-	+
Initial Boiling Point	++	++	++	--	--
50% recovered	+	++	+	--	--
Dry Point	+	++	+	++	++
Iron as Fe	-	(--)	+	(--)	+
Purity by GC as received	++	-	++	(--)	++
Dipropylene glycol	++	++	++	++	++
Specific Gravity 20/20°C	++	++	+	+/-	+
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 Acidity as Acetic Acid on sample #23195; results in %M/M

lab	method	value	mark	z(targ)	remarks
120	D1613	0.0010		0.86	
169	D1613	0.00093		0.72	
171	D1613	0.0006	C	0.06	reported 6 %M/M
173	D1613	0.00058		0.02	
174	D1613	0.00058		0.02	
315	D1613	0.0005		-0.14	
323	D1613	0.0006		0.06	
334	D1613	0.0016	G(0.05)	2.06	
343	INH-2196	0.0004		-0.34	
347		-----		-----	
444	D1613	0.0002		-0.74	
446		-----		-----	
551	D1613	0.0005		-0.14	
663	D1613	0.00033		-0.48	
823	D1613	0.0009		0.66	
913	D1613	0.0003	C	-0.54	reported 3 %M/M
1016	D1613	0.002103	DG(0.05)	3.06	
1158	D1613	0.0016	DG(0.05)	2.06	
1509	D1613	0.0008		0.46	
1603	In house	0.00014		-0.86	
1823	D1613	0.00057		0.00	
6507	E2679	0.00080		0.46	

normality	OK	
n	17	
outliers	3	
mean (n)	0.000572	
st.dev. (n)	0.0002527	
R(calc.)	0.000708	
st.dev.(D1613:17R23)	0.0005000	
R(D1613:17R23)	0.0014	

Kernel Density
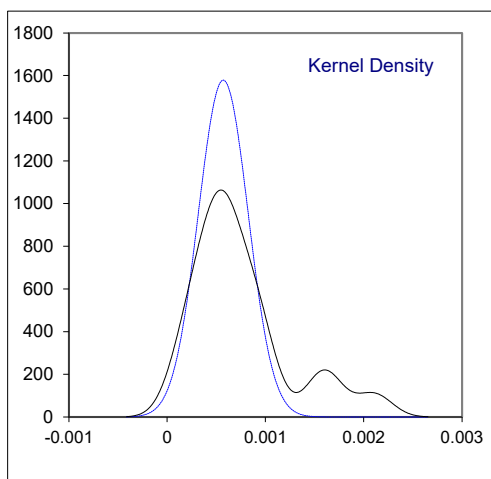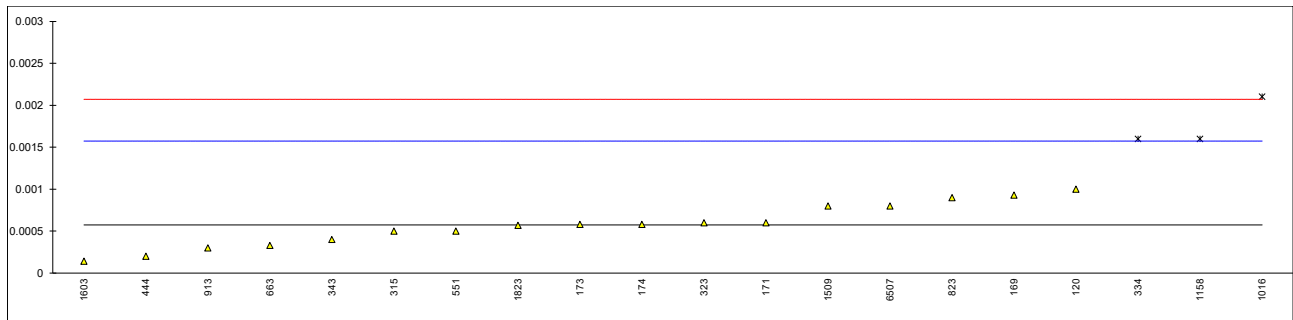
Determination of Appearance on sample #23195;

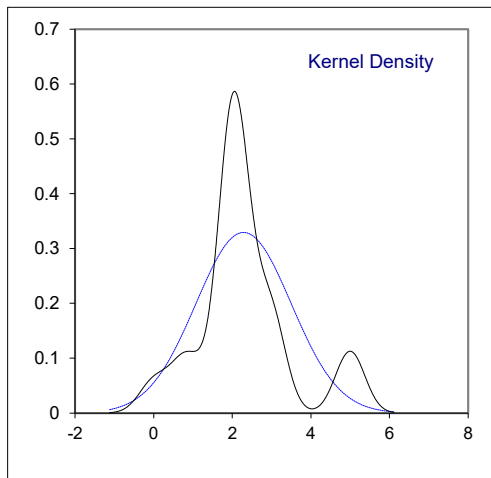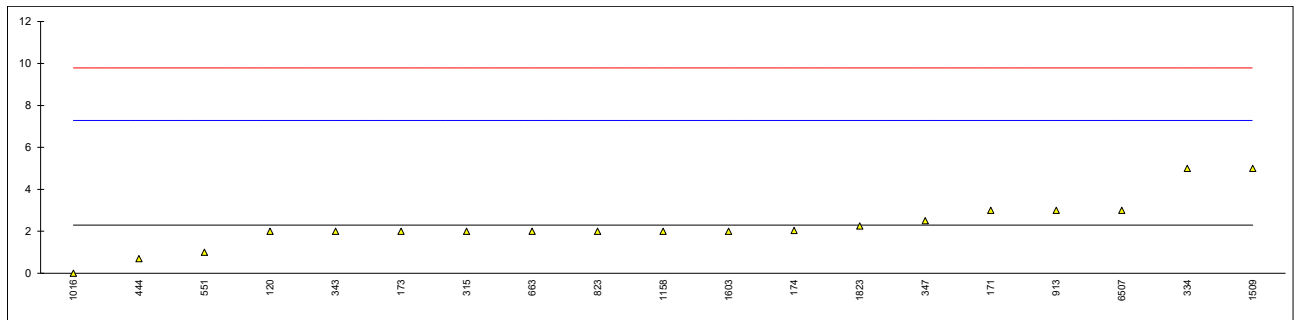| lab	method	value	mark	z(targ)	remarks
120	Visual	Clear & Bright		-----	
169	Visual	PASS		-----	
171	E2680	pass		-----	
173	E2680	Pass		-----	
174	Visual	Clear & Free		-----	
315	E2680	pass		-----	
323	D2679	C&B		-----	
334	Visual	clear and bright		-----	
343	E2680	Pass		-----	
347	E2680	Pass		-----	
444	E2680	Pass		-----	
446	E2680	PASS		-----	
551	E2680	Pass		-----	
663	Visual	Pass		-----	
823	E2680	Pass		-----	
913	E2680	Clear and Bright		-----	
1016	Visual	Pass		-----	
1158		-----		-----	
1509	E2680	Clear & FFSM		-----	
1603	Visual	CFP		-----	
1823	D4176	Pass		-----	
6507	E2680	pass		-----	
	n	21			
	mean (n)	Pass (Clear & Bright)			

Determination of Inorganic Chloride as Cl on sample #23195; results in mg/kg

lab	method	value	mark	z(targ)	remarks
120		-----		-----	
169		-----		-----	
171	E2469	<0.01		-----	
173	INH-0221	<0.5		-----	
174		-----		-----	
315	INH-158	<0.2		-----	
323	E2469	<0.03		-----	
334		-----		-----	
343	E2469	<0.1		-----	
347	INH-029	<1		-----	
444	E2469	0.034		-----	
446		-----		-----	
551		-----		-----	
663		-----		-----	
823	E2469	0.10		-----	
913	In house	<1		-----	
1016		-----		-----	
1158		-----		-----	
1509	E2469	0.09		-----	
1603	In house	0.11		-----	
1823	E2469	0.0535		-----	
6507	E2469	0.1466		-----	
	n	11			
	mean (n)	<0.5			

Determination of Color Pt/Co on sample #23195;

lab	method	value	mark	z(targ)	remarks
120	D5386	2		-0.12	
169	D1209	<5		-----	
171	D1209	3		0.28	
173	D1209	2		-0.12	
174	D5386	2.04		-0.10	
315	D5386	2		-0.12	
323	D1209	<5		-----	
334	D1209	5		1.08	
343	D5386	2		-0.12	
347	INH-177	2.5		0.08	
444	D5386	0.7		-0.64	
446	D1209	<10		-----	
551	D1209	1		-0.52	
663	D5386	2		-0.12	
823	D5386	2		-0.12	
913	D5386	3		0.28	
1016	D1209	0		-0.92	
1158	D1209	2		-0.12	
1509	D1209	5		1.08	
1603	In house	2		-0.12	
1823	D5386	2.25		-0.02	
6507	D1209	3		0.28	

normality	suspect
n	19
outliers	0
mean (n)	2.29
st.dev. (n)	1.211
R(calc.)	3.39
st.dev.(D1209:05R19)	2.500
R(D1209:05R19)	7
compare	
R(D5386:16)	4.95

Kernel Density

Determination of Density at 20 °C on sample #23195; results in kg/L

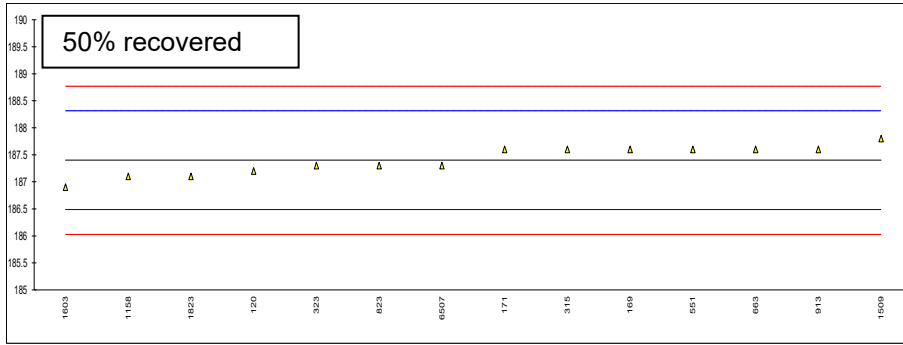| lab	method	value	mark	z(targ)	remarks
120	D4052	1.0361		-0.14	
169	D4052	1.0361		-0.14	
171	D4052	1.036		-0.70	
173	D4052	1.03613		0.03	
174	D4052	1.03612		-0.02	
315	D4052	1.0361		-0.14	
323	D4052	1.0361		-0.14	
334	ISO12185	1.0362		0.42	
343	D4052	1.036	C	-0.70	first reported 1.038
347	D4052	1.03622		0.54	
444	D4052	1.0362		0.42	
446	D4052	1.0362	C	0.42	first reported 1.0358
551	D4052	1.0363	C	0.98	first reported 1.0366
663	D4052	1.03614		0.09	
823	ISO12185	1.0361		-0.14	
913	D4052	1.0361		-0.14	
1016	D4052	1.0361		-0.14	
1158		-----		-----	
1509	D4052	1.03652	C,G(0.01)	2.22	first reported 1.03649
1603	In house	1.03617		0.26	
1823	D4052	1.0360		-0.70	
6507	D4052	1.0361		-0.14	

normality	OK	
n	20	
outliers	1	
mean (n)	1.036124	
st.dev. (n)	0.0000763	
R(calc.)	0.000214	
st.dev.(ISO12185:96)	0.0001786	
R(ISO12185:96)	0.0005	

Kernel Density
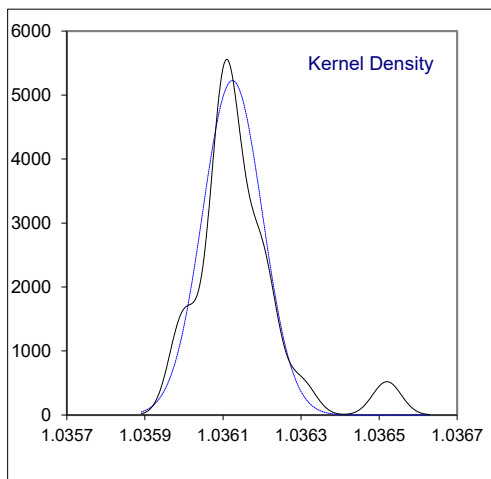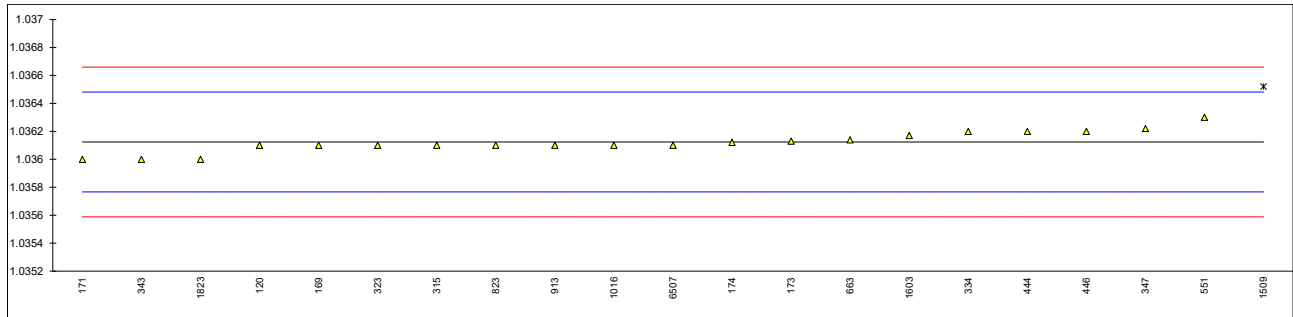
Determination of Distillation: IBP, 50% recovered, Dry Point on sample #23195; results in °C

lab	method	IBP	mark	z(targ)	50% rec	mark	z(targ)	DP	mark	z(targ)
120	D1078-automated	187.0		0.24	187.2		-0.44	187.4		-0.67
169	D1078-automated	185.9	C	-0.81	187.6		0.44	188.3		0.58
171	D1078-automated	187.2		0.44	187.6		0.44	188.3		0.58
173		-----		-----	-----		-----	-----		-----
174		-----		-----	-----		-----	-----		-----
315	D1078-automated	187.0		0.24	187.6		0.44	187.8		-0.11
323	D1078-automated	187.0		0.24	187.3		-0.22	188.2		0.45
334		-----		-----	-----		-----	-----		-----
343		-----		-----	-----		-----	-----		-----
347	D1078-automated	186.9		0.15	-----		-----	187.8		-0.11
444		-----		-----	-----		-----	-----		-----
446		-----		-----	-----		-----	-----		-----
551	D1078-automated	186.7		-0.04	187.6		0.44	188.4		0.72
663	D1078-manual	186.8		0.05	187.6		0.44	188.0		0.17
823	D1078-automated	186.7		-0.04	187.3		-0.22	187.5		-0.53
913	D1078-manual	187.2		0.44	187.6		0.44	188.0		0.17
1016		-----		-----	-----		-----	-----		-----
1158	D1078-manual	186.1		-0.62	187.1		-0.66	187.5		-0.53
1509	D1078-automated	187.0		0.24	187.8		0.87	188.1		0.31
1603	D1078-automated	186.3		-0.43	186.9		-1.09	187.1		-1.09
1823	D1078	186.6		-0.14	187.1		-0.66	188.1		0.31
6507	D1078-automated	186.8		0.05	187.3		-0.22	187.7		-0.25
	normality	OK			OK			OK		
	n	15			14			15		
	outliers	0			0			0		
	mean (n)	186.75			187.40			187.88		
	st.dev. (n)	0.383			0.263			0.380		
	R(calc.)	1.07			0.74			1.06		
	st.dev.(D1078-A:11R19)	1.040			0.457			0.718		
	R(D1078-A:11R19)	2.91			1.28			2.01		
	compare									
	R(D1078-M:11R19)	2.00			1.21			2.44		

Lab 169 first reported 181.8

Initial Boiling Point

50% recovered

Dry Point
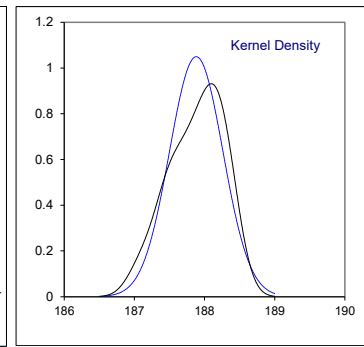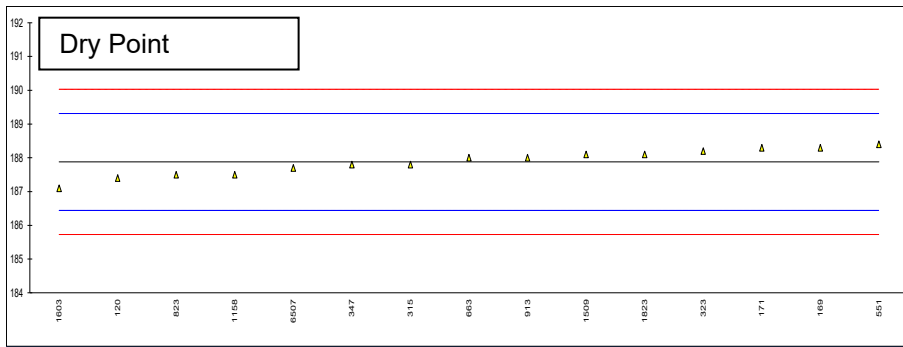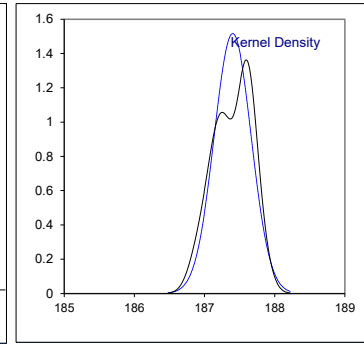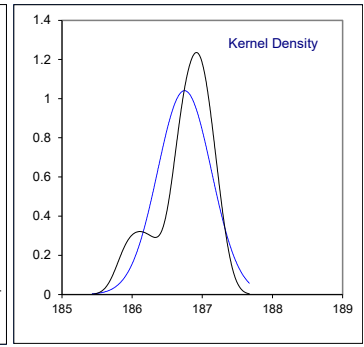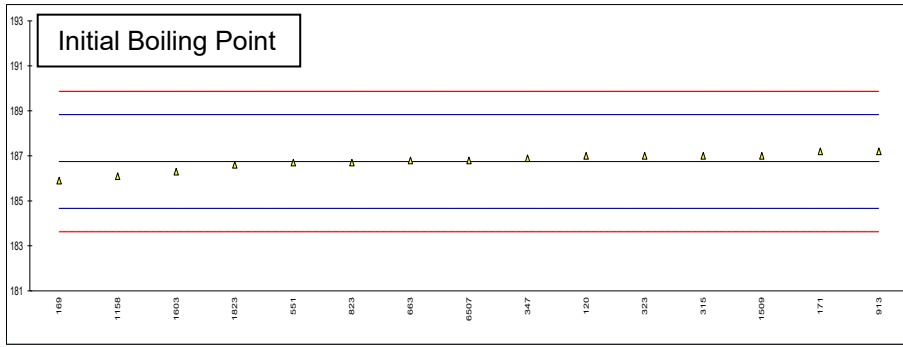
Determination of Iron as Fe on sample #23195; results in mg/kg

lab	method	value	mark	z(targ)	remarks
120	INH-0290	0.110		-0.25	
169	E394	0.092		-1.82	
171	E394	0.12		0.62	
173	E394	0.125		1.05	
174	E1615	0.123		0.88	
315	E1615	0.139		2.27	
323	E1615	0.129		1.40	
334	E394	<0.01		<-8.96	possibly a false negative test result?
343	E394	0.1		-1.12	
347		-----		-----	
444	E202	0.075		-3.30	
446	E202	0.10		-1.12	
551	E394	0.13		1.49	
663	E394	0.123		0.88	
823	E394	0.11		-0.25	
913	E394	0.100		-1.12	
1016	NEN6966	0.102	C	-0.95	first reported 0.224
1158		-----		-----	
1509	E394	0.129		1.40	
1603	In house	0.108		-0.43	
1823	D1615	0.126		1.14	
6507	E1615	0.1038		-0.79	

normality	OK
n	19
outliers	0
mean (n)	0.1129
st.dev. (n)	0.01612
R(calc.)	0.0451
st.dev.(E394:22)	0.01148
R(E394:22)	0.0322
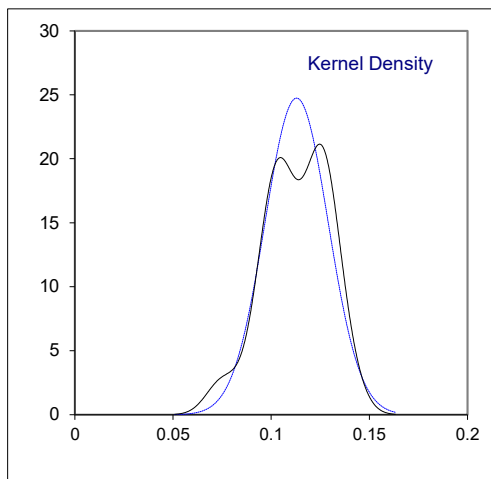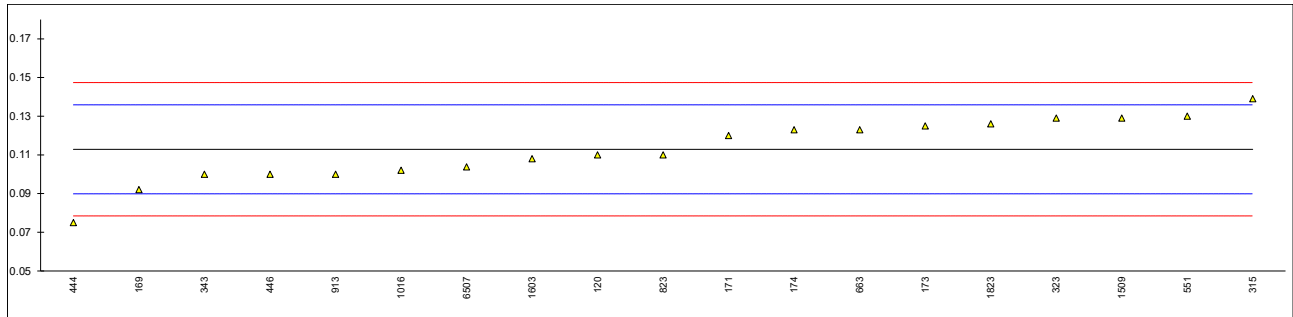
Determination of Purity by GC as received on sample #23195; results in %M/M

lab	method	value	mark	z(targ)	remarks
120	INH-0542	99.96		0.39	
169	E2409	99.9171		-0.32	
171	E2409	99.99		0.88	
173	INH-0540	99.950985		0.24	
174	E2409	99.92		-0.27	
315	E2409	99.92		-0.27	
323	E202	99.94		0.06	
334		-----		-----	
343	INH-1321	99.95		0.22	
347	INH-179	99.963		0.44	
444	INH-100687	99.907		-0.48	
446	INH-130	99.96		0.39	
551		-----		-----	
663	INH-100687	99.926		-0.17	
823	E2409	99.924		-0.20	
913	E2409	99.908		-0.47	
1016	E202	99.949		0.21	
1158	In house	99.89		-0.76	
1509	E202	99.946		0.16	
1603	In house	99.91		-0.43	
1823	E202	99.9438		0.12	
6507	E2409	99.953		0.27	

normality	OK	
n	20	
outliers	0	
mean (n)	99.9364	
st.dev. (n)	0.02447	
R(calc.)	0.0685	
st.dev.(E202:18)	0.06071	
R(E202:18)	0.17	

Kernel Density
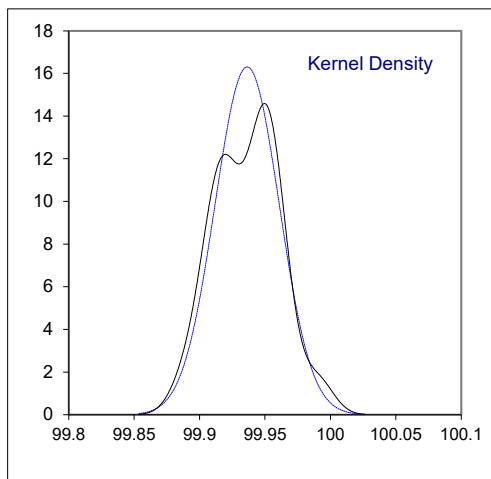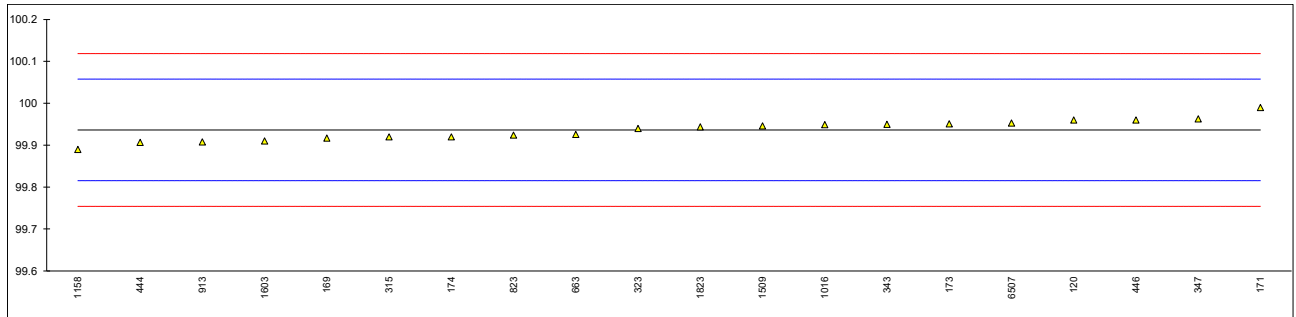
Determination of Dipropylene glycol on sample #23195; results in %M/M

lab	method	value	mark	z(targ)	remarks
120	INH-0542	0.0246		-0.24	
169	E2409	0.03407		-0.05	
171		-----		-----	
173	INH-0540	0.0294299		-0.14	
174	E2409	0.0333		-0.07	
315	E2409	0.040		0.07	
323	E202	0.0360		-0.01	
334		-----		-----	
343	INH-1321	0.054	C	0.35	first reported 540 %M/M
347	INH-179	0.0345		-0.04	
444	INH-100687	0.0577		0.42	
446	INH-130	0.04		0.07	
551		-----		-----	
663	INH-100687	0.06482	C	0.56	first reported 0.07272
823	E2409	0.0297		-0.14	
913		-----		-----	
1016	E202	0.023		-0.27	
1158	In house	0.030		-0.13	
1509	E202	0.0305		-0.12	
1603	In house	0.0470		0.21	
1823	E202	0.0324		-0.08	
6507	E2409	0.01746		-0.38	

normality	OK
n	18
outliers	0
mean (n)	0.03658
st.dev. (n)	0.012344
R(calc.)	0.03456
st.dev.(E202:18)	0.050000
R(E202:18)	0.14
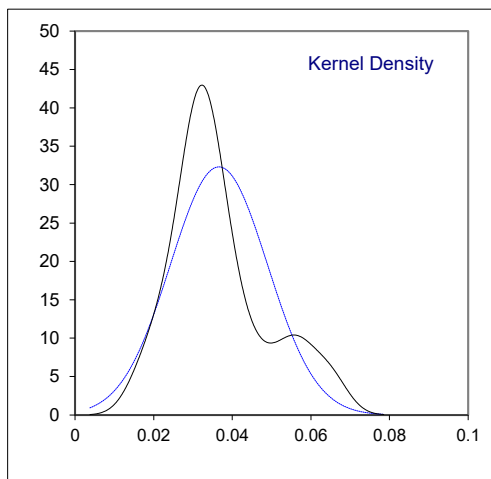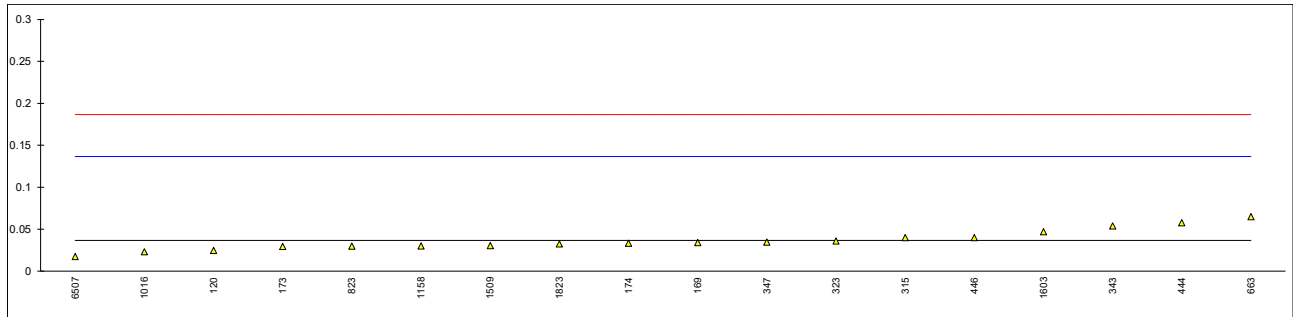
Determination of Specific Gravity 20/20 °C on sample #23195;

lab	method	value	mark	z(targ)	remarks
120	D4052	1.03796		-0.30	
169	D4052	1.03799		-0.13	
171		-----		-----	
173	D4052	1.03801		-0.02	
174	D4052	1.03798		-0.19	
315	D4052	1.0380		-0.08	
323	D4052	1.0380		-0.08	
334	D4052	1.038		-0.08	
343	D4052	1.038	C	-0.08	first reported 1.040
347	D4052	1.03808		0.37	
444	D4052	1.0381		0.48	
446	D4052	1.0381	C	0.48	first reported 1.0377
551	D4052	1.0381	C	0.48	first reported 1.0384
663	D4052	1.0380		-0.08	
823	D4052	1.0380		-0.08	
913	D4052	1.0380	C	-0.08	first reported 1.0800
1016	D4052	1.0380		-0.08	
1158		-----		-----	
1509	D4052	1.03839	C,G(0.01)	2.11	first reported 1.03836
1603	In house	1.03804		0.15	
1823	D4052	1.0379		-0.64	
6507	D4052	1.0380		-0.08	

normality	OK
n	19
outliers	1
mean (n)	1.03801
st.dev. (n)	0.000051
R(calc.)	0.00014
st.dev.(E202:18)	0.000179
R(E202:18)	0.0005
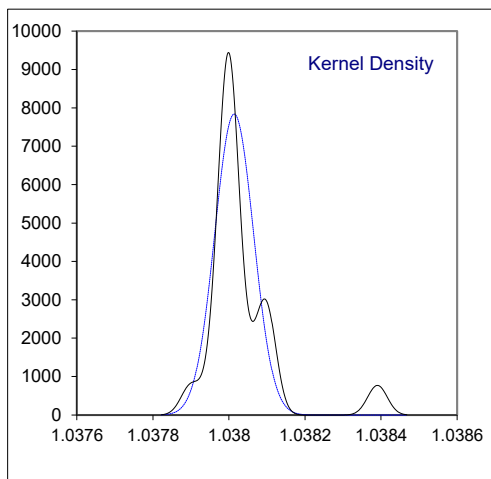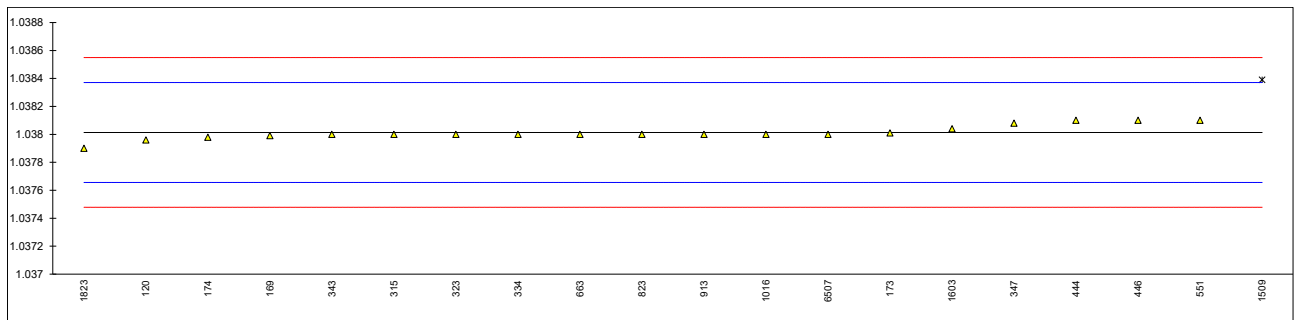
Determination of Water on sample #23195; results in mg/kg

lab	method	value	mark	z(targ)	remarks
120	E1064	203.1		-3.06	
169	E1064	398	DG(0.05)	10.91	
171	E1064	250		0.31	
173	E203	228		-1.27	
174	E1064	278	C	2.31	first reported 0.0278 mg/kg
315	E1064	210		-2.56	
323	E1064	225		-1.49	
334	E1064	243		-0.20	
343	E1064	260		1.02	
347	INH-176	280		2.46	
444	E1064	268	C	1.60	first reported 0.0268 mg/kg
446	E203	750	G(0.01)	36.14	
551	E1064	229		-1.20	
663	E1064	239.25		-0.46	
823	E1064	220		-1.84	
913	E1064	270		1.74	
1016	D1364	350	G(0.05)	7.47	
1158	E203	510	G(0.01)	18.94	
1509	E203	236.5		-0.66	
1603	In house	390	DG(0.05)	10.34	
1823	E1064	237.7		-0.58	
6507	E1064	300	C	3.89	first reported 0.030 mg/kg

normality	OK
n	17
outliers	5
mean (n)	245.74
st.dev. (n)	26.748
R(calc.)	74.89
st.dev.(E1064:23)	13.954
R(E1064:23)	39.07
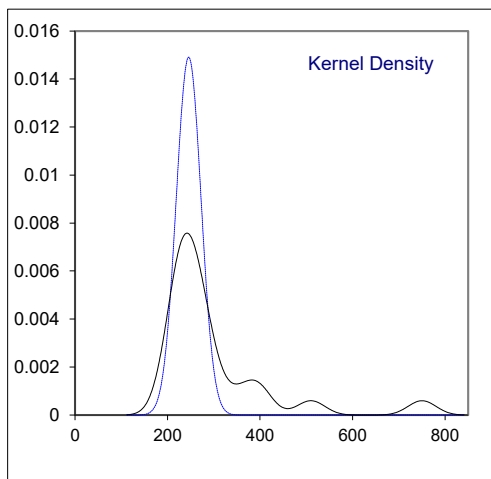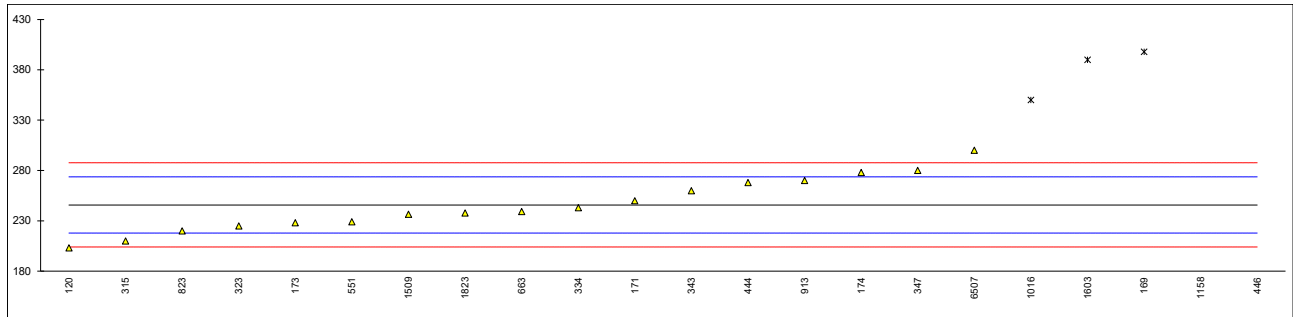
APPENDIX 2

Number of participants per country

1 lab in BELGIUM

1 lab in BRAZIL

1 lab in CHINA, People's Republic

1 lab in FRANCE

2 labs in GERMANY

1 lab in INDIA

1 lab in KOREA, Republic of

2 labs in NETHERLANDS

1 lab in ROMANIA

1 lab in SINGAPORE

2 labs in SPAIN

1 lab in THAILAND

2 labs in UNITED KINGDOM

5 labs in UNITED STATES OF AMERICA

APPENDIX 3

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

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3   ISO5725 parts 1-6:94

4   ISO13528:05

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7   P.L. Davies, Fr. Z. Anal. Chem, 331, 513, (1988)

8   J.N. Miller, Analyst, 118, 455, (1993)

9   Analytical Methods Committee, Technical Brief, No 4, January 2001

10   P.J. Lowthian and M. Thompson, The Royal Society of Chemistry, Analyst, 127, 1359-1364, (2002)

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)