

Results of Proficiency Test
Aviation gasoline
April 2018

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 2011, the Institute for Interlaboratory Studies (iis) organizes a proficiency scheme for Aviation Gasoline 100LL (AvGas) once every two years. During the annual proficiency testing program of 2017/2018, it was decided to continue the round robin for the analysis of Aviation Gasoline 100LL in accordance with the latest applicable specifications: ASTM D910 and UK DEF STAN 91-090.

In this interlaboratory study 14 laboratories from 12 different countries registered for participation. See appendix 2 for the number of participants per country. In this report, the results of the 2018 proficiency test on Aviation Gasoline 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 organiser of this proficiency test. Sample analyses for fit-for-use and homogeneity testing were subcontracted to an ISO/IEC 17025 accredited laboratory. It was decided to send two identical samples of Aviation Gasoline (2 times 1 litre bottle, labelled #18041) to the participants. 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/IEC 17043:2010. 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 organisation 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 March 2017 (iis-protocol, version 3.4). This protocol can be downloaded from 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

The necessary bulk material of Aviation Gasoline 100LL was obtained from retained material. From the approximately 80 litres, after homogenisation, 58 amber glass bottles of 1 litre were filled and labelled #18041. The homogeneity of the subsamples #18041 was checked by determination of Density at 15°C in accordance with ISO12185 on 8 stratified randomly selected samples.

	Density at 15°C in kg/m ³
sample #18041-1	715.50
sample #18041-2	715.31
sample #18041-3	715.31
sample #18041-4	715.32
sample #18041-5	715.28
sample #18041-6	715.31
sample #18041-7	715.31
sample #18041-8	715.32

Table 1: homogeneity test results of Benzene sub samples #18041

From the above test results the repeatability was calculated and compared with 0.3 times the corresponding reproducibility of the reference test method, in agreement with the procedure of ISO 13528, Annex B2 in the next table;

	Density at 15°C in kg/ m ³
r (observed)	0.193
Reference test method	ISO12185:96
0.3*R (reference test method)	0.45

Table 2: evaluation of repeatabilities of subsamples #18041

The calculated repeatability for sample #18041 was in agreement with 0.3 times the corresponding reproducibility of the reference test method. Therefore, homogeneity of the subsamples was assumed.

To the participants two 1L bottles of sample #18041 were sent on March 16, 2018. An SDS was added to the sample package.

2.5 STABILITY OF THE SAMPLES

The stability of Aviation Gasoline 100LL, packed in amber glass bottles, was checked. The material was found sufficiently stable for the period of the proficiency test.

2.6 ANALYSES

The participants were requested to determine on the sample #18041: Aromatics by HPLC and FIA, Color, Copper Strip 2hrs/100°C, Density at 15°C, Distillation, Existent Gum (solvent washed), Freezing Point, Heat of Combustion (Net), Lead as Pb, Lead as TEL, Lead Precipitate, Potential Gum, Sulphur, Water Reaction and MON.

It was explicitly requested to treat the samples as if they were routine samples. Therefore, each laboratory is advised to perform only those analyses that normally are done in daily routine (but the laboratories are allowed to do all analyses). Furthermore, it was requested to report the test results using the indicated units on the report form and not to round the test results more, 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 calculations.

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 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 raw data of these tests (no reanalyses). Additional or corrected test results are used for data analysis and the original test results are placed under the test 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 Organization, Statistics and Evaluation' of March 2017 (iis-protocol, version 3.4). For the statistical evaluation the *unrounded* (when available) test results 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 judgment 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.

In accordance with ISO 5725 the original test results per determination were submitted to Dixon's, Grubbs' and/or Rosner's outlier tests. Outliers are marked by D(0.01) for the Dixon 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 test, by G(0.05) or DG(0.05) for the Grubbs test and by R(0.05) for the Rosner 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. When the uncertainty passed the evaluation, no remarks are made in the report. However, when the uncertainty failed the evaluation it is mentioned in the report and it will have consequences for the evaluation of the test results.

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 an "cross". Accepted data are represented as a triangle.

Furthermore, Kernel Density Graphs were made. The Kernel Density Graph 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 was projected over the Kernel Density Graph for reference.

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, e.g. ASTM reproducibilities, 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. In some cases, a reproducibility based on former iis proficiency tests could be used.

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 in accordance with:

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

The $z_{(\text{target})}$ 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.

The usual interpretation of z-scores is as follows:

$ z < 1$	good
$1 < z < 2$	satisfactory
$2 < z < 3$	questionable
$3 < z $	unsatisfactory

4 EVALUATION

No problems were encountered during the execution of this proficiency test. All laboratories reported test results. One laboratory reported the test results after the final reporting date. Not all laboratories were able to perform all analyses requested. Finally, 14 laboratories did report 159 numerical test results. Observed were 3 outlying test results, which is 1.9%. In proficiency tests, outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER TEST

In this section, the reported test results are discussed per test. The methods, which are used by the various laboratories, were taken into account for explaining the observed differences when possible and applicable. These methods are also in the tables together with the original data. The abbreviations, used in these tables, are listed in appendix 3.

In the iis PT reports, ASTM methods are referred to with a number (e.g. D381) and an added designation for the year that the method was adopted or revised (e.g. D381:12). If applicable, a designation in parentheses is added to designate the year of reapproval (e.g. D381:12(2017)). In the results tables of appendix 1 only the method number and year of adoption or revision e.g. D381:12 will be used.

Not all original 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.

Aromatics: Only one laboratory reported test results for Aromatics by HPLC, two laboratories reported test results for FIA in %M/M and two more also in %V/V. No conclusions could be drawn from this small number of results.

Color: All participants, except one, reported the color as “Blue”.

Copper Corrosion: All participants agreed on a result of 1 (1a or 1b).

Density at 15°C: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ISO12185:96.

Distillation: This determination was not problematic. Two statistical outliers were observed over six parameters. All calculated reproducibilities after rejection of the statistical outliers are in agreement with the requirements of ASTM D86-A:17, the automatic mode.

Existent Gum: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in good agreement with the requirements of ASTM D381:12(2017).

- Freezing Point: All reporting participants agreed on a result below -58°C . The value of -58°C is the upper limit for freezing point according to the product specification ASTM D910:17a and DEF STAN 91-090:2015.
- Heat of Combustion: This determination was problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is not in agreement with the requirements of ASTM D3338:09(2014e1). No calculation errors were observed.
- Lead as Pb: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D3341:16.
- Lead as TEL: This determination may be problematic. Only two laboratories reported a test result. No conclusions could be drawn from these two results. iis calculated TEL values from the test results reported for Lead as Pb. The two test reported test results were calculated correctly. The estimated reproducibility of the calculated results is not in agreement with the requirements of ASTM D3341:16.
- Lead precipitate: No significant conclusions were drawn. Five laboratories agreed on a value "less 1 mg/100ml".
- Potential Gum: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in good agreement with the requirements of ASTM D873:12.
- Sulphur: No significant conclusions were drawn. One false positive test result was observed. Probably, interference of lead in the sample maybe an explanation for the false positive test result.
All other reporting laboratories agreed on a result below of near the application range (3 mg/kg – 4.6% M/M) of ASTM D2622:16.
- Water reaction: This determination may not be problematic. Ten participants reported a test result below 1.
- MON: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in full agreement with the requirements of ASTM D2700:17a.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibility as declared by the relevant reference test method and the reproducibility as found for the group of participating laboratories. The average values, calculated reproducibilities and reproducibilities derived from literature reference test methods (in casu ASTM standards) are compared in the next table.

Parameter	unit	n	average	2.8 * sd	R (lit)
Aromatics by HPLC	%M/M	1	n.a.	n.a.	n.a.
Aromatics by HPLC	%V/V	1	n.a.	n.a.	n.a.
Aromatics by FIA	%M/M	1	n.a.	n.a.	n.a.
Aromatics by FIA	%V/V	4	n.a.	n.a.	n.a.
Color	rating	5	Blue	n.a.	n.a.
Copper Corrosion 2 hrs/100°C	rating	12	1	n.a.	n.a.
Density at 15°C	kg/m ³	14	715.5	0.6	1.5
Distillation - Initial Boiling Point	°C	14	36.8	3.7	4.7
Distillation - 10% evaporated	°C	14	64.7	2.7	4.4
Distillation - 40% evaporated	°C	13	98.3	0.9	3.9
Distillation - 50% evaporated	°C	14	104.3	0.9	3.3
Distillation - 90% evaporated	°C	14	130.1	2.1	4.8
Distillation - Final Boiling Point	°C	13	158.7	2.0	7.1
Existent Gum	mg/100ml	10	0.6	0.9	2.2
Freezing Point	°C	10	<-58	n.a.	n.a.
Heat of Combustion (Net)	MJ/kg	6	43.696	0.083	0.046
Lead as Pb	g/l	9	0.553	0.056	0.028
Lead as TEL	ml/l	2	n.e.	n.a.	n.a.
Lead precipitate content	mg/100ml	5	<1	n.a.	n.a.
Potential Gum	mg/100ml	6	1.06	1.31	3
Sulphur	mg/kg	10	<3	n.a.	n.a.
Water reaction interface	ml	10	≤0.5	n.a.	n.a.
MON		5	101.8	1.9	2

Table 3: performance evaluation sample #18041

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

4.3 COMPARISON OF THE PROFICIENCY TEST OF APRIL 2018 WITH PREVIOUS PTS

	April 2018	April 2016	April 2014	April 2013
Number of reporting labs	14	20	17	17
Number of results reported	159	211	193	209
Statistical outliers	3	3	9	6
Percentage outliers	1.9%	1.4%	4.7%	2.9%

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 against the requirements of the respective reference test methods. The conclusions are given the following table:

Parameter	April 2018	April 2016	April 2014	April 2013
Aromatics	n.e.	--	-	--
Density at 15°C	++	++	+	++
Distillation at 760 mm Hg	++	++	+	+
Existent Gum	++	++	++	+/-
Heat of Combustion (Net)	--	--	--	--
Lead as Pb	--	-	--	--
Lead as Tel	n.e.	-	--	--
Potential Gum	++	+/-	n.e.	+
Sulphur	n.e.	n.e.	n.e.	n.e.
MON	+/-	-	+	--

Table 5: comparison determinations against the standard requirements

The performance of the determinations against the requirements of the respective reference test methods is listed in the above table. 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 Aromatics by HPLC on sample #18041; results in %M/M and %V/V

lab	method	%M/M	mark	z(targ)	%V/V	mark	z(targ)
62		----		----	----		----
150		----		----	----		----
334		----		----	----		----
496	D6379	18.01		----	14.69		----
631		----		----	----		----
1016		----		----	----		----
1141		----		----	----		----
1155		----		----	----		----
1161		----		----	----		----
1299		----		----	----		----
1521		----		----	----		----
1538		----		----	----		----
1650		----		----	----		----
1677		----		----	----		----
	normality	n.a.			n.a.		
	n	1			1		
	outliers	n.a.			n.a.		
	mean (n)	n.a.			n.a.		
	st.dev. (n)	n.a.			n.a.		
	R(calc.)	n.a.			n.a.		
	st.dev.(D6379:11)	n.a.			n.a.		
	R(D6379:11)	n.a.			n.a.		

Determination of Aromatics by FIA on sample #18041; results in %M/M and %V/V

lab	method	%M/M	mark	z(targ)	%V/V	mark	z(targ)
62		----		----	----		----
150		----		----	----		----
334		----		----	----		----
496		----		----	----		----
631	D1319	----		----	14.21		----
1016		----		----	----		----
1141		----		----	----		----
1155		----		----	----		----
1161		----		----	----		----
1299		----		----	----		----
1521	EN15553	18.0		----	14.8		----
1538		----		----	----		----
1650	D1319	----		----	14.07		----
1677	D1319	8.9367	ex	----	12.4928		----
	normality	n.a.			n.a.		
	n	1+1ex			4		
	outliers	n.a.			n.a.		
	mean (n)	n.a.			n.a.		
	st.dev. (n)	n.a.			n.a.		
	R(calc.)	n.a.			n.a.		
	st.dev.(D1319:15)	n.a.			n.a.		
	R(D1319:15)	n.a.			n.a.		

Lab 1677: test result for %M/M appears to be incorrect for it is lower than the result for %V/V, possible typing error?

Determination of Color on sample #18041

lab	method	value	mark	z(targ)	remarks
62		----		----	
150	D2392	Blue		----	
334		----		----	
496		----		----	
631		----		----	
1016	In house	3.0		----	
1141	Visual	BLUE		----	
1155	Visual	blue		----	
1161		----		----	
1299		----		----	
1521	IP569	3,3 blue		----	
1538		----		----	
1650		----		----	
1677	IP17	Blue 3.3		----	
n		5			
mean (n)		Blue			

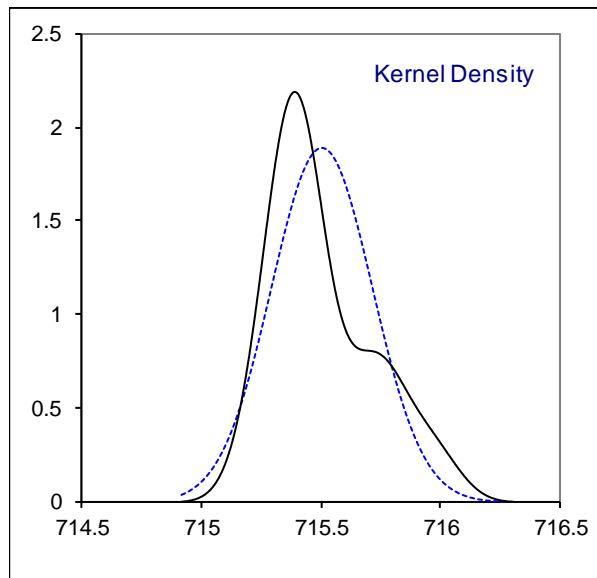
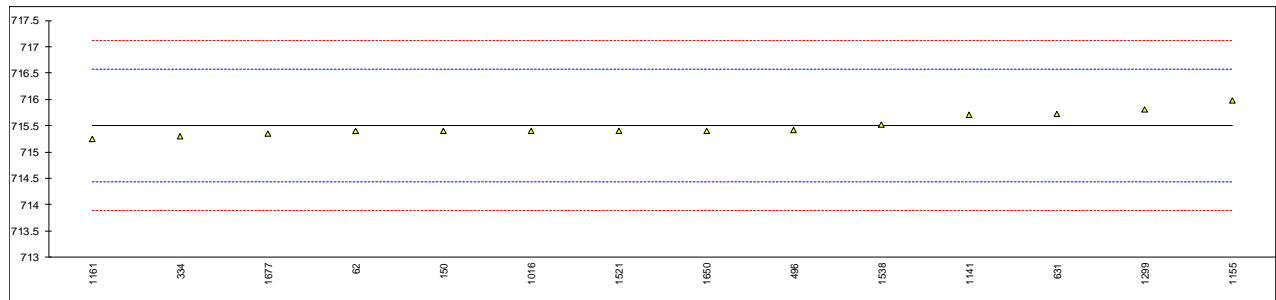
Determination of Copper Corrosion 2hrs/100°C on sample #18041

lab	method	value	mark	z(targ)	remarks
62	D130	1b		----	
150	D130	1a		----	
334		----		----	
496	D130	1a		----	
631	D130	1a		----	
1016	D130	1a		----	
1141	D130	1a		----	
1155	ISO2160	1a		----	
1161	ISO2160	1a		----	
1299	D130	1A		----	
1521	D130	1		----	
1538		----		----	
1650	D130	1a		----	
1677	D130	1A		----	
	n	12			
	mean (n)	1			

Determination of Density at 15°C on sample #18041; results in kg/m³

lab	method	value	mark	z(targ)	remarks
62	D4052	715.4		-0.19	
150	D4052	715.4		-0.19	
334	D4052	715.3		-0.38	
496	D4052	715.42		-0.15	
631	D4052	715.72		0.41	
1016	D4052	715.4		-0.19	
1141	D4052	715.7		0.37	
1155	ISO3675	715.97		0.87	
1161	ISO12185	715.25		-0.47	
1299	D4052	715.8		0.56	
1521	D4052	715.4		-0.19	
1538	D4052	715.52		0.03	
1650	D4052	715.40		-0.19	
1677	D4052	715.35		-0.28	

normality suspect
n 14
outliers 0
mean (n) 715.502
st.dev. (n) 0.2114
R(calc.) 0.592
st.dev.(ISO12185:96) 0.5357
R(ISO12185:96) 1.5



Determination of Distillation at 760 mm Hg on sample #18041; results in °C.

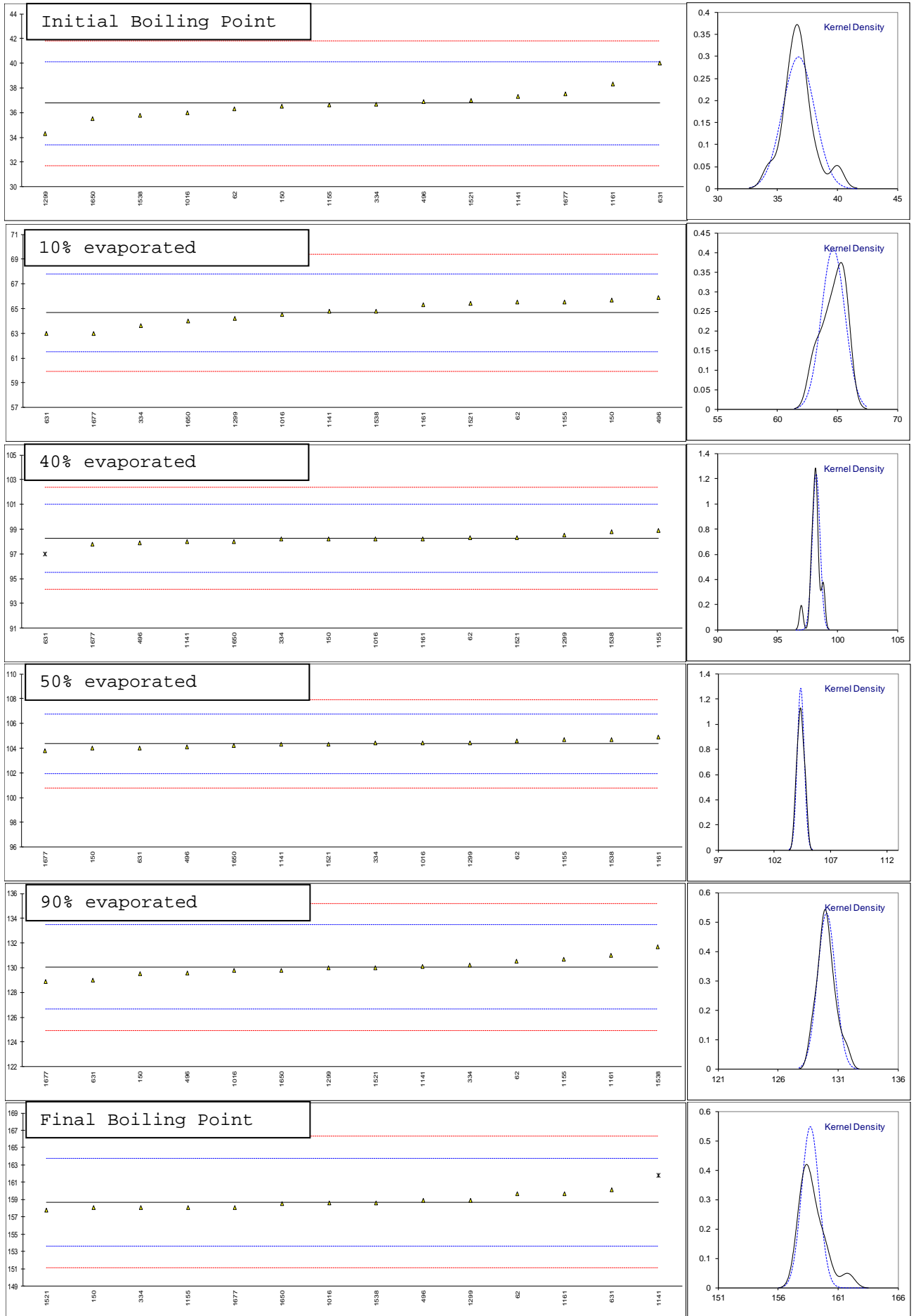
lab	method	IBP	10%	40%	50%	90%	FBP	res.
62	D86-automated	36.3	65.5	98.3	104.6	130.5	159.7	0.8
150	D86-automated	36.5	65.7	98.2	104.0	129.5	158.1	1.0
334	D86-automated	36.7	63.6	98.2	104.4	130.2	158.1	1.3
496	D86-automated	36.9	65.9	97.9	104.1	129.6	158.9	1.0
631	D86-automated	40.0 C	63.0 C	97.0 C,G(5)	104.0 C	129.0 C	160.1	0.8
1016	D86	36.0	64.5	98.2	104.4	129.8	158.6	1.0
1141	D86-automated	37.3 C	64.8 C	98.0 C	104.3	130.1	161.8 G(5)	1.0
1155	ISO3405-autom.	36.6	65.5	98.9	104.7	130.7	158.1	1.1
1161	D86-automated	38.3	65.3	98.2	104.9	131.0	159.7	0.9
1299	D86-automated	34.3	64.2	98.5	104.4	130.0	158.9	1.0
1521	D86-automated	37.0	65.4	98.3	104.3	130.0	157.8	0.9
1538		35.8	64.8	98.8	104.7	131.7	158.6	1.0
1650	D86-automated	35.5	64.0	98.0	104.2	129.8	158.5	1.1
1677	D86-automated	37.5	63.0	97.8	103.8	128.9	158.1	0.8
normality		not OK	OK	OK	OK	OK	OK	
n		14	14	13	14	14	13	
outliers		0	0	1	0	0	1	
mean (n)		36.76	64.66	98.25	104.34	130.06	158.71	
st.dev. (n)		1.337	0.974	0.323	0.311	0.751	0.727	
R(calc.)		3.74	2.73	0.90	0.87	2.10	2.04	
st.dev.(D86-A:17)		1.679	1.580	1.381	1.192	1.708	2.536	
R(D86-A:17)		4.7	4.42	3.87	3.34	4.78	7.1	

Lab 631: first reported 41.5, 61.0, 96.0, 101.0, 133.0

Lab 1114: first reported 40.1, 67.6, 95.5

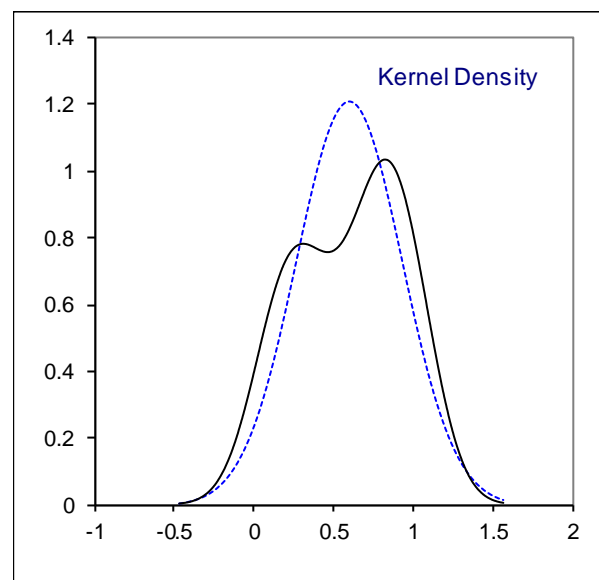
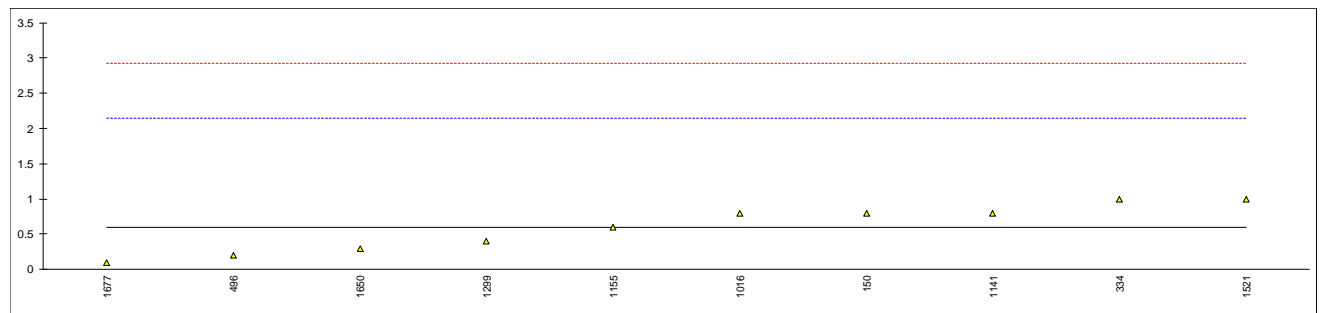
Z-scores

lab	IBP	10%	40%	50%	90%	FBP
62	-0.28	0.53	0.03	0.22	0.26	0.39
150	-0.16	0.66	-0.04	-0.29	-0.33	-0.24
334	-0.04	-0.67	-0.04	0.05	0.08	-0.24
496	0.08	0.79	-0.26	-0.20	-0.27	0.08
631	1.93	-1.05	-0.91	-0.29	-0.62	0.55
1016	-0.46	-0.10	-0.04	0.05	-0.15	-0.04
1141	0.32	0.09	-0.18	-0.04	0.03	1.22
1155	-0.10	0.53	0.47	0.30	0.38	-0.24
1161	0.91	0.41	-0.04	0.47	0.55	0.39
1299	-1.47	-0.29	0.18	0.05	-0.03	0.08
1521	0.14	0.47	0.03	-0.04	-0.03	-0.36
1538	-0.57	0.09	0.40	0.30	0.96	-0.04
1650	-0.75	-0.42	-0.18	-0.12	-0.15	-0.08
1677	0.44	-1.05	-0.33	-0.46	-0.68	-0.24



Determination of Existent Gum, solvent washed on sample #18041; results in mg/100ml

lab	method	value	mark	z(targ)	remarks
62	D381	<0.5		-----	
150	D381	0.8		0.26	
334	D381	1		0.52	
496	D381	0.20		-0.52	
631	D381	<1		-----	
1016	D381	0.8		0.26	
1141	D381	0.8		0.26	
1155	ISO6246	0.6		0.00	
1161		-----		-----	
1299	D381	0.4		-0.26	
1521	D381	1		0.52	
1538		-----		-----	
1650	D381	0.3		-0.39	
1677	D381	0.1		-0.65	
normality		OK			
n		10			
outliers		0			
mean (n)		0.60			
st.dev. (n)		0.330			
R(calc.)		0.92			
st.dev.(D381:12)		0.773			
R(D381:12)		2.17			

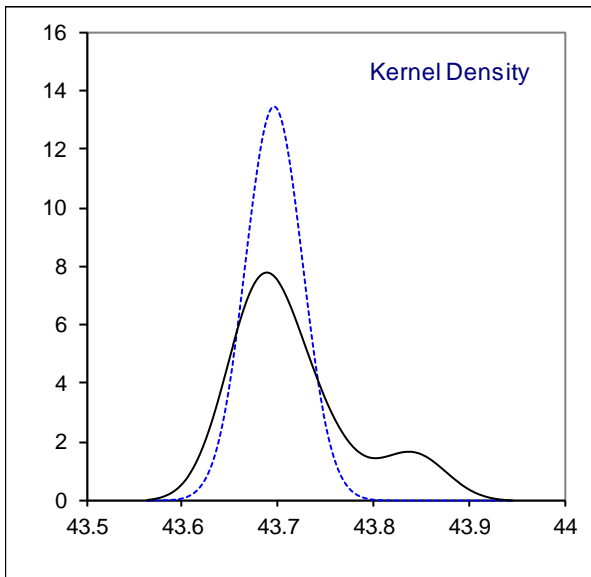
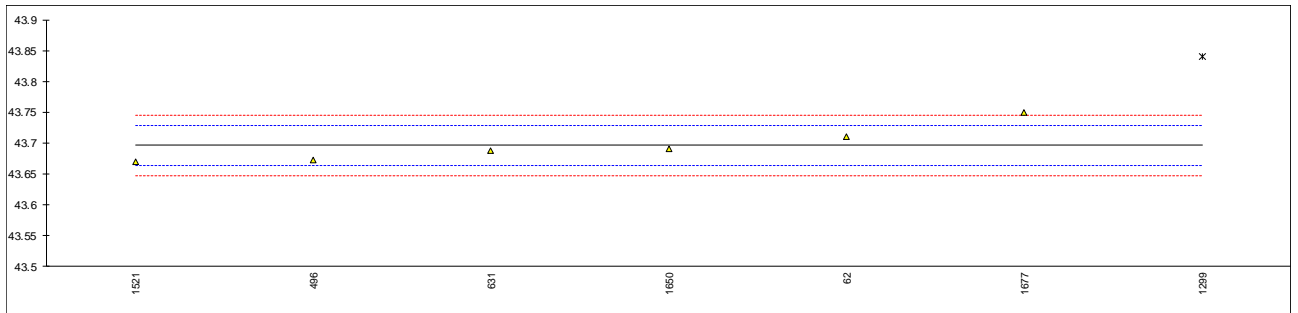


Determination of Freezing Point on sample #18041; results in °C

lab	method	value	mark	z(targ)	remarks
62		----		----	
150	D2386	<-58		----	
334		----		----	
496	D2386	<-77		----	
631	D2386	<-58.0		----	
1016	D2386	-67		----	
1141	D2386	< -60		----	
1155	ISO3013	<-66		----	
1161		----		----	
1299	D2386	<-65.0		----	
1521	D2386	<-60		----	
1538		----		----	
1650	D2386	< -70		----	
1677	D2386	< -80		----	
	n	10			
	mean (n)	<-58			

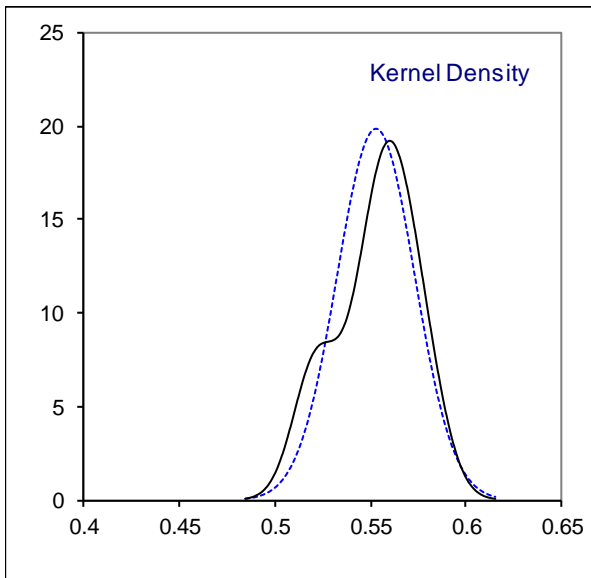
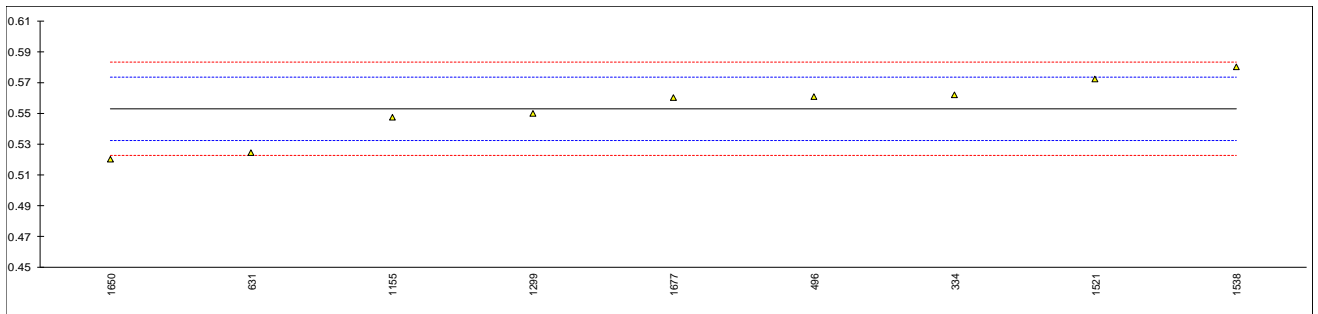
Determination of Heat of Combustion (Net) on sample #18041; results in MJ/kg

lab	method	value	mark	z(target)	remarks
62	D3338	43.710		0.84	
150		-----		-----	
334		-----		-----	
496	D3338	43.672	C	-1.48	First reported 43.555
631	D3338	43.6876		-0.53	
1016		-----		-----	
1141		-----		-----	
1155		-----		-----	
1161		-----		-----	
1299	D3338	43.841	G(0.05)	8.81	
1521	D3338	43.669		-1.66	
1538		-----		-----	
1650	D3338	43.69		-0.38	
1677	D3338	43.749		3.21	
normality		unknown			
n		6			
outliers		1			
mean (n)		43.6963			
st.dev. (n)		0.02972			
R(calc.)		0.0832			
st.dev.(D3338:09)		0.01643			
R(D3338:09)		0.0460			



Determination of Lead as Pb on sample #18041; results in g Pb/l

lab	method	value	mark	z(target)	remarks
62		----		----	
150		----		----	
334	ISO3830	0.562		0.89	
496	D3341	0.561		0.79	
631	D3237	0.5242		-2.83	
1016		----		----	
1141		----		----	
1155	D3341	0.5472		-0.56	
1161		----		----	
1299	D5059-C	0.55		-0.29	
1521	D3341	0.572		1.88	
1538	D5059-A	0.580		2.67	
1650	IP352	0.52		-3.24	
1677	IP270	0.56		0.70	
normality		OK			
n		9			
outliers		0			
mean (n)		0.5529			
st.dev. (n)		0.02014			
R(calc.)		0.0564			
st.dev.(D3341:16)		0.01015			
R(D3341:16)		0.0284			



Determination of Lead as Tetra Ethyl Lead on sample #18041; results in ml TEL/L

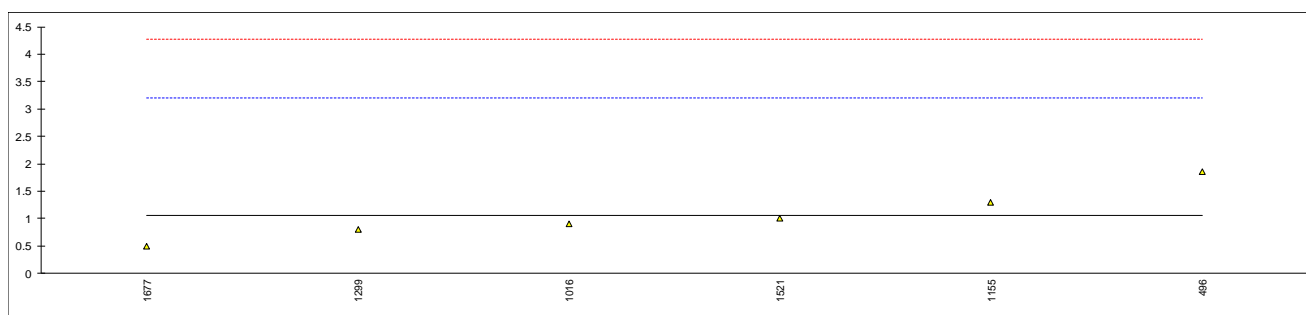
lab	method	value	mark	z(targ)	calc. by iis	remarks
62		----		----	----	
150		----		----	----	
334	ISO3830	0.532		----	0.532	
496		----		----	0.531	
631		----		----	0.496	
1016		----		----	----	
1141		----		----	----	
1155		----		----	0.518	
1161		----		----	----	
1299		----		----	0.520	
1521		----		----	0.541	
1538		----		----	0.549	
1650		----		----	0.492	
1677	IP270	0.53		----	0.530	
	normality	unknown			OK	
	n	2			9	
	outliers	n.a.			0	
	mean (n)	n.a.			0.5231	
	st.dev. (n)	n.a.			0.01905	
	R(calc.)	n.a.			0.0533	
	st.dev.(D3341:16)	n.a.			0.00987	
	R(D3341:16)	n.a.			0.0276	

Determination of Lead Precipitate content on sample #18041; results in mg/100ml

lab	method	value	mark	z(targ)	remarks
62		----		----	
150	D873	<1		----	
334		----		----	
496	D873	0.00		----	
631		----		----	
1016		----		----	
1141		----		----	
1155		----		----	
1161		----		----	
1299	D873	0.0		----	
1521	D873	<1		----	
1538		----		----	
1650		----		----	
1677	D873	0		----	
n		5			
mean (n)		<1			

Determination of Potential Gum on sample #18041; results in mg/100ml

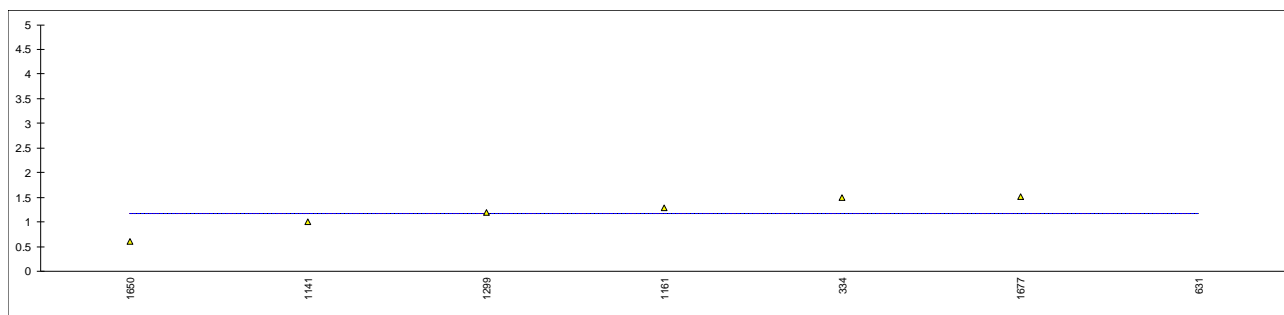
lab	method	value	mark	z(targ)	remarks
62		----		----	
150	D873	<1		----	
334		----		----	
496	D873	1.85		0.74	
631	D873	<1		----	
1016	D873	0.9		-0.15	
1141		----		----	
1155	D873	1.3		0.23	
1161		----		----	
1299	D873	0.8		-0.24	
1521	D873	1		-0.05	
1538		----		----	
1650		----		----	
1677	D873	0.5		-0.52	
normality		unknown			
n		6			
outliers		0			
mean (n)		1.058			
st.dev. (n)		0.4674			
R(calc.)		1.309			
st.dev.(D873:12)		1.0714			
R(D873:12)		3			



Determination of Sulphur content on sample #18041; results in mg/kg

lab	method	value	mark	z(target)	remarks
62		-----		-----	
150	D2622	<3		-----	
334	D5453	1.5		-----	
496	D2622	<3		-----	
631	D4294	354.3		-----	False positive test result?
1016		-----		-----	
1141	D5453	1		-----	
1155	ISO20846	<3		-----	
1161	ISO20846	1.28		-----	
1299	ISO20884	1.2		-----	
1521	D5453	<3		-----	
1538		-----		-----	
1650	D5453	0.6		-----	
1677	D5453	1.52		-----	
normality		n.a.			
n		10			
outliers		n.a.			
mean (n)		<3			
st.dev. (n)		n.a.			
R(calc.)		n.a.			
st.dev.(D2622:16)		n.a.			
R(D2622:16)		n.a.			

Application range: (3 – 46000 mg/kg)

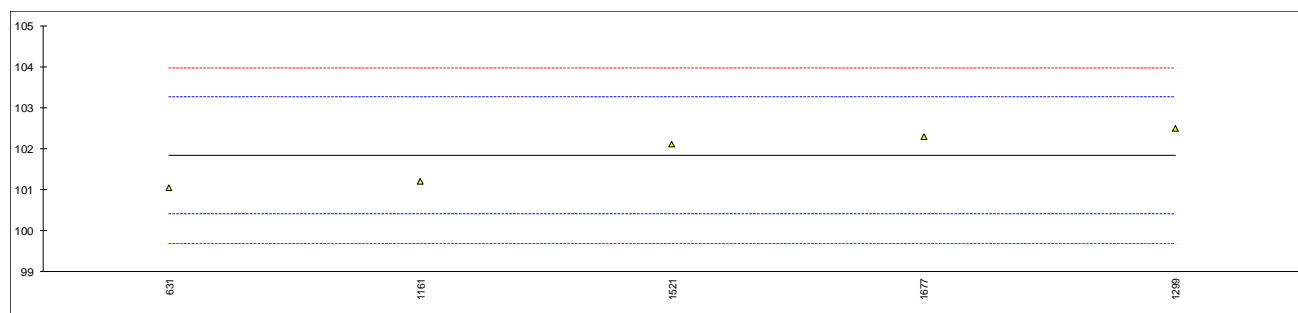


Determination of Water reaction, volume change on sample #18041; results in ml

lab	method	value	mark	z(targ)	remarks
62		-----		-----	
150	D1094	<0.5		-----	
334		-----		-----	
496	D1094	0		-----	
631	D1094	<0.5		-----	
1016	D1094	0		-----	
1141	D1094	0.5		-----	
1155	D1094	1.0		-----	
1161		-----		-----	
1299	D1094	0.5		-----	
1521	D1094	0.0		-----	
1538	D1094	<0,5		-----	
1650	D1094	< 0.5		-----	
1677	D1094	< 0.5		-----	
	normality	n.a.			
	n	10			
	outliers	n.a.			
	mean (n)	≤ 0.5			
	st.dev. (n)	n.a.			
	R(calc.)	n.a.			
	st.dev.(D1094:07)	n.a.			
	R(D1094:07)	n.a.			

Determination of MON on sample #18041

lab	method	value	mark	z(targ)	remarks
62		----		----	
150		----		----	
334		----		----	
496		----		----	
631	D2700	101.04		-1.10	
1016		----		----	
1141		----		----	
1155	ISO5163	>100		----	
1161	ISO5163	101.2		-0.88	
1299	D2700	102.5		0.94	Reported 107.7 as Aviation Rating Lean Mixture
1521	D2700	102.1		0.38	
1538		----		----	
1650		----		----	
1677	D2700	102.3		0.66	Reported 107.21 as Aviation Rating Lean Mixture.
	normality	unknown			
	n	5			
	outliers	0			
	mean (n)	101.83			
	st.dev. (n)	0.664			
	R(calc.)	1.86			
	st.dev.(D2700:17a)	0.714			
	R(D2700:17a)	2			



APPENDIX 2

Number of participants per country

1 lab in CANADA
1 lab in ESTONIA
1 lab in FRANCE
1 lab in GERMANY
1 lab in MACEDONIA
1 lab in NETHERLANDS
1 lab in PHILIPPINES
2 labs in POLAND
2 labs in SERBIA
1 lab in SPAIN
1 lab in TURKEY
1 lab 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	= probably an error in calculations
W	= test result withdrawn on request of participant
ex	= test result excluded from statistical evaluation
U	= probably reported in wrong unit
fr.	= first reported
n.a.	= not applicable
n.e.	= not evaluated
n.d.	= not detected
SDS	= Safety Data Sheet

Literature:

- 1 iis Interlaboratory Studies, Protocol for the Organisation, Statistics & Evaluation, March 2017
- 2 ASTM E178:02
- 3 ASTM E1301:03
- 4 ISO 5725:86
- 5 ISO 5725, parts 1-6, 1994
- 6 ISO13528:05
- 7 M. Thompson and R. Wood, J. AOAC Int, 76, 926, (1993)
- 8 W.J. Youden and E.H. Steiner, Statistical Man of the AOAC, (1975)
- 9 IP 367:84
- 10 DIN 38402 T41/42
- 11 P.L. Davies, Fr. Z. Anal. Chem, 331, 513, (1988)
- 12 J.N. Miller, Analyst, 118, 455, (1993)
- 13 Analytical Methods Committee Technical Brief, No 4 January 2001
- 14 P.J. Lowthian and M. Thompson, The Royal Society of Chemistry, Analyst 2002, 127, 1359-1364
- 15 Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, *Technometrics*, 25(2), 165-172, (1983).